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# DEVELOPMENT OF SCENARIOS FOR HEALTH AND LONG-TERM CARE EXPENDITURE IN THE EUROPEAN UNION MEMBER STATES

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# Development of Scenarios for Health and Long-term Care Expenditure in the European Union Member States*


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**Abstract**

Over the next fifty years, the size and age structure of Europe's population will experience major changes due to low fertility rates, continuous increases in life expectancy due to medical advances and the retirement of the baby boom generation. The main output of this work package is a model which allows the construction of scenarios for health and long-term care expenditure based on the premise that health spending is driven by a number of demographic, economic, social and institutional variables. The projections computed in this study are not forecasts but are instead intended to provide an indication on the potential timing and scale of budgetary challenges that could result from Europe's ageing population.



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**CONTENTS**

# 1. Introduction

One main characteristic of the European Union (EU) member states is the growing share of health and long-term care expenditure in GDP. In consequence, to control, and as much as possible to limit, the increase of those expenditure has become a major issue of European governments. In order to do so, we need to know what the main determinants of health and long-term care expenditure are and what their impact is. In effect, health and long-term care expenditure is usually explained by either a demand or a supply approach. In the former, health and long-term care expenditure depends on the level of GDP per capita and the relative price of health and long-term care, whilst, in the latter, health and long-term care spending depends on technical progress and the general behaviour of medical practitioners through induced demand. Throughout this report the term health care expenditure includes expenditure on long-term care unless explicitly stated that it does not.

Public expenditure on health care comprises a large part of government budgets. Overall health spending, including long-term care for the elderly, already accounts for around 9% of GDP in the EU countries (European Commission, 2006). There is also a question mark over how much funding will be available in the future, given an expected slowdown in GDP growth as the progressive decline in fertility rates since the late 1960s has caused labour supply to expand more slowly. How much health care expenditure might increase is difficult to say as there are numerous factors at play whose impact is quite uncertain. Past studies provide only limited guidance. Key factors that might explain rising expenditure appear to have been rapid introduction of new technologies, and higher demand for health care, itself a reflection of rising incomes and a more educated public. Calculating exactly how much spending will be needed, who will provide it, and the best way to spend it, is as complex a task as it is urgent.

Many EU member states are concerned about the financial sustainability and the efficiency of their national health care systems. They share the collective challenge of discovering ways to deal with issues like the increase of the ageing population, the emergence of new and costly medical innovations, and the public's growing outlook regarding the quality and availability of health care. The affordability of health care is indeed at great risk.

The main output of this work package is a model built from the results of the earlier work packages in combination, and used to construct scenarios for health care expenditure in the EU. The underlying modelling framework is embedded in a series of EXCEL spreadsheets for subsequent use by policymakers. This makes it possible to explore the implications of changes either to parameters of the model or to underlying drivers such as demographic projections.

# 2. Data and Methodology

The model is macroeconomic in form and represents the demand and supply side jointly, incorporating factors such demographic variables and the importance of the public sector. The baseline of our calculations is provided by Christiansen *et. al* (2006) who investigate the relationship between ageing and aggregate health care expenditure in the EU countries. We have essentially taken their model and re-estimated it in a form which is convenient for incorporation into a spreadsheet model. Our analysis relates to thirteen "old" EU countries (the EU-15 excluding Greece and Luxemburg) because data for the newer members were not available for long enough for satisfactory estimation to be possible.

***2.1 Data***

Following from Christiansen *et. al* (2006) the data used in this paper are a balanced panel dataset that covers 13 of the old EU member states (excluding Greece and Luxemburg). We refer to the results as relating to the EU15. The panel spans over a time period of 24 years (1980-2003).[1]

The dependent variable used in this paper is the natural logarithm of total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices and adjusted for both purchasing power parities (PPP) and inflation. Christiansen *et. al* (2006) make use of data collected from the OECD Health Data 2004 for OECD countries and data from the WHO (European health for all databases, WHO Regional

[1] At an early state an attempt was made to estimate a similar model for new and prospective member states but the data were not of suitable quality.

Office for Europe, Copenhagen, Denmark) for non-OECD countries[2]. The OECD's measure of health care expenditure includes important parts of long-term care.

**Table 1 Data and Data Sources**

| Variable | Description | Data Source |
|---|---|---|
| THEPC | Total health care expenditure per capita, US$ in nominal prices and adjusted for PPP (in logs). | OECD/WHO |
| GDPPC | Gross domestic product per capita, US$ in nominal prices and adjusted for PPP (in logs). | OECD |
| AGE65-74 | Population aged 65-74 as a share of the total population. | Eurostat |
| AGE75+ | Population aged 75+ as a share of the total population. | Eurostat |
| ALE | Average of Life expectancy at aged 65 for males and females. | WHO |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). | OECD |
| UNEMP | Unemployed individuals as a share of the total labour force. | OECD |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). | OECD/WHO |
| MORTALITY | Number of registered deaths/mid-year population (per 100) (in logs). | WHO |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. | OECD/WHO |
| SALARYGP | Dummy variable for countries with salaried GPs. | Christiansen *et. al* (2006) |
| CAPGP | Dummy variable for countries with capitation payment GPs. | Christiansen *et. al* (2006) |
| CASEHO | Dummy variable for countries with case-based reimbursement of hospitals. | Christiansen *et. al* (2006) |
| COPAYGP | Dummy variable for countries with significant co-payment for GPs. | Christiansen *et. al* (2006) |
| COPAYHO | Dummy variable for countries with significant co-payment for inpatient hospital treatment. | Christiansen *et. al* (2006) |
| FREEGP | Dummy variable for countries with free choice of GP or primary care physician. | Christiansen *et. al* (2006) |
| FREEHO | Dummy variable for countries with overall ceiling of hospitals. | Christiansen *et. al* (2006) |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). | OECD/WHO |

The explanatory variables can be grouped into 3 broad categories. The first group includes the economic variable, the natural logarithm of GDP per capita (*GDPPC*), a behavioural variable (alcohol consumption[3]) and two social variables (female labour force participation and unemployment rate). The age structure variables, life expectancy and mortality rates are included as demographic variables. The mortality rate was included to account for the recent arguments made in the literature that health care spending is more related to the nearness of death than to age (Zweifel *et. al*, 1999; Seshamani and Gray, 2004a; Seshamani and Gray, 2004b). Studies overseas using unit record data have shown than one-quarter or more of lifetime health care

[2] More extensive descriptive statistics are reported in work package 6, Part A, see (Schulz, 2005).
[3] We had hoped to include tobacco consumption as well but the data did not seem to be reliable.

expenditure may be consumed, on average, in the last year of life (Miller, 2001; Yang *et. al*, 2003).

The second group includes characteristics of each country's health care system in the period for which data has been collected. This list includes variables that describe institutional factors assumed to affect utilisation. This second group of institutional variables is included to catch incentives and regulatory factors on the supply side.

Finally, the number of hospital beds reflects a variable which is generally believed to be an important determinant of costs.

### *2.2 The problem in making cross-country projections*

The projections are in general made on the basis of 'no policy change', in that they reflect only existing legislation and not possible future policy changes. While these projections can point to key drivers of health care spending, it needs to be noted that they cannot completely model the specific institutional arrangements and policies which exist at the national level. A certain level of caution must be exercised when interpreting the long-run projections and the degree of uncertainty increases the further into the future the projections go.

## 3. The Model

Since the seminal paper by Newhouse (1977), it has been widely debated whether health care expenditures are a luxury good. Although over time the original empirical model by Newhouse has been improved in several directions in order to obtain a more realistic model, after three decades, the main result that emerges from these studies is that aggregate income appears to be the most important factor explaining health expenditure. Where disagreement occurs, is on the question of whether health care expenditure is either a luxury or a necessary good, i.e. on whether the income elasticity of demand is above or below one.

### *3.1 Panel unit root tests*

Firstly, we check so see if there are unit roots for health care expenditure and the other explanatory variables in our model. Along with the standard augmented Dickey-Fuller (ADF) test (1979) and the Im, Pesaran and Shin (2003) test, **Error! Reference source**

**not found.** presents four other panel data unit root tests that have been performed for all the variables in question for the EU15. The optimal lag length is selected using the Bartlett kernel and the automatic bandwidth parameter suggested by Newey and West (1994).

The results show that we cannot reject the null hypothesis of the presence of a unit root for health care expenditure and GDP per capita. This hypothesis is only rejected for the female labour force participation rate (*FLFPR*) for the EU15 countries.

**Table 2 Panel Unit Root Tests for the EU15**

| Variable | Lag Order | Levin, Lin and Chu[a] (2002) | Breitung[b] (2000, 2002) | Im, Pesaran and Shin[c] (2003) | Augmented Dickey-Fuller[d] (1979) | Phillips and Perron[e] (1988) | Hadri[f] (2000) |
|---|---|---|---|---|---|---|---|
| THEPC | 6 | 6.8393 | -2.1523 | -0.7470 | 24.1278 | 251.1278 | 2.8618 |
| *p*-value | | (1.0000) | (0.0157) | (0.2275) | (0.2275) | (0.0000) | (0.0021) |
| GDPPC | 6 | 5.8171 | -4.1700 | -2.1002 | 38.2773 | 154.504 | 0.5577 |
| *p*-value | | (1.0000) | (0.0000) | (0.0179) | (0.1428) | (0.0000) | (0.2885) |
| AGE65_74 | 6 | 4.3733 | -2.4932 | -0.3544 | 25.3944 | 32.6828 | 2.0804 |
| *p*-value | | (1.0000) | (0.0063) | (0.3615) | (0.7056) | (0.3365) | (0.0187) |
| AGE75_ | 6 | 3.8639 | -1.7226 | -0.8477 | 24.1797 | 48.4834 | -0.0752 |
| *p*-value | | (0.9999) | (0.0425) | (0.1983) | (0.7638) | (0.0177) | (0.5300) |
| ALE | 6 | 3.0061 | -1.7951 | -1.3904 | 34.1273 | 934.556 | 4.4105 |
| *p*-value | | (0.9987) | (0.0363) | (0.0822) | (0.2758) | (0.0000) | (0.0000) |
| FLFPR | 6 | 2.3024 | -2.2114 | -1.7238 | 29.7737 | 573.939 | 3.0968 |
| *p*-value | | (0.9893) | (0.0135) | (0.0424) | (0.2771) | (0.0000) | (0.0010) |
| UNEMP | 6 | 3.3033 | -4.0794 | -3.6606 | 55.1869 | 350.331 | 1.0309 |
| *p*-value | | (0.9995) | (0.0000) | (0.0001) | (0.0034) | (0.0000) | (0.1513) |
| ALCCON | 6 | 3.7001 | -3.4188 | -0.9583 | 29.0145 | 264.818 | 7.1720 |
| *p*-value | | (0.9999) | (0.0003) | (0.1690) | (0.5168) | (0.0000) | (0.0000) |
| PUHES | 6 | 5.8974 | -1.7204 | -0.2598 | 20.9425 | 304.899 | 3.1054 |
| *p*-value | | (1.0000) | (0.0427) | (0.3975) | (0.8897) | (0.0000) | (0.0010) |
| BEDS | 6 | 11.2182 | -1.0813 | -0.3283 | 2.7560 | 26.8064 | -1.4385 |
| *p*-value | | (1.0000) | (0.1398) | (0.3713) | (0.5995) | (0.0000) | (0.9249) |
| MORTALITY | 6 | 7.2338 | -3.5880 | -0.5334 | 27.3345 | 982.770 | 4.2770 |
| *p*-value | | (1.0000) | (0.0002) | (0.2969) | (0.6057) | (0.0000) | (0.0000) |

Note: Panel unit root tests a, b, c, d and e all assume a null hypothesis of a common unit root process. Test f is the only test that assumes a null hypothesis of no unit root.

### *3.1 The Co-integration Rank*

The presence of unit root variables inevitably mean that we have to consider how many co-integrating vectors may be present in the model. We do this in the context set out by Breitung (2005). He suggests that the co-integrating vectors can be estimated first of all applying the first stage of Johansen's (1988) approach to each member of the panel separately. This allows the data to be purged of dynamic effects and the co-integrating vectors can be estimated by means of a pooled regression based on exactly the same derived variables as is used in Johansen's approach. He then sets out a test which, given an initial assumption about the number of co-integrating vectors, tests for the significance of at least one extra co-integrating vector. The test is based on orthogonal complements as suggested by Saikonnen (1999). It relies on the fact that, if the rank of the co-integration matrix is sufficient, then linear combinations of the co-integration variables calculated using the orthogonal complement of the assumed co-integrating vector should have no explanatory power in the pooled regression.

With twelve variables apart from the dummies and a short annual series there is a pragmatic question about how to explore the rank of the co-intergrating space. Breitung presents test statistics for co-integrating spaces of up to rank 6 against alternatives of lower rank. The test statistics present mixed messages. GDP per capita is generally believed to be *I(1)* and it would therefore be surprising if health spending were not. Morality rates by age are also often thought to follow *I(1)* processes (Lee and Miller, 2001), and one would therefore expect average life expectancy to be so. For the same reasons we include the population shares aged 65-74 and aged 75+ in the group of variables amongst which we explore co-integration. Finally, we consider also the share of public health expenditure relative to total health care expenditure. This gives us six variables with a maximum of five co-integrating relationships, allowing Breitung's test to establish whether we can accept the hypothesis that there is no more than one co-integrating relationship between the two. If there is no more than one such relationship we can use standard methods for estimating dynamic equations in panels, with the statistically significant present of lagged variables in levels indicating co-integration. This gives a test statistic of $\lambda = 86.35$ where, with $N$ the number of panel elements and $T$ the sample size, the distribution of

$$\sqrt{N}\,\frac{\lambda - 76.94}{119.7} \sim \underset{N \to \infty}{\overset{Lt}{T \to \infty}}\; N(0,1)$$

tests the hypothesis that there are *k-5* co-integrating vectors against the null of *k-1*. It is plain that the hypothesis is easily accepted, and we proceed on the assumption that there is at most one co-integrating vector linking the variables in levels.

### *3.2 Estimation*

It has been known for many years that estimation of panel models with lagged dependent variables is subject to biases (Nickell, 1982). One popular means of dealing with this problem is to use the estimation methods described by Arellano and Bond (1991) and Arellano and Bover (1995) using dynamic generalised method of moments (GMM). However, as Nickell shows, the biases fall off rapidly as the sample size increases. For our sample size of over twenty observations it is by no means clear that Arellano and Bond's method is better than more conventional generalised least squares. We did experiment with both methods and found it difficult to identify satisfactory instruments for use with Arellano and Bons' method. Accordingly we have instead relied on generalised least squares estimation with country fixed effects.

We consider the simple autoregressive model

$$THEPC_{it} = \delta THEPC_{i,t-1} + x_{it}'\beta + u_{it} \quad i = 1,...,N;\ t = 1,...,T \qquad (1)$$

where $x_{it}$ is a $K \times N$ matrix of covariates, $\beta$ a $1 \times K$ vector of regression slopes and $u_{it} = \mu_i + \upsilon_{it}$ with $\mu_i \sim \left(0, \sigma_\mu^2\right)$ and $\upsilon_{it} \sim \left(0, \sigma_\upsilon^2\right)$, independent and identically distributed (i.i.d) over the panels. With the hypothesis of a single co-integrating vector accepted we have, provided that the covariates include both current and lagged values of the *I(1)* variables, a satisfactory means of estimating the dynamic relationship.

### *3.3 Least-squares restriction*

From the unrestricted equation we can use least-squares methods to explore various restrictions (Theil, 1971). This can be done following on from the estimation procedure, making it possible to explore the effects of different restrictions in the EXCEL spreadsheet produced as part of this work and allowing users to impose their own structures.

It is assumed that there is a parameter vector $\mathbf{x}$ defined as the unrestricted set of variables, which should satisfy the accounting constraint, $\mathbf{Ax} = \mathbf{r}$, where $\mathbf{r}$ is a vector of accounting residuals. It is also assumed that the observed parameters are distributed without bias around the true parameter values $\mathbf{x}^*$ with known variance matrix, $\mathbf{V}$.

The least-squares problem presented here is then one of finding a vector $\mathbf{x}^*$, i.e. the set of restricted variables, which satisfies the accounting constraints, $\mathbf{Ax}^* = \mathbf{r}$, and is close as possible to the observed parameter vector, $\mathbf{x}$. The problem is that of minimising

$$\left(\mathbf{x}^* - \mathbf{x}\right)' \mathbf{V}^{-1} \left(\mathbf{x}^* - \mathbf{x}\right) \tag{3}$$

subject to the constraint

$$\mathbf{Ax}^* = \mathbf{r} \tag{4}$$

The Lagrangian function takes the form

$$\mathbf{Min}\, L = \left(\mathbf{x}^* - \mathbf{x}\right)' \mathbf{V}^{-1} \left(\mathbf{x}^* - \mathbf{x}\right) - \lambda\left(\mathbf{Ax}^* - \mathbf{r}\right) \tag{5}$$

The first-order conditions are then

$$\frac{\partial L}{\partial \mathbf{x}^*} = 2\mathbf{V}^{-1}\left(\mathbf{x}^* - \mathbf{x}\right) - \mathbf{A}'\lambda = \mathbf{0} \tag{6}$$

$$\frac{\partial L}{\partial \lambda} = \mathbf{Ax}^* - \mathbf{r} = \mathbf{0} \tag{7}$$

Rearranging equation (6) gives

$$\mathbf{VA}'\lambda = 2\left(\mathbf{x}^* - \mathbf{x}\right) \tag{8}$$

Now by premultiplying both sides by $\mathbf{A}$ and rearranging yields

$$\lambda = 2\left(\mathbf{AVA}'\right)^{-1} \mathbf{A}\left(\mathbf{x}^* - \mathbf{x}\right) \tag{9}$$

and given that $\mathbf{Ax}^* = \mathbf{r}$, we have

$$\lambda = -2\left(\mathbf{AVA}'\right)^{-1}\left(\mathbf{Ax} - \mathbf{r}\right) \tag{10}$$

Substituting this into equation [8] yields the constrained least-squares solution

$$\mathbf{x}^* = \mathbf{x} - \mathbf{VA}'\left(\mathbf{AVA}'\right)^{-1}\left(\mathbf{Ax} - \mathbf{r}\right) \tag{11}$$

The estimator is just a linear combination of the unrestricted parameters. That is, we need only run the unrestricted regression and then by performing a few computations we get the restricted estimates. We conclude this least-squares adjustment process by noting that the difference between the constrained and the unconstrained least-squares coefficient vectors is a linear function of the vector $\mathbf{Ax}^* - \mathbf{r}$, which measures the degree to which the unconstrained coefficient vector fails to satisfy the constraints.

The mean of this estimator can be shown to be

$$E\left(\mathbf{x}^{*}\right)=\mathbf{x}-\mathbf{VA}'\left(\mathbf{AVA}'\right)^{-1}\left(\mathbf{Ax}-\mathbf{r}\right) \tag{12}$$

So the restricted least squares estimator is unbiased only when the linear restrictions are identically correct. The restricted least-squares estimator (Equation (11)) does not appear to be affected by premultiplication of the variance matrix $\mathbf{V}$ by any scalar constant. This implies that the balancing process depends on relative but not on absolute data reliability. Restricting the parameters also leads to a reduction in the data variance, which can be seen by considering the restricted variance matrix

$$\mathbf{V}^{*}=\mathbf{V}-\mathbf{VA}'\left(\mathbf{AVA}'\right)^{-1}\mathbf{AV} \tag{13}$$

Given that equation (13) is a positive semi-definite matrix, it follows that the process of least-squares balancing has the effect of not making the data less accurate. The restricted variance matrix has a smaller variance than its unrestricted counterpart since $\mathbf{VA}'\left(\mathbf{AVA}'\right)^{-1}\mathbf{AV}$ is positive definite and by restricting the parameters we enhance their reliability.

## 4. The Health Care Expenditure Model

The model is built around a macro programme in EXCEL which uses the parameters estimated by GLS for the EU-15 excluding Luxemburg and Greece; we nevertheless refer to the model as a model of the EU-15. It is set up in such a way that users can impose restrictions on the parameters and also restrict the long-run elasticity of health care expenditure with respect to GDP. A set of restrictions has been programmed into the model but users can change any of these by adjusting the number of restrictions in the model. The long-run elasticity can be changed in the same way. An empty box implies that no restriction has been put in place on that parameter. Once the user is satisfied with the restrictions the $\chi^2$ output will present a test for the validity of the restrictions.

Once the restrictions have been imposed the user can select the member states whose health expenditure they wish to project. The spreadsheet for each country contains the data output from Christiansen *et. al* (2006) which is used to estimate the restricted model. For each of the variables, users can select the start and end period of the data in question. Alternatively, a trend growth can be applied to any of the variables. It is important to mention here that the growth rates of the parameters projected may not be entirely logical and users are recommended to change the growth rates for the variables in question accordingly. For example, with the age variables, the proportion of the elderly may be very large the further the projections go and so therefore it is advisable for users to insert their own growth rates.

Finally, users can enter an intercept correction by entering an initial and final years over which the correction is to be calculated. The default of this for the forecasting model is that the results are aligned to the last five years of the data. This avoids sharp jumps between data and forecast periods and is in keeping with common practice among economic forecasters. When users are content with the restrictions in place along with the relevant data selected for the countries in question then the model will compute projections for health care spending between 2004 and 2050 (or up to any other year the user specifies). Each time the model is run, the new projected figures are pasted over the existing ones. In order to show more clearly how to apply the model, appendix A provides a step-by-step guide on how to use the programme to project health care spending.

# 5. Estimation Results

By using the unrestricted and restricted parameters following from the least-squares estimation method outlined in section 3 we have estimated health care projections for the EU15 excluding Luxemburg and Greece. For an analysis of the descriptive statistics along with the correlation matrix of the variables the reader is referred to Christiansen *et*. *al* (2006).

### *5.1 Parameter Estimates for EU15 countries*

Table 3 gives the long-run elasticities of the variables in our initial regression analysis.

| Table 3 Long-Run Elasticities | |
|---|---|
| Variable | Unrestricted Models |
| GDPPC | 0.9363 |
| AGE65_74 | -0.0230 |
| AGE75_ | -0.0381 |
| AVELE65 | 0.0920 |
| FLFPR | 0.0253 |
| UNEMP | -0.0082 |
| ALCCON | -0.0006 |
| PUHES | 0.0125 |
| SALARYGP | 0.1212 |
| CAPGP | 0.2013 |
| CASEHO | 0.0079 |
| COPAYGP | 0.0812 |
| COPAYHO | -0.1409 |
| FREEGP | 0.2458 |
| FREEHO | 0.0690 |
| BEDS | 0.0369 |
| MORTALITY | 0.2152 |

As we can see from Table 3, the age effects have negative long-run semi-elasticities while the effects of mortality and average life expectancy are positive. Since the variables are not independent of each other such a structure need not be inconsistent with the idea that the partial effect of each demographic term should be positive. However we are able to accept a set of restrictions which set the long-run age effects to zero and which also limit the effect of mortality to zero, so that the only age effect is associated with rising life expectancy. We impose these restrictions jointly with others on insignificant variables giving the base restrictions for model 0 shown in Table 4. If we restrict only the population structure terms to zero the mortality effect becomes negative and for this reason it too is restricted to zero.

**Table 4 Unrestricted and Restricted Regression Results from EU15**

| | Unrestricted | | Restricted Model 0 | |
|---|---|---|---|---|
| | Coeff | z-stat | Coeff | z-stat |
| LOGTHEPC(-1) | 0.712597 | 14.75834 | 0.7001 | 22.4300 |
| LOGGDP | 0.286783 | 2.266419 | 0.3021 | 10.8121 |
| LOGGDP(-1) | -0.01768 | -0.14216 | 0.0000 | Rest* |
| AGE65_74 | 0.023154 | 1.99257 | 0.0338 | 5.0139 |
| AGE65_74(-1) | -0.029777 | -2.729757 | -0.0338 | -5.0139 |
| AGE75_ | 0.038199 | 1.904183 | 0.0311 | 3.3023 |
| AGE75_(-1) | -0.049141 | -2.26814 | -0.0311 | -3.3023 |
| AVELE65 | -0.008697 | -0.582769 | -0.0163 | -1.8821 |
| AVELE65(-1) | 0.035151 | 2.510683 | 0.0288 | 2.5109 |
| FLFPR | 0.005525 | 1.982653 | 0.0084 | 7.3622 |
| FLFPR(-1) | 0.001753 | 0.720535 | 0.0000 | Rest* |
| UNEMP | -0.002544 | -0.917307 | -0.0019 | -3.2634 |
| UNEMP(-1) | 0.000201 | 0.083806 | 0.0000 | Rest* |
| ALCCON | -0.012096 | -1.768828 | -0.0058 | -1.1924 |
| ALCCON(-1) | 0.011911 | 1.846001 | 0.0032 | 0.6695 |
| PUHES | 0.004087 | 1.831964 | 0.0028 | 4.9738 |
| PUHES(-1) | -0.000487 | -0.198353 | 0.0000 | Rest* |
| SALARYGP | 0.024331 | 1.369935 | 0.0000 | Rest* |
| SALARYGP(-1) | 0.010513 | 0.729624 | 0.0000 | Rest* |
| CAPGP | 0.036716 | 3.136739 | 0.0220 | 4.5991 |
| CAPGP(-1) | 0.021145 | 1.849732 | 0.0201 | 5.6771 |
| CASEHO | -0.038563 | -3.436662 | -0.0496 | -6.9427 |
| CASEHO(-1) | 0.040823 | 3.760246 | 0.0447 | 5.6206 |
| COPAYGP | 0.038339 | 1.553251 | 0.0472 | 4.7847 |
| COPAYGP(-1) | -0.014997 | -1.140861 | 0.0086 | 1.5641 |
| COPAYHO | -0.024313 | -2.015252 | -0.0199 | -3.2467 |
| COPAYHO(-1) | -0.01619 | -0.972756 | 0.0000 | Rest* |
| FREEGP | 0.007112 | 0.441763 | 0.0000 | Rest* |
| FREEGP(-1) | 0.06352 | 3.966351 | 0.0429 | 3.8931 |
| FREEHO | 0.052506 | 4.974856 | 0.0541 | 8.1592 |
| FREEHO(-1) | -0.032686 | -2.76244 | -0.0329 | -4.1439 |
| BEDS | 0.011626 | 0.890551 | 0.0187 | 5.8882 |
| BEDS(-1) | -0.001009 | -0.096272 | 0.0000 | Rest* |
| MORTM | -0.107016 | -0.668941 | -0.2128 | -2.0307 |
| MORTM(-1) | 0.168854 | 1.190521 | 0.2128 | 2.0307 |
| Test of Restriction | | | $\chi^2_{13}$=12.90 | |

The long-run coefficients of the restricted model are compared with the earlier unrestricted model in Table 5.

**Table 5 The Impact of Restrictions on the Long-Run Coefficients**

| | Unrestricted | Model 0 |
|---|---|---|
| GDPPC | 0.9363 | 1.0071 |
| AGE65_74 | -0.0230 | 0.0000 |
| AGE75_ | -0.0381 | 0.0000 |
| AVLE65 | 0.0920 | 0.0419 |
| FLFPR | 0.0253 | 0.0281 |
| UNEMP | -0.0082 | -0.0065 |
| ALCCON | -0.0006 | -0.0087 |
| PUHES | 0.0125 | 0.0094 |
| SALARYGP | 0.1212 | 0.0000 |
| CAPGP | 0.2013 | 0.1405 |
| CASEHO | 0.0079 | -0.0162 |
| COPAYGP | 0.0812 | 0.1862 |
| COPAYHO | -0.1409 | -0.0662 |
| FREEGP | 0.2458 | 0.1429 |
| FREEHO | 0.0690 | 0.0707 |
| BEDS | 0.0369 | 0.0622 |
| MORTM | 0.2152 | 0.0000 |

While income is the main driving force in most studies of health care expenditure, there is little consensus regarding the elasticity with respect to per capita health care spending (McGuire *et. al*, 1993). Herwartz and Theilen, 2003 argue that estimated elasticity seems to have decreased since the beginning of the 1980s, possibly reflecting cost-containment policies. Earlier studies using cross-sectional data found elasticities greater than one (Gerdtham *et. al*, 1998), suggesting that health care expenditure is a luxury good. More recent studies using pooled time-series data and a wider range of explanatory variables suggest elasticities near or less than one (Hitiris and Posnett, 1992). Though, for time-series data, it is difficult to separate demand from supply related factors, since supply side factors are often not available, and those that are show little variance or are correlated with the income variable. With the restrictions in place which are easily accepted model 0 delivers an elasticity very close to 1.

Among the social and demographic variables, alcohol consumption might be thought to have an incorrect sign. However, there is little consensus about how far alcohol consumption is harmful and we have therefore not tried to restrict this variable. There is an expected positive sign on public health care expenditure (*PUHES*); high public provision raises total expenditure. The positive term in acute beds is not a surprise.

The dummy variables merit particular discussion. They arise from an attempt to identify the characteristics of the health care systems of the different countries at different times. There is an obvious question how well they do this, since, for example, one might expect a country with small co-payments to be more like one without copayments than like one with large copayments. The supply-side dummy variables tend to have positive signs apart for case-based remuneration of hospitals (*CASEHO*) and co-payments to hospitals (COPAYHO). The demand-side dummy variables show a mixture of positive signs for co-payment for visiting a GP (*COPAYGP*), free choice of GP (*FREEGP*) and free choice of hospitals (*FREEHO*) but a negative sign for co-payment for using hospitals (*COPAYHO*).

Of these variables one in particular, the positive sign on copayments to GPs is of some concern. One might expect that copayments to GPs would reduce rather than increase health spending for any given share of public spending in the total. Since our model includes country fixed effects, the dummies affect our projections only if they change in the projection period. This happens only to Austria where the change is the removal of co-payments for visiting GPs. This has a powerful effect in depressing expenditure. Since there are obvious questions whether the dummy might actually represent a combination of characteristics rather than just the characteristic attributed to it, there are grounds for doubting that the impact of that single change would actually be what our model shows. In the report on Austria we therefore also present a projection on the assumption of no change.

The large impact of the dummy variables suggests that institutional arrangements are an important influence on costs. However it is hard to be precise about exactly what characteristics of institutional arrangements do in fact have this influence.

## 6. Hypotheses about Determinants of Health Care Spending

The model allows us to explore the implications of basic scenarios about the determinants of health spending in the context of the richer framework provided by regression analysis. We can explore hypotheses about the long-run elasticity of health spending with respect to GDP, that spending is closely related to the age structure of the population and that it is substantially driven by death-related costs.

With the equation given as

$$THEPC_{it} = \delta THEPC_{i,t-1} + \beta_{11} \ln GDP_{it} + \beta_{12} \ln GDP_{it-1} + ... + u_{it} \quad i = 1,...,N;\ t = 1,...,T \quad (14)$$

The long-run elasticity with respect to GDP is

$$\varepsilon_{GDP} = \frac{\beta_{11} + \beta_{12}}{1-\delta} \quad (15)$$

For a given value of $\varepsilon_{GDP}$ this defines a linear restriction linking $\beta_{11}, \beta_{12}$ and $\delta$. Equation (15) shows the long-run elasticities which result from imposing various restrictions on long run income elasticity. We can see in table 5 that, while an elasticity of 1.1 is accepted by the data, one of 1.2 is firmly rejected. Raising the elasticity affects the other coefficients. Most notably it reduces the coefficient on life expectancy. This explains why we find, in our country studies, that when the elasticity is raised, projected expenditure may fall. The impact of the reduced weight put on life expectancy more than compensates for the effect of a greater than unit elasticity on GDP with a rising GDP.

**Table 6 Long-Run Coefficients with Different GDP Elasticities**

| | | | | |
|---|---|---|---|---|
| GDPPC | 1.0071 | 1.0000 | 1.1000 | 1.2000 |
| AGE65_74 | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| AGE75_ | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| AVELE65 | 0.0419 | 0.0431 | 0.0244 | 0.0029 |
| FLFPR | 0.0281 | 0.0282 | 0.0273 | 0.0264 |
| UNEMP | -0.0065 | -0.0066 | -0.0059 | -0.0059 |
| ALCCON | -0.0087 | -0.0089 | -0.0068 | -0.0055 |
| PUHES | 0.0094 | 0.0094 | 0.0101 | 0.0104 |
| SALARYGP | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| CAPGP | 0.1405 | 0.1405 | 0.1460 | 0.1628 |
| CASEHO | -0.0162 | -0.0161 | -0.0149 | -0.0107 |
| COPAYGP | 0.1862 | 0.1856 | 0.1929 | 0.1982 |
| COPAYHO | -0.0662 | -0.0647 | -0.0845 | -0.1017 |
| FREEGP | 0.1429 | 0.1459 | 0.1088 | 0.0805 |
| FREEHO | 0.0707 | 0.0702 | 0.0788 | 0.0895 |
| BEDS | 0.0622 | 0.0628 | 0.0547 | 0.0465 |
| MORTM | **0.0000** | **0.0000** | **0.0000** | **0.0000** |
| | $\chi_{12}^2$=12.90 | $\chi_{13}^2$=12.93 | $\chi_{13}^2$=16.42 | $\chi_{13}^2$=24.6 |

The model also allows us to explore the hypothesis that spending is age-related, or death-related. The first of these hypotheses implies that it changes as the age structure of the population changes while the second implies that it responds to movements in the mortality rate. As the population ages through increased longevity the proportion of old people in the population is likely to rise, while at the same time the mortality rate will decline. Thus the two hypotheses may have rather different implications for the evolution of health spending.

We consider the long-run model in schematic form as

$$THEPC = \alpha_1 GDPPC + \alpha_2 AGE65-74 + \alpha_3 AGE75 + \alpha_4 MORTALITY + etc \qquad (15)$$

It is important to recall here that the dependent variable, *THEPC*, used is defined in natural logarithms. The coefficients $\alpha_2$ to $\alpha_4$ show the semi-elasticities of the population share age 65-74, the population share aged 75 and over and the mortality rate on health spending. If health spending is driven only by population structure and the amount spent per person under 65 is $\beta_1$, per person aged 65-74 is $\beta_2$, and per person aged 75+ is $\beta_3$ with $\pi_1$, $\pi_2$, $\pi_3$ being the number of people in each of the three categories, then total spending per capita is

$$THEPC = \log\left[\frac{\beta_1\pi_1 + \beta_2\pi_2 + \beta_3\pi_3}{\pi_1 + \pi_2 + \pi_3}\right] + GDPPC + constant \tag{16}$$

The effect on the proportion of 65-74 year olds of a change in $\pi_2$ is

$$\frac{\partial \frac{\pi_2}{\pi_1 + \pi_2 + \pi_3}}{\partial \pi_2} = \frac{1}{\pi_1 + \pi_2 + \pi_3} - \frac{\pi_2}{(\pi_1 + \pi_2 + \pi_3)^2} = \frac{\pi_1 + \pi_3}{(\pi_1 + \pi_2 + \pi_3)^2} \tag{17}$$

and the effect of the same change given the model of health spending is

$$\frac{\partial THEPC}{\partial \pi_2} = \frac{\beta_2}{\beta_1\pi_1 + \beta_2\pi_2 + \beta_3\pi_3} - \frac{1}{\pi_1 + \pi_2 + \pi_3} \tag{18}$$

Thus the semi-elasticity with respect to the proportion is given as

$$\begin{aligned}\frac{\partial THEPC}{\frac{\partial \pi_2}{\pi_1 + \pi_2 + \pi_3}} &= \frac{\frac{\beta_2}{\beta_1\pi_1 + \beta_2\pi_2 + \beta_3\pi_3} - \frac{1}{\pi_1 + \pi_2 + \pi_3}}{\frac{\pi_1 + \pi_3}{\left(\pi_1 + \pi_2 + \pi_3\right)^2}} \\ &= \frac{\frac{\beta_2\left(\pi_1 + \pi_2 + \pi_3\right)}{\beta_1\pi_1 + \beta_2\pi_2 + \beta_3\pi_3} - 1}{\frac{\pi_1 + \pi_3}{\left(\pi_1 + \pi_2 + \pi_3\right)}}\end{aligned} \tag{19}$$

Here the numerator is the ratio of what health spending would be if it were $\beta_2$ per capita for the whole population to actual spending less 1, divided by 1 minus the proportion of people aged 65-74 in the actual population. Thus by restricting $\alpha_2$ to this value we can impose the hypothesis that health spending is driven in this precise way by population structure. Obviously the effect of the population aged 75+ can be derived in the same way. Note that the coefficient actually changes as the population numbers change. We impose it using the most recent information available. Since the equation is estimated for the EU15 as a whole, with country-specific effects dealt with by means of country dummy variables, we base the restrictions on the EU15 average and impose the same restrictions for all countries.

We have used age profiles for health and long-term care supplied by the European Commission. While health profiles are available for all countries, the long-term care profiles are not available for Austria, Eire, France, Greece and Spain, Eire. We have used the *per capita* expenditure average for the other countries to substitute for these missing data. Table 7 shows the derivation of the restrictions to be imposed on the long-run coefficients if health spending is taken to be age-related.

**Table 7 Derivation of the Restrictions of the Long-Run Values of the Age Terms when Health Expenditure is Age-Related**

| Country | Health spending as of GDP | GDP (2003) | Health and Long-term Care Spending | Proportion of Health and Long-term Care Expenditure by Age Group | | | Health and Long-term Care Expenditure by Age Group | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 0-64 | 65-74 | 75+ | 0-64 spend | 65-75 spend | 75+ spend |
| Austria | 8.65% | 226243 | 19570 | 0.468 | 0.124 | 0.408 | 9162 | 2422 | 7986 |
| Belgium | 9.28% | 274658 | 25495 | 0.396 | 0.134 | 0.470 | 10089 | 3412 | 11994 |
| Denmark | 8.68% | 188500 | 16363 | 0.430 | 0.108 | 0.462 | 7031 | 1774 | 7558 |
| Finland | 6.48% | 145938 | 9463 | 0.385 | 0.096 | 0.518 | 3646 | 911 | 4906 |
| France | 9.58% | 1594814 | 152734 | 0.450 | 0.125 | 0.425 | 68708 | 19049 | 64977 |
| Germany | 11.37% | 2161500 | 245799 | 0.461 | 0.154 | 0.385 | 113310 | 37861 | 94628 |
| Greece | 10.22% | 155543 | 15892 | 0.447 | 0.130 | 0.423 | 7100 | 2064 | 6728 |
| Eire | 7.47% | 138941 | 10378 | 0.464 | 0.127 | 0.408 | 4820 | 1320 | 4239 |
| Italy | 8.50% | 1335354 | 113504 | 0.464 | 0.167 | 0.369 | 52699 | 18964 | 41841 |
| Luxemburg | 5.94% | 25607 | 1522 | 0.411 | 0.129 | 0.460 | 626 | 197 | 699 |
| Netherlands | 8.71% | 476945 | 41539 | 0.432 | 0.105 | 0.462 | 17951 | 4381 | 19207 |
| Portugal | 9.60% | 137523 | 13198 | 0.468 | 0.124 | 0.408 | 6179 | 1633 | 5385 |
| Spain | 6.91% | 782531 | 54073 | 0.442 | 0.164 | 0.393 | 23922 | 8876 | 21274 |
| Sweden | 9.01% | 269548 | 24292 | 0.339 | 0.069 | 0.592 | 8234 | 1679 | 14380 |
| U.K | 7.76% | 1604497 | 124549 | 0.407 | 0.119 | 0.474 | 50685 | 14822 | 59041 |
| Total | 9.10% | 9518142 | 868369 | | | | 384162 | 119365 | 364844 |
| Number of people | | | | | | | 318998600 | 35344285 | 45546619 |
| Share of spending by age | | | | | | | | 0.442 | 0.137 |
| Spend per person | | | | | | | 1204 | 3377 | 8010 |
| Population shares | | | | 0.798 | 0.088 | 0.114 | | | |
| Coefficients | | | | | | | | **0.006** | **0.030** |

Data Source. Ageing Working Group. European Commission

We can similarly impose the restriction that a proportion of health spending is determined by the number of deaths. If

$$THEPC = \log \gamma_1 + \gamma_2 MORTALITY \tag{20}$$

then

$$\frac{\partial THEPC}{\partial MORTALITY} = \frac{\gamma_2}{THEPC} = \exp(THEPC) \tag{21}$$

Thus if spending per death (or spending in the last year of life) is known the associated semi-elasticity can be imposed.

Here there are two data problems. First of all data on death-related costs are not available for all countries. This means that we have to work out the relevant restriction for those countries for which we have data. Secondly, while we can identify expenditure on health care in the year prior to death, at least for some countries, it is much less clear how to handle long-term care costs. These undoubtedly increase with age, but at the same time mortality rates of people receiving long-term care are probably higher than those not receiving it. Unfortunately, mortality rates for people in receipt of long-term care are not available and it is therefore impossible to establish this. *Faut de mieux* we simply use the information on death related health costs and assume that the same proportion applied to long-term care. The calculation of the EU15 share of mortality-related costs in the total is shown in Table 8.

**Table 8 Mortality-Related Costs as a Proportion of Total Health Expenditure**

| Country | Mortality-related costs (% of total) | Health spending | Mortality-related spending |
|---|---|---|---|
| Austria | 24.0% | 19570 | 4697 |
| Belgium | 28.0% | 25495 | 7139 |
| Denmark | 23.0% | 16363 | 3770 |
| France | 43.0% | 152734 | 65675 |
| Germany | 25.3% | 245799 | 62070 |
| Italy | 28.0% | 113504 | 31781 |
| Netherlands | 27.0% | 41539 | 11216 |
| Portugal | 36.8% | 13198 | 4853 |
| Spain | 45.4% | 54073 | 24529 |
| Sweden | 23.0% | 24292 | 5587 |
| EU as a whole: based on countries reporting results | | 706575 | 221318 |
| Mortality-related share Coefficient restriction | | | **0.313** |

Data Source. Ageing Working Group. European Commission

Given these calculations we are able to explore a range of scenarios summarised in Table 9. Model 0 is our starting point. We next look at the effect of restricting the mortality coefficient both without and then with the coefficient on life expectancy restricted to zero. We repeat the process with the ageing coefficients taking their restricted values but with the mortality coefficient set at zero. Thus models 2 and 4 have demographic influences restricted to mortality and populations structure respectively, while models 1 and 4 are closer to the original model. The GDP elasticity moves as a consequence of the effects of the restrictions on unrestricted coefficients of the model

We repeat the exercise with the GDP elasticity set to 1.

**Table 9 Scenarios of Different Restrictions**

**On the Demographic Parameters**

| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT |
|---|---|---|---|---|---|
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** |
| 3 | 0.9653 | **0.006** | **0.030** | 0.0227 | **0** |
| 4 | 1.0403 | **0.006** | **0.030** | **0** | **0** |
| 5 | **1** | **0** | **0** | 0.0431 | **0** |
| 6 | **1** | 0 | 0 | 0.0564 | **0.313** |
| 7 | **1** | **0** | **0** | **0** | **0.313** |
| 8 | **1** | **0.006** | **0.030** | 0.0163 | **0** |
| 9 | **1** | **0.006** | **0.030** | **0** | **0** |

The impact of these restrictions on the long-run coefficients is shown in Table 10 and Table 11.

**Table 10 Long-run Coefficients with Demographic Restrictions. GDP Elasticity Unrestricted**

| | Unrestricted | Model 0 | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|---|---|
| GDPPC | 0.9363 | 1.0071 | 1.0151 | 1.1738 | 0.9653 | 1.0403 |
| AGE65_74 | -0.0230 | **0.0000** | **0.0000** | **0.0000** | 0.0060 | **0.0060** |
| AGE75_ | -0.0381 | **0.0000** | **0.0000** | **0.0000** | 0.0300 | **0.0300** |
| AVELE65 | 0.0920 | 0.0419 | 0.0538 | **0.0000** | 0.0227 | **0.0000** |
| FLFPR | 0.0253 | 0.0281 | 0.0321 | 0.0323 | 0.0322 | 0.0308 |
| UNEMP | -0.0082 | -0.0065 | -0.0034 | -0.0054 | -0.0055 | -0.0061 |
| ALCCON | -0.0006 | -0.0087 | -0.0144 | -0.0142 | -0.0156 | -0.0148 |
| PUHES | 0.0125 | 0.0094 | 0.0138 | 0.0136 | 0.0103 | 0.0102 |
| SALARYGP | 0.1212 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| CAPGP | 0.2013 | 0.1405 | 0.1539 | 0.1937 | 0.1615 | 0.1728 |
| CASEHO | 0.0079 | -0.0162 | -0.0144 | -0.0132 | -0.0196 | -0.0080 |
| COPAYGP | 0.0812 | 0.1862 | 0.2572 | 0.3042 | 0.2610 | 0.2965 |
| COPAYHO | -0.1409 | -0.0662 | -0.0663 | -0.0736 | -0.0677 | -0.0821 |
| FREEGP | 0.2458 | 0.1429 | 0.0858 | 0.0599 | 0.0928 | 0.0951 |
| FREEHO | 0.0690 | 0.0707 | 0.0872 | 0.1130 | 0.0766 | 0.0869 |
| BEDS | 0.0369 | 0.0622 | 0.0775 | 0.0554 | 0.0807 | 0.0715 |
| MORTM | 0.2152 | **0.0000** | **0.3130** | **0.3130** | **0.0000** | **0.0000** |
| | | $\chi_{12}^2$=12.9 | $\chi_{12}^2$=21.2$^*$ | $\chi_{14}^2$=34.4$^{**}$ | $\chi_{12}^2$=23.5$^*$ | $\chi_{14}^2$=27.5$^*$ |

**Table 11 Long-run Coefficients with Demographic Restrictions. GDP Elasticity Restricted to One**

| | Unrestricted | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 |
|---|---|---|---|---|---|---|
| GDPPC | 0.9363 | **1.0000** | **1.0000** | **1.0000** | **1.0000** | **1.0000** |
| AGE65_74 | -0.0230 | **0.0000** | **0.0000** | **0.0000** | **0.0060** | **0.0060** |
| AGE75_ | -0.0381 | **0.0000** | **0.0000** | **0.0000** | **0.0300** | **0.0300** |
| AVELE65 | 0.0920 | 0.0431 | 0.0564 | **0.0000** | 0.0163 | **0.0000** |
| FLFPR | 0.0253 | 0.0282 | 0.0322 | 0.0349 | 0.0319 | 0.0314 |
| UNEMP | -0.0082 | -0.0066 | -0.0035 | -0.0094 | -0.0052 | -0.0070 |
| ALCCON | -0.0006 | -0.0089 | -0.0148 | -0.0233 | -0.0148 | -0.0164 |
| PUHES | 0.0125 | 0.0094 | 0.0137 | 0.0099 | 0.0105 | 0.0095 |
| SALARYGP | 0.1212 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| CAPGP | 0.2013 | 0.1405 | 0.1539 | 0.2401 | 0.1630 | 0.1774 |
| CASEHO | 0.0079 | -0.0161 | -0.0144 | -0.0027 | -0.0193 | -0.0065 |
| COPAYGP | 0.0812 | 0.1856 | 0.2560 | 0.3380 | 0.2636 | 0.3108 |
| COPAYHO | -0.1409 | -0.0647 | -0.0631 | -0.0125 | -0.0747 | -0.0688 |
| FREEGP | 0.2458 | 0.1459 | 0.0921 | 0.1921 | 0.0795 | 0.1241 |
| FREEHO | 0.0690 | 0.0702 | 0.0861 | 0.1159 | 0.0795 | 0.0870 |
| BEDS | 0.0369 | 0.0628 | 0.0787 | 0.0588 | 0.0780 | 0.0717 |
| MORTM | 0.2152 | **0.0000** | **0.3130** | **0.3130** | **0.0000** | **0.0000** |
| | | $\chi_{13}^2$=12.9 | $\chi_{13}^2$=21.4 | $\chi_{15}^2$=48.6** | $\chi_{13}^2$=24.0* | $\chi_{15}^2$=28.7* |

* Significant at 5%
** Significant at 1%
Restricted demographic coefficients are shown in bold type.

A conclusion from tables 9 and 10 is that simple demographic hypotheses- that spending is driven by the age structure of the population, or by death-related costs, in a manner connected with observed spending on different age categories or in the year before death- are rejected by the data at a 5% level. The rejection is relatively marginal, with only the hypothesis that mortality is the sole demographic influence being rejected at the 1% level; on the other hand the increase in the $\chi^2$ statistic between model 0 and the models with the demographic restrictions in place points to these restrictions being strongly rejected. While we noted earlier the difficulty in determining the appropriate restriction, it is unlikely that the error is so large as to affect this conclusion.

We present scenarios for the countries to which our model is fitted with the various restrictions imposed above in place. This allows us to explore what would happen if such models were true despite the statistical evidence against them.

## 7. Simulation Results

The results for each country are presented in the appendix (to be completed). We show a summary of these in Table 12. The results are generated using the unrestricted model, model 0. Some general points emerge from these figures for model 0. Increases in the share of health spending in GDP are expected everywhere except in Denmark and Sweden where a reduction in the share of health spending which is publicly funded is expected to offset demographic effects. Austria manages to keep its rise in spending modest on account of a change in the structure of co-payments to GPs.

**Table 12 Summary Results of Health Care Projections for the EU15**

Health Care Expenditure as % of GDP

| | | 2050 Projected Value | | | | | |
|---|---|---|---|---|---|---|---|
| Country | 2003 Value | Model 0 | Model 2 Mortality Restrictions | Model 5 $\varepsilon_{GDP}$=1 | Model 7 $\varepsilon_{GDP}$=1 Mortality Restrictions | Model 4 AGE65-74 and AGE75+ restricted | Model 9 $\varepsilon_{GDP}$=1 AGE65-74 and AGE75+ restricted |
| Austria | 8.7% | 9.0% | 9.1% | 9.0% | 7.8% | 9.9% | 9.5% |
| Belgium | 9.3% | 11.6% | 11.6% | 11.6% | 10.5% | 13.0% | 12.7% |
| Denmark | 8.7% | 8.6% | 9.0% | 8.6% | 8.3% | 9.8% | 9.6% |
| Finland | 7.4% | 9.2% | 9.5% | 9.2% | 8.7% | 10.1% | 9.8% |
| France | 9.6% | 11.3% | 11.3% | 11.3% | 10.1% | 13.4% | 13.0% |
| Germany | 11.4% | 12.9% | 14.2% | 12.9% | 13.1% | 16.0% | 15.7% |
| Eire | 7.5% | 12.1% | 15.1% | 12.1% | 13.6% | 14.5% | 14.0% |
| Italy | 8.5% | 10.0% | 10.2% | 10.0% | 9.7% | 11.6% | 11.5% |
| Netherlands | 8.7% | 9.9% | 12.5% | 9.9% | 10.4% | 12.2% | 11.8% |
| Portugal | 9.6% | 13.8% | 13.0% | 13.8% | 11.9% | 15.9% | 15.5% |
| Spain | 7.7% | 11.1% | 12.9% | 11.1% | 12.6% | 14.8% | 14.5% |
| Sweden | 9.0% | 8.7% | 9.0% | 8.7% | 8.3% | 9.3% | 9.1% |
| United Kingdom | 7.8% | 9.9% | 9.3% | 9.9% | 8.6% | 10.8% | 10.5% |

The individual country reports show, in addition the effects on the outcome of individual variables remaining constant instead of changing as specified in our projections.

# 8. Comparison with Ageing Working Group Results

These results naturally invite comparison with the findings of the Ageing Working Group (European Commission, 2006). However, such a comparison is fraught with difficulties. An initial difficulty is that the data provided by the OECD plainly differ from those used by the Ageing Working Group. There are two factors behind this. First of all, the OECD figures include all spending while the AWG figures include only spending by the public sector. In principle it ought to be possible to correct for this because the OECD also provides data on the share of total health and long-term care expenditure paid for by the public sector. We therefore show in Table 13 the AWG figures for the pure ageing scenario plus the long-term care figures. This represents core projection in the AWG Report, scaled up to expand from the public sector to the whole economy and the OECD figures side by side. Ageing Working Group figures are available for 2004 but not for 2003. We do not regard this as an important influence on the comparison.

**Table 13 The Ageing Working Group and the OECD Data**

| | **Ageing Working Group 2004** | | | | | **Ahead** |
|---|---|---|---|---|---|---|
| | Health | Long-term Care | Total Public | Public Share | Total | OECD 2003 |
| Austria | 5.3% | 0.6% | 5.9% | 70.3% | 8.4% | 8.65% |
| Belgium | 6.2% | 0.9% | 7.1% | 71.6% | 9.9% | 9.28% |
| Denmark | 6.9% | 1.0% | 7.9% | 82.9% | 9.5% | 8.68% |
| Finland | 5.6% | 1.7% | 7.3% | 73.8% | 9.9% | 7.39% |
| France | 7.7% | 0.0% | 7.7% | 76.1% | 10.1% | 9.58% |
| Germany | 6.0% | 1.0% | 7.0% | 79.4% | 8.8% | 11.37% |
| Eire | 5.3% | 0.6% | 5.9% | 77.5% | 7.6% | 7.47% |
| Italy | 5.8% | 1.5% | 7.3% | 75.3% | 9.7% | 8.50% |
| Netherlands | 6.1% | 0.5% | 6.6% | 63.0% | 10.5% | 8.71% |
| Portugal | 6.7% | 0.0% | 6.7% | 69.7% | 9.6% | 9.60% |
| Spain | 6.1% | 0.5% | 6.6% | 71.2% | 9.3% | 7.68% |
| Sweden | 6.7% | 3.8% | 10.5% | 84.3% | 12.5% | 9.01% |
| United Kingdom | 7.0% | 1.0% | 8.0% | 82.2% | 9.7% | 7.76% |

Source: European Commission(2006). Table 4-8 p. 128 (Health Expenditure). Table 5-13. p.157 (Long-term Care)

The correlation between the two sets of data in the last two columns is 0.11 suggesting that, at least in some countries, there are serious differences of definition between them. On its own this might be thought to render comparison of the projections pointless.

A second substantial point affects our projections. As we have discussed, the share of public spending in the total can be an important influence on total spending. Countries with a high public share tend to have a high total level of spending. In our core projections country authors have generally assumed that trends in the share of public spending are likely to continue while the AWG figures can be presumed to be calculated on the assumption that the share is constant since, as far as we are aware the projection methods used do not consider the issue.

A declining public sector share has two impacts. First of all as noted, it depresses the projected value generated by our model for 2050. Secondly, if we gross up the AWG projections for 2050 using the projected public sector share figures for 2050, public spending lower in 2050 than in 2004 raises the grossing up factor applied to the AWG figure. Thus a decline the public sector share reduces the estimate of total spending generated by our model and raises the grossed up figure computed from the AWG figures. For this reason we present two sets of comparisons. The first is with our projections  from model 0 using the values assumed there for the public sector share in 2050.  The second is an alternative projection with the results generated on the assumption that the share of public sector spending in the total remains constant. We show in Table 14 the implications of these two assumptions for the interpretation of the AWG figures for 2050.

**Table 14 Ageing Working Group Projections for 2050 and the Public Sector Share**

| | Ageing Working Group 2050 | | | | | | |
|---|---|---|---|---|---|---|---|
| | Health | Long-term Care | Total Public | Base Public Share | Total | Constant Public Share | Total |
| Austria | 6.9% | 1.5% | 8.4% | 59.9% | 14.0% | 70.3% | 11.9% |
| Belgium | 7.7% | 2.1% | 9.8% | 70.6% | 13.9% | 71.6% | 13.7% |
| Denmark | 8.0% | 2.3% | 10.3% | 82.9% | 12.4% | 82.9% | 12.4% |
| Finland | 7.0% | 4.0% | 11.0% | 73.8% | 14.9% | 73.8% | 14.9% |
| France | 9.5% | 0.0% | 9.5% | 76.1% | 12.5% | 76.1% | 12.5% |
| Germany | 7.3% | 2.3% | 9.6% | 79.4% | 12.1% | 79.4% | 12.1% |
| Eire | 7.3% | 1.3% | 8.6% | 69.9% | 12.3% | 77.5% | 11.1% |
| Italy | 7.2% | 2.4% | 9.6% | 70.0% | 13.7% | 75.3% | 12.7% |
| Netherlands | 7.4% | 1.2% | 8.6% | 75.0% | 11.5% | 63.0% | 13.7% |
| Portugal | 7.3% | 0.0% | 7.3% | 61.4% | 11.9% | 69.7% | 10.5% |
| Spain | 8.3% | 0.8% | 9.1% | 63.9% | 14.2% | 71.2% | 12.8% |
| Sweden | 7.8% | 6.3% | 14.1% | 70.3% | 20.1% | 84.3% | 16.7% |
| United Kingdom | 9.3% | 2.0% | 11.3% | 69.4% | 16.3% | 82.2% | 13.7% |

In Table 15 we compare the figures produced on the two assumptions. Moving to the assumption that the public sector share is held constant reduces the gap between the AHEAD projections and those from the AWG. The sum of squared deviations falls from 128.9 to 69.0 showing the importance of the issue.

**Table 15: Comparison of AWG and Ahead Project Projections**

| | **Ahead** Model 0 | | **Ahead** Increase 2003 to 2050 Percentage Points | | **AWG** Increase 2004 to 2050 Percentage Points | |
|---|---|---|---|---|---|---|
| | Base Public Share | Constant Public Share | Base Public Share | Constant Public Share | Base Public Share | Constant Public Share |
| Austria | 9.0% | 8.7% | 0.3 | 0.1 | 5.6 | 3.5 |
| Belgium | 11.6% | 11.7% | 2.3 | 2.5 | 4.0 | 3.8 |
| Denmark | 8.6% | 9.3% | -0.1 | 0.7 | 2.9 | 2.9 |
| Finland | 9.2% | 9.2% | 1.8 | 1.8 | 5.0 | 5.0 |
| France | 11.3% | 11.4% | 1.7 | 1.8 | 2.4 | 2.4 |
| Germany | 12.9% | 12.7% | 1.6 | 1.4 | 3.3 | 3.3 |
| Eire | 12.1% | 12.9% | 4.6 | 5.5 | 4.7 | 3.5 |
| Italy | 10.0% | 10.5% | 1.5 | 2.0 | 4.0 | 3.0 |
| Netherlands | 9.9% | 8.9% | 1.2 | 0.2 | 1.0 | 3.2 |
| Portugal | 13.8% | 13.8% | 4.2 | 4.2 | 2.3 | 0.9 |
| Spain | 11.1% | 11.9% | 3.4 | 4.2 | 4.9 | 3.5 |
| Sweden | 8.7% | 10.0% | -0.3 | 0.9 | 7.6 | 4.2 |
| United Kingdom | 9.9% | 11.1% | 2.1 | 3.4 | 6.6 | 4.0 |

This comparison is still open to the objection that we have used our core model, with public sector shares adjusted while the AWG uses an ageing scenario. We address this final issue in Table 16. Here we draw on our simulations of model 9, where the demographic effects are limited to those arising from the changing age structure of the population and the income elasticity of health spending is held at one. We also hold the share of public spending in the total at the level identified in 2003, so as to remove the influence of this.

**Table 16 Comparison with Ageing Working Group Projections with Constant Public Sector Share and Similar Demographic Effects**

| | **AWG** | **Ahead** | **Percentage Point Increase 2003/4 to 2050** | |
|---|---|---|---|---|
| | | | AWG | Ahead |
| Austria | 11.9% | 9.6% | 3.5 | 1.0 |
| Belgium | 13.7% | 13.2% | 3.8 | 3.9 |
| Denmark | 12.4% | 10.7% | 2.9 | 2.0 |
| Finland | 14.9% | 10.1% | 5.0 | 2.7 |
| France | 12.5% | 13.5% | 2.4 | 4.0 |
| Germany | 12.1% | 15.7% | 3.3 | 4.3 |
| Eire | 11.1% | 15.6% | 3.5 | 8.1 |
| Italy | 12.7% | 12.3% | 3.0 | 3.8 |
| Netherlands | 13.7% | 10.8% | 3.2 | 2.1 |
| Portugal | 10.5% | 15.9% | 0.9 | 6.3 |
| Spain | 12.8% | 15.9% | 3.5 | 8.2 |
| Sweden | 16.7% | 10.7% | 4.2 | 1.7 |
| United Kingdom | 13.7% | 12.1% | 4.0 | 4.4 |

Source: European Commission(2006). Table 4-8 p. 128 (Health Expenditure). Table 5-13. p.157 (Long-term Care)

In fact this change serves to widen the gap between the two sets of estimates further. The sum of squared deviations rises to 96.6. It can be seen that there are very substantial differences in Eire, Spain and Portugal. One further point is of importance. We have already noted that for Austria our projections are depressed by the change in copayments to GPs in 2050; with this change we would find a figure of 12.6% for 2050 in this simulation, giving an increase of 3.9 percentage points which is close to the AWG figure of 3.5 percentage points.

# 9. Discussion and Conclusions

The aim of this work package is to present projections of health care expenditure in order to assess the impact of ageing populations on future spending levels. Projections of public expenditure on health are required to inform the debate on the future impact of ageing populations for the overall sustainability of future EU public finances. The expenditure projections modelled in this work package for the EU member states have attempted to measure the impact of health care expenditure in the first half of the current century.

Health care spending is to a large extent determined by the policy decisions of national governments, for example, whether specific treatment are provided by public health systems, the coverage of individuals eligible for public health services, the ‘quality’ of public health care (policy choices/ preferences for waiting lists, size of hospital wards, etc.). The different institutional arrangements of health care systems across member states imply that these factors cannot be taken into account in projections made at a multilateral level, although they can be included in national projections when clear policy targets exist (Wanless, 2004).

In general, the health of the public in EU countries has improved significantly in recent years. Though, all member states face problems with the affordability and efficiency of the provision of health care, as well as with the realisation of good quality health care for all individuals. There are many lessons to be learned about good and bad practices where effective and ineffective health care policy is concerned. Finally, there tends to be a general consensus within the EU member states that there is no ideal system to project health care expenditure. There are indeed trade-offs between various government objectives. Every member state attempts to reconcile social and economic goals and makes its own balance of trade-offs, reflecting different national values, traditions and institutions. There is therefore no ‘one size fits all’ approach to projecting health care expenditure.

Nevertheless, perhaps the most important message which emerges from this work is that a variety of variables seems to influence health spending- and the influence of factors such as the share of the public sector in the total could easily be omitted from more mechanical calculations. Thus the results from this study provide a valuable insight into influences on health spending and also shed some light on the policy structures which governments can adopt to keep health spending in check.

Our results suggest that the share of GDP spent on health is likely to increase by more than four percentage points in Eire and Portugal, with a slightly smaller increase in Spain. Other countries should expect increases of the order of 1 to 2 ½ percentage points with the exception of Austria where only a small increase is anticipated and Denmark and Sweden where slight declines are expected. These figures are generally below those found by the Ageing Working Group, but the comparison is affected by the assumption made about the size of the public sector. If we compare our projections on the assumption that spending is driven by demographic effects with those of the Ageing Working Group we find substantial differences for Eire, Portugal and Spain, for which we project increases substantially larger than those of the Ageing Working Group.

The study suggests that institutional variables are of great importance. Finland is an acknowledged success story in having limited its health spending over the last ten years or so by means of institutional change and this may provide an example to other countries. However, the use of dummy variables to represent institutional differences is not completely satisfactory since a number of countries reported that they did not see institutional structures being as clear cut as the dummy variables themselves suggested. Thus, if institutional change is to be used as a means of limiting spending, careful case studies will be needed to identify more precisely the effects of different arrangements.

Nevertheless, one institutional issue does stand out unambiguously. Total spending on health is significantly and positively related to the share of health spending paid for by the public sector. This result is extremely intuitive and is likely to be of considerable importance in any future discussion of budgetary pressures associated with population ageing.

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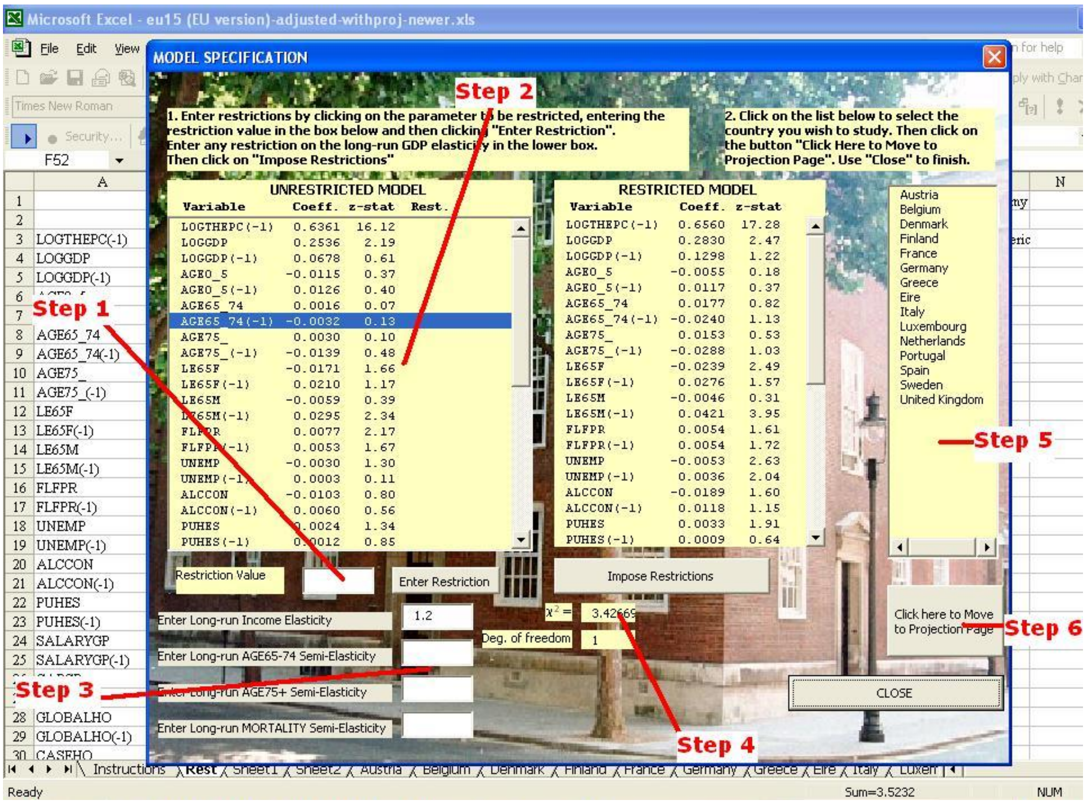
# Appendix A: The Model in EXCEL

The health care projections were constructed using a model embedded in a macro programme and set of spreadsheets in the workbook *healthn.xls* in EXCEL using a fixed effects panel regression estimated by Generalised Least Squares. Access to the model is given by running the macro “Health Model” . The structure of the spreadsheets is the same in both cases. The sole difference between them is that in healths.xls changes to one model parameter do not affect other parameters making this more useful for simulation work.

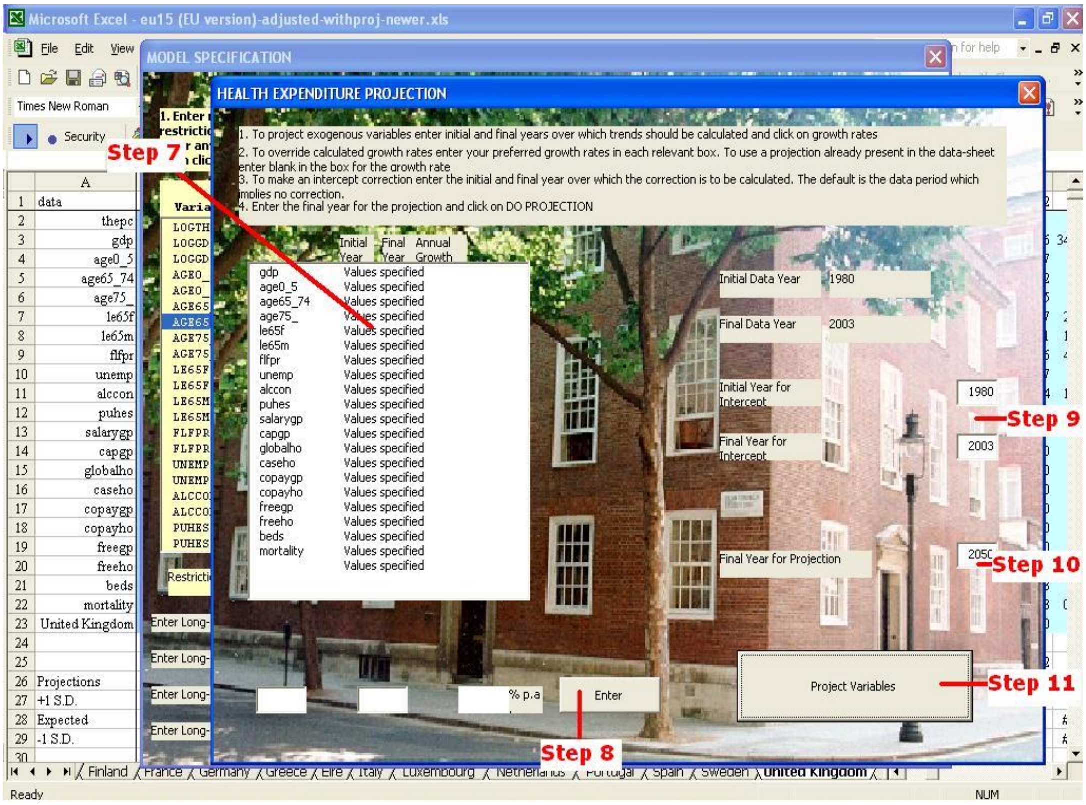
The first figure displays the window laying out the regression parameters that users can access by running the macro ‘Health Model’ from the tools menu. Restrictions can be imposed on the parameters.




- Step 1: Enter long-run elasticity with respect to GDP. Leave blank if this is not restricted.
- Step 2: Impose restrictions on specific parameters by entering desired values in boxes. Note that we have pre-specified a set of restrictions. This is shown in the

boxes but can be changed. If a box is left blank then no linear restriction is imposed.

- Step 3: Clicking the box marked ‘impose restrictions’ presents the restricted coefficients and the impact of these restrictions on unrestricted coefficients.
- Step 4: Once the restrictions are imposed a test for the validity of the restrictions is performed and shown by the $\chi^2$ statistic with its $p$ value.
- Step 5: Users should now select the first country whose health expenditure they wish to project. Failure to select a country will result in an error, and the programme has to be restarted. Users should note that if the model strongly rejects the restrictions that they have imposed, there is a substantial risk that the projections they generate will be meaningless.
- Step 6: By clicking here users will be moved to the next window for the projection stage of the model.




- Step 7: In order to project the exogenous variables, users must select the growth rates and the initial and final years over which the trends should be calculated. The exogenous values are entered up to 2003 and the remaining cells up to 2050 are left blank. However, users can insert their own values here and then move onto the projections.

- Step 8: This button will compute the growth rates from the trend start and end dates selected. As noted above, it is important to mention here that the growth rates of the parameters may be illogical and users are recommended to change the growth rates for the variables in question accordingly. Alternatively, may enter their own projected values in the spreadsheet for the country concerned. Step 9: Enter in the initial and final data years.
- Step 8: This button will compute the growth rates from the trend start and end dates selected. As noted above, it is important to mention here that the growth rates of the parameters may be illogical and users are recommended to change the growth rates for the variables in question accordingly. Alternatively, may enter their own projected values in the spreadsheet for the country concerned. Step 9: Enter in the initial and final data years.
- Step 9: To make an intercept correction, enter the initial and final years over which the intercept should be calculated.
- Step 10: Users should enter here the final year up to which the projections will go.
- Step 11: Finally, by clicking here users will find projections of health care expenditure for the country selected in the previous window. Expectations of health care expenditure are projected in row 16 (and in row 21 in percentages of GDP per capita) for the sheet of the country in question. Rows 14 and 16 (and in rows 20 and 22 in percentages) provide ±1 standard deviation on either side of the projected health care spending profile. It is important to mention here that the growth rates of the parameters projected may not be entirely logical. For example, with the age variables, the proportion of the elderly may be very large the further the projections go and so therefore it is advisable for users to insert their own growth rates.

- Note: In order to run the programme for another country, either (i) repeat steps 4-11 if you wish to keep the long-run elasticity and the linear restrictions the same (ii) or start from the beginning at step 1 to change the long-run elasticity and the restrictions to be imposed.

# Appendix B: Country Reports

## B1 Austria

Markus Kraus, Sandra Müllbacher and Alexander Schnabl, IHS

### *Health care expenditure, 1980-2003*

Health care expenditure in Austria grew by an estimated 1.24 percentage points from 7.41 per cent to 8.65 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 this compares with a growth of 2.5 percentage points for the EU 15 member states over the same period with average health care expenditure reaching 9.0 per cent of the GDP in 2003.

Austrian health care expenditure can be broadly divided into public spending, which is defined as expenditures by the social health insurance as well as by the federal government, federal states and municipals, and private spending, which is defined as expenditures by the households. Public health expenditure as a share of the total increased between 1980 and 2003 by an estimated 1.49 percentage points to 70.32 %.

### *Health care expenditure, 2004-2050*

The projected data for Austria supposes that the female labour force participation (FLFPR) will continue to grow until 2050 (from 44.89 to 46.20). The unemployment rate (UNEMP) is expected to fall from 4.16% to 3.43%.

The dependent variable in this paper is total health care expenditure per capita (THEPC), measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and for inflation. However, in the presented results THEPC is converted to a percentage of GDP. The variables used are listed in Table B1-1. Demographic, economic and institutional variables included in our model have been collected from both the OECD Health Data 2006 and the AWG. The variables alcohol consumption (ALCCON), public health care expenditures (PUHES) and acute care beds (BEDS) have been evaluated by extrapolating the trend over the period 1980-2003. Dummy variables are assumed unchanged. The source or method of derivation is indicated in the table.

| Table B1-1 Demographic, economic and institutional variables included in model. | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 7.98 | 11.92 | 0.88 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 7.56 | 18.22 | 1.93 |
| AVELE65+ | The average life expectancy at aged 65 for males and females. Source: WHO | 18.02 | 22.46 | 0.48 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000). Source: WHO. | 0.98 | 1.46 | 0.91 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: OECD and AWG. | 44.89 | 46.20 | 0.06 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 4.16 | 3.43 | -0.42 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend. | 10.49 | 9.61 | -0.19 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD and Annual Growth Trend. | 70.38 | 73.35 | 0.09 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. | 0 | 0 | Na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. | 0 | 0 | Na |
| GLOBALHO | Dummy variable taking the value of one for countries with global budget reimbursement of hospitals; zero otherwise. | 0 | 0 | Na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. | 1 | 1 | Na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. | 1 | 0 | Na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. | 1 | 1 | Na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. | 1 | 1 | Na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. | 1 | 1 | Na |
| BEDS | Acute care beds per 1,000 inhabitants. Source: OECD and Annual Growth Trend. | 6.01 | 3.35 | -1.26 |

### *Simulation models of health care expenditure in Austria, 2004-2050: Influences of Driving Variables*

### Economic and demographic variables

Table B1-2 shows the projections for expenditures on health as a proportion of GDP. The base-line expenditures on health care, as shown in the first line of the table, are expected to rise from 8.65% of GDP in 2003 to 8.98% in 2050.

**Table B1-2 The influence of socio-economic variables on projected health spending**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Base | | | 8.98% | 0.00% |
| GDP | 28118 | 57180 | 9.25% | 0.27% |
| GDP (1.5% p.a. growth) | 28118 | 57180 | 8.97% | -0.01% |
| AGE 65-74 | 8.01 | 11.92 | 9.01% | 0.03% |
| AGE 75+ | 7.45 | 18.22 | 8.84% | -0.14% |
| AVELE65 | 18.17 | 22.46 | 7.59% | -1.39% |
| MORT | 0.95 | 1.49 | 9.12% | 0.14% |
| FLFPR | 44.24 | 46.20 | 8.48% | -0.50% |
| UNEMP | 4.30 | 3.43 | 8.93% | -0.05% |
| ALCCON | 10.51 | 9.61 | 8.97% | -0.01% |
| PUHES | 70.32 | 73.35 | 8.73% | -0.25% |

Additionally to the base value, Table B1-2 shows the results of simulations in which each socio-economic variable is set to the value that it held in 2003. A comparison of the results of these simulations with the base therefore indicates the importance of the projected path of each variable, and shows how they influence the base projection.

Most of the variables have only little influence on the share of health spending in GDP. Although the elasticity of health spending with respect to GDP is slightly bigger than one (1.0071), rising GDP in itself decreases the share of health spending in GDP. With GDP constant the projected value is 0.27 percentage points higher than the base (9.25% vs. 8.98%). Restricting the GDP growth to 1.5% p.a. leads to almost no difference in the expenditure share value. The reason for that is that the coefficient on life expectancy falls as the income elasticity is raised.

The age structure is likewise not very important. The growing share of people aged 75+ leads to higher spending. Keeping their share as in 2003 reduces the health expenditure by 0.14 percentage points. The development of the share of people aged 65-74 has almost no influence. Mortality is as influential the aged 75+, but with a reverse sign. (Keeping mortality as in 2003 leads to lower costs by 0.14 percentage points.) A more influential demographic variable is the average life expectancy of people aged 65 since the long-term effects of the other demographic variables are restricted to zero. If this stayed at its 2003 value spending would be reduced by 1.39 percentage points. A net demographic effect can be calculated by adding together the deviations of all demographic terms. If all these variables stayed at their 2003 values, spending would be reduced by –1.36 percentage points, but one has to reconsider that almost the whole effect is based on the effect of the life expectancy.

The share of the public sector in health spending is also of little importance. Leaving it constant reduces projected spending by 0.25 percentage points. A more influential variable is the female participation rate on the labour market. If the rate stayed at its 2003 value, spending would be reduced by 0.50 percentage points.

## Health policy variables

We use a similar approach to look at the effects of the variables, which can be regarded as health policy variables. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each variable in turn is switched between the base run and the alternatives. Thus if a dummy took the value of 1 in the base it is switched to 0 in the alternative and vice versa. The results are provided in Table B1-3.

**Table B1-3: The influence of policy variables on projected health spending.**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Beds | 6.09 | 3.35 | 9.29% | 0.31% |
| | Value in Base Run | Value in Alternative | | |
| Salary GP | 0 | 1 | 8.98% | 0.00% |
| CapGP | 0 | 1 | 10.33% | 1.35% |
| CaseHo | 1 | 0 | 9.12% | 0.14% |
| CoPayGP | 1 | 0 | 8.98% | 0.00% |
| CoPayHo | 1 | 0 | 9.59% | 0.61% |
| FreeGP | 1 | 0 | 7.78% | -1.20% |
| FreeHo | 1 | 0 | 8.36% | -0.62% |

**Note:** The entry for beds has the same interpretation as in Table B2. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa.
**Source**: IHS HealthEcon 2007.

Reducing the number of beds between 2003 and 2050 depresses costs, but only by 0.31 percentage points. The most influential variable is the one for Capitation-paid GPs, that add to costs by 1.35 percentage points. However, salaried GPs have no influence on health spending. Not charging the public for visiting a hospital would increase costs by 0.61 percentage points, whereas co-payments for visiting a GP have no influence. Abolishing the free choice of hospitals and GPs would both reduce costs (0.62 and 1.20 percentage points respectively).

### *Influences of Expenditure Elasticities*

Table B1-4 provides further information on the effects of the income elasticity if it was restricted to 1, 1.1 and 1.2. The unrestricted elasticity amounts to 1.01. It can be seen that the impact of the elasticity is particular weak for values just above 1. Thus, restricting it to 1.1 or 1.2 should increase projected health care expenditures in 2050, whereas in this case projected spending decreases (8.93% and 8.82%). The reason for that is that the coefficient on life expectancy falls as the income elasticity is raised.

| **Table B1-4: Scenario of Different Restrictions on Long-run Income Elasticity on Health Care Expenditure in Austria** | | | |
|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
| Unrestricted | 9.48% | 8.98% | 8.49% |
| 1 | 9.48% | 8.98% | 8.50% |
| 1.2 | 9.39% | 8.82% | 8.29% |

**Source:** IHS HealthEcon 2007.

### *Influences of Restrictions on Demographic Parameters*

Finally in Table B1-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to income left unrestricted and being restricted to 1. In the table the boldface entries indicate that a demographic restriction has been imposed. For the age variables it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population. For the mortality it is the coefficient that would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub-case of each cell tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

| **Table B1-5 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 9.48% | 8.98% | 8.49% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 11.05% | 10.43% | 9.84% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 9.73% | 9.11% | 8.52% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 11.25% | 10.61% | 10.01% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 10.51% | 9.92% | 9.36% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 9.58% | 9.06% | 8.57% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 11.05% | 10.44% | 9.85% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 8.42% | 7.84% | 7.29% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 11.22% | 10.59% | 9.99% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 10.01% | 9.53% | 8.99% |

**Note:** Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.
**Source:** IHS HealthEcon 2007.

The importance of the interactions between the coefficients can be deduced from this table. When the income elasticity is restricted to 1, the restriction on mortality has a decreasing effect on spending (Model 7, 7.84%), whereas with unrestricted income elasticity the restriction on mortality increases projected spending to 9.11% of GDP (Model 2). We also note that when the parameters on the age variables are restricted, there are in both cases (Model 3 and Model 8) pronounced increases, with no effect of a restriction on the income elasticity. If the life expectancy term is set to zero this effect is reduced slightly.

## *Conclusion*

Summing up, in the group of the socio-economic variables "average life expectancy of people aged 65" and "female participation rate on the labour market" are the most influential ones. If average life expectancy of people aged 65 stayed on its 2003 value spending would be reduced by 1.4 percentage points. Keeping female participation rate on the labour market at its 2003 level, health care expenditure would be reduced by a half percentage point.

## B2 Belgium

Peter Willemé. Federal Planning Bureau

### *Health care expenditure, 1980-2003*

Health care expenditure in the Belgium grew by an estimated 2.9 percentage points from 6.4 per cent to 9.3 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 (OECD, 2006) this compares with a growth of 2.5 percentage points for the EU15 member states over the same period with health care expenditure in 2003 reaching 9.0 per cent of GDP.

Belgian health care expenditure can be broadly divided into public spending, which is mainly spent by RIZIV through sickness funds, and private spending, which is defined as expenditure by the household and corporate sector on health care. Public health expenditure as a share of the total has fluctuated around 71 per cent between 1980 and 2003.

### *Health care expenditure projections, 2004-2050*

The projected data for Belgium assume that female labour force participation (*FLFPR*) will continue to grow slowly until 2050, whilst the unemployment rate (*UNEMP*) is expected to decrease from 8.2 percent in 2003 to 6.5 percent in 2013 and thereafter. Both the amount of alcohol consumption per capita (*ALCCON*) and the number of acute care beds (*BEDS*) are expected to decline until 2050. Finally, private health care expenditure is expected to remain constant at around 71 per cent throughout the projections.

The dependent variable used in this paper is total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and for inflation, although this is converted to a percentage of GDP in presenting the results. The variables listed in Table B2-1 have been collected from both the OECD Health Data 2006 and the AWG. The projected data are either derived from the OECD, AWG or evaluated by extrapolating the trend over the period 1980-2003. Dummy variables are assumed unchanged. The source or method of derivation is indicated in the table.

| **Table B2-1 Demographic, economic and institutional variables included in our model** | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Av Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 9.29 | 11.19 | 0.40 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 7.83 | 15.99 | 1.53 |
| AVELE65 | Average life expectancy at age 65 for males and females. Source: WHO. | 18.13 | 22.54 | 0.49 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO. | 0.98 | 1.18 | -0.40 |
| GDP | Gross domestic product in US $ PPP. Source: OECD. | 27120 | 57284 | 1.6 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: OECD and AWG. | 44.79 | 46.62 | 0.09 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 8.40 | 6.50 | -0.54 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend. | 8.19 | 6.34 | -0.54 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD and AWG. | 70.58 | 70.58 | 0.00 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 0.00 | 0.00 | na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et. al* (2006) | 4.41 | 3.35 | -0.58 |

It is important to note that many of the variables, such as those representing the public share in health spending may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one.

### *Simulation models of health care expenditure in Belgium, 2004-2050: Influences of Driving Variables*

Table B2-2 shows the base-line expenditure on health as a proportion of GDP, with expenditure on health care expected to rise to 11.63% of GDP in 2050 from 9.3% in 2003. This compares with the most recent national estimates by the Study Committee on Ageing (SCA) 1 of 14.8% obtained by grossing up the original figure, which includes only public expenditure. As Table B2-2 shows, public expenditure in Belgium is expected to remain constant at around 71% of total health care expenditure, so the SCA figure for 2050 (10.5%) was divided by 0.71. Even when the uncertainty surrounding both models is taken into account, projected total health expenditures as a share of GDP with the current model appear to be significantly lower.

In Table B2-2 we show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. Comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection. These results are calculated using model 0 of Table B5.

**Table B2-2 The Influence of Socio-Economic Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Base | | | 11.63% | --- |
| GDP | 26539 | 57284 | 12.03% | 0.40% |
| GDP (1.5% p.a. growth) | 26539 | 57284 | 11.67% | 0.04% |
| AGE65-74 | 9.33 | 11.19 | 11.67% | 0.04% |
| AGE75+ | 7.69 | 15.99 | 11.60% | -0.03% |
| AVELE65 | 15.95 | 20.50 | 9.71% | -1.92% |
| MORTALITY | 1.03 | 1.18 | 11.66% | 0.03% |
| FLFPR | 44.77 | 46.62 | 11.03% | -0.60% |
| UNEMP | 8.2 | 6.50 | 11.51% | -0.12% |
| ALCCON | 7.88 | 6.34 | 11.61% | -0.02% |
| PUHES | 71.61 | 70.58 | 11.75% | 0.12% |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

This table shows that some of our projections have a powerful influence on the share of spending. Although the steady state elasticity with respect to GDP is very close to 1, a reduction in the growth rate affects the dynamics of the process and thus the

[1] Study Committee on Ageing, Annual Report, June 2007.

projected value for 2050. The share of the population in each age group is not very important, which is not very surprising since the variables are specified to have no long-run effect. Mortality likewise has little influence. However rising average life expectancy of men and of women adds 1.75 percentage points to the expenditure share.

The projected continuation of the historical trend in female labour force participation by nearly 2 percentage points also has some impact on projected health care spending, accounting for a 0.60% percentage point difference of the 2050 expenditure figure.

We use a similar approach to look at the effects of the variables which can be regarded as health policy variables. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives. Thus if a dummy took the value of 1 in the base it is switched to 0 in the alternative and vice versa. These results are shown in Table B2-3.

**Table B2-3 The Influence of Policy Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Beds | 4.41 | 3.35 | 11.90% | 0.27% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 11.63% | 0.00% |
| CapGP | 0 | 1 | 13.39% | 1.49% |
| CaseHO | 0 | 1 | 11.44% | -0.46% |
| CoPAyGP | 1 | 0 | 9.66% | -1.97% |
| CoPayHO | 1 | 0 | 12.43% | 0.80% |
| FreeGP | 1 | 0 | 10.08% | -1.55% |
| FreeHO | 1 | 0 | 10.84% | -0.79% |

Note: The entry for beds has the same interpretation as in Table B1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa.

The table shows that it is the management of GPs rather than the management of hospitals which has an important effect on health spending. Introducing capitation-payment and abolishing co-payment of GPs both add to costs. A word of caution is in order to qualify these counter-intuitive results. It should be noted that the estimated effects of the health system dummies were obtained from a limited number of institutional changes in just some of the countries (the dummies are constant over time in approximately half of the countries). Consequently, they capture country-specific effects of these transitions. It is not clear whether these effects can be meaningfully attributed to countries like Belgium, where no such institutional changes have taken place in the past. Limiting the free choice of GP appears to be a promising way to keep health expenditures under control, leading to a rather substantial decrease of around 1.5 percentage points in health spending (although, once again, this result is based on average effects in a limited number of other countries).

### *Influences of Expenditure Elasticities*

Table B2-4 shows the effect of increases in the elasticity of health spending with respect to GDP on total expenditure as a proportion of GDP. Since in model 0 the GDP elasticity is very close to one, it is no surprise that the result is scarcely changed by imposing an elasticity of 1. Higher elasticities result in lower expenditure shares. This is because of the interaction between the elasticity and the coefficient on life expectancy as discussed in the main body of the paper.

**Table B2-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in Belgium**

| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
|---|---|---|---|
| Unrestricted | 12.10% | 11.63% | 11.18% |
| 1 | 12.10% | 11.64% | 11.19% |
| 1.1 | 11.94% | 11.47% | 11.01% |
| 1.2 | 11.70% | 11.20% | 10.72% |

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B2-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table the boldface entries indicate that a restriction has been imposed. For the age variables it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

| Table B2-5 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 12.10% | 11.63% | 11.18% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 13.56% | 13.04% | 12.54% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 12.08% | 11.58% | 11.11% |
| 3 | 0.9653 | **0.009** | **0.020** | 0.0227 | **0** | 13.62% | 13.08% | 12.57% |
| 4 | 1.0403 | **0.009** | **0.020** | **0** | **0** | 12.86% | 12.36% | 11.87% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 12.10% | 11.64% | 11.19% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 13.58% | 13.06% | 12.57% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 11.01% | 10.54% | 10.09% |
| 8 | **1** | **0.009** | **0.020** | 0.0163 | **0** | 13.60% | 13.07% | 12.56% |
| 9 | **1** | **0.009** | **0.020** | **0** | **0** | 12.30% | 11.82% | 11.37% |

Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.

The importance of the interactions between the coefficients can be deduced from this table. The restriction that spending is driven by death-related costs in the manner set out in section 3.2 has the effect of raising projected expenditure by 1.41 percentage points. However, if the life expectancy effects are restricted to zero so that death-related costs are the only demographic influence, then projected expenditure is reduced by 0.05 percentage points. By contrast when expenditure is assumed to be age related, it is raised by nearly 1.45 percentage points, falling to 0.74 percentage points when life expectancy effects are also suppressed. If the GDP elasticity is also restricted to one these effects are altered. In particular, when demographic effects are assumed to come only through mortality, a unit elasticity has the effect of reducing age projected expenditure fairly sharply.

## *Conclusions*

The exercise has indicated a number of key influences on health spending in Belgium. Estimates of the influence of demographic effects are crucially dependent on the interaction between these and the estimated GDP elasticity of health spending. With the figures for the Belgian projections, raising the GDP elasticity from its unrestricted value of 1.0071 to 1.2 has the effect of reducing projected expenditure because of offsetting movements in the effects of the demographic variables. The effect of rising life expectancy is enhanced because the restriction results in the coefficient on this being raised.

Of the other variables the female labour force participation rate is important; a projected increase in this variable adds 0.6 percentage points to total expenditure by 2050. The structure of GP remuneration and the basis on which GDP services are provided are also important influences, although some of the estimated effects of these institutional variables contradict a priori expectation.

# B3 Denmark

Erika Schulz, DIW

### *Health care expenditure, 1980-2003*

Total health care expenditures (public and private) in Denmark decreased by an estimated 0.4 percentage points from 9.1 per cent to 8.7 per cent of GDP between 1980 and 2003. According to OECD Health Data 2006 (OECD, 2006) this compares with a growth of 2.5 percentage points for the EU15 member states over the same period with health care expenditures in 2003 reaching 9.0 per cent of GDP.

Health care expenditure in Denmark can be broadly divided into public spending, which is mainly spent on National Health Service, and private spending, which is defined as expenditure of households and corporate sector on health care. The public health expenditure as a share of the total decreased by an estimated 4.9 percentage points to 82.9 percent between 1980 and 2003. Public health care expenditure as a percentage of GDP declined from 7.9 percent in 1980 to 7.7 per cent in 2003.

### *Health care expenditure projections, 2004-2050*

The projected data for Denmark assume that the unemployment rate (*UNEMP*) is expected to fall slightly. In the past the alcohol consumption (ALCCON) increased by 0.07 percent per year and it is assumed that this trend will continue. The number of beds decreased markedly by 1.91 per cent per year (BEDS). It is assumed that the further decline is restricted to 0.5 per cent per year. While the share of the elderly will increase until 2050, the number of inhabitants shows a different development: Until 2035 an increase in population is expected, and afterwards a decrease. In 2050 the population is projected to reach 5.5 million which means a slight increase in comparison to the base year. As a result the crude mortality rate will decline until 2012 and will then rise to 1.34 in 2050.

The dependent variable used in this paper is total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and inflation. In the presentation of the results it is additionally converted to a percentage of GDP. The variables which are included in our model are listed in Table B3-1. They were collected from both the OECD Health Data 2006 and the AWG. The projected data are either derived from the OECD, AWG or evaluated by extrapolating the trend over the period 1980-2003.  Dummy variables are assumed to remain unchanged. The source or method of derivation is indicated in the table.

| Table B3-1 Demographic, economic and institutional variables included in our model | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| FLFPR | Proportion of females in total labour force Source: OECD, AWG | 47.00 | 46.4 | -0.03 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: EUROSTAT, AWG. | 7.89 | 10.32 | 0.61 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: EUROSTAT, AWG. | 7.02 | 14.63 | 1.62 |
| AVELE65 | Life expectancy at aged 65 for females and males. Source: WHO, AWG. | 16.60 | 19.54 | 0.36 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100) (in logs). Source: WHO, AWG. | 1.13 | 1.34 | 0.39 |
| GDP | Gross domestic product per capita in US$ PPP Source: OECD and AWG. | 29196 | 62122 | 1.66 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 5.26 | 4.26 | -0.45 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend. | 9.56 | 9.89 | 0.07 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD and AWG. | 82.73 | 73.90 | -0.25 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 0.00 | 0.00 | na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et. al* (2006) | 3.37 | 2.67 | -0.5 |

It is important to note that many of the variables, such as those representing the public share in health spending may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one.

### *Simulation models of health care expenditure in Denmark, 2004-2050: Influences of driving variables*

**Table B3-2 The Influence of Socio-Economic Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
|---|---|---|---|---|
| Base | | | 8.61% | |
| GDP | 28745 | 62122 | 8.98% | 0.37 |
| GDP (1.5% p.a. growth) | 28745 | 62122 | 8.71% | 0.10 |
| AGE65-74 | 7.80 | 10.32 | 8.83% | 0.22 |
| AGE75+ | 7.03 | 14.63 | 8.50% | -0.11 |
| AVELE65 | 16.70 | 19.54 | 7.70% | -0.91 |
| FLFRP | 47.00 | 46.40 | 8.76% | 0.15 |
| MORTALITY | 1.07 | 1.34 | 8.62% | 0.01 |
| UNEMP | 5.40 | 4.26 | 8.55% | -0.06 |
| ALCCON | 9.55 | 9.89 | 8.61% | 0.00 |
| PUHES | 82.94 | 73.90 | 9.34% | 0.73 |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

In Table B3-2 we show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. A comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection. They are calculated by using model 0 of Table 3.

This table shows that some of our projections have a powerful influence on the share of spending. Because the health spending elasticity with respect to GDP is 1.0071, rising GDP in itself (1.5 per cent annual growth rate) increases the share of health spending in GDP by 0.1 percentage points. With constant GDP the projected value is 0.37 percentage points higher than the base. The ageing of the population with an increase in the share of the elderly leads to different effects in the two included age-groups. If the share of people aged 65 to 74 was held constant, the health care spending would rise by 0.22 percentage points. On the other hand, if the share of people aged 75 and over was held constant, a decline in health care spending by 0.11 percentage points would be the result. While the effects of increasing shares of the older age-groups show a relative small effect since the variables have no long run effect in our equation, increase in life expectancy has a significant impact on health care spending. Constant life expectancy reduces the spending by 0.91 percentage points. Changes in the crude death (MORTALITY) have nearly no effect in the case of Denmark because, once again, they have no long-run influence on the model. A net demographic effect can be calculated by adding together the deviations of all the demographic terms. If all of these stayed at their 2003 values spending would be reduced by 0.79 percentage points. The share of the public sector in health spending is also important, since the projected decline in the share reduces the total expenditure by 0.73 percentage points.

In order to look at the effects of the variables which can be regarded as health policy variables, we use a similar approach. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives. Thus, if a dummy takes the value of 1 in the base, it is switched to 0 in the alternative and vice versa. These results are shown in Table B3-3 using our model 0.

**Table B3-3 The Influence of Policy Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
|---|---|---|---|---|
| Base | | | 8.61% | |
| Beds | 3.38 | 11.01 | 8.73% | 0.12 |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 8.61% | 0.00 |
| CapGP | 0 | 1 | 9.91% | 1.30 |
| CaseHO | 0 | 1 | 8.47% | -0.14 |
| CoPAyGP | 0 | 1 | 10.37% | 1.76 |
| CoPayHO | 0 | 1 | 8.06% | -0.55 |
| FreeGP | 1 | 0 | 7.47% | -1.14 |
| FreeHO | 1 | 0 | 8.02% | -0.59 |

Note: The entry for beds has the same interpretation as in Table B1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa.

The table shows that it is the management of GPs rather than the management of hospitals which has an important effect on health spending. If GP's were reimbursed by capitation the health care spending would rise by 1.3 percentage points. Copayments for visiting a GP increases the total health care expenditures by 1.76 percentage points due to a rise in private spending. However, there is a question whether this dummy in fact represents this term. Limiting the access to GP's would lead to a decline in health spending by 1.14 percentage points.

### *Influences of Expenditure Elasticities*

Table B3-4 shows that a reduction in the elasticity of health spending with respect to GDP to 1 results in a very small fall and an increase of GDP elasticity up to 1.1 and 1.2 results in an increase in total expenditure as a proportion of GDP.

Table B3-4 provides further information on the effect of income elasticity. As we have already observed when reducing it from the unrestricted value to 1, there is little overall change because of offsetting changes in the other parameters of the model. It can be seen that the impact of the elasticity is particularly weak for values just above 1.

| **Table B3-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in Denmark** | | | |
|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
| Unrestricted | 8.89% | 8.61% | 8.35% |
| 1 | 8.87% | 8.60% | 8.34% |
| 1.1 | 9.05% | 8.77% | 8.49% |
| 1.2 | 9.24% | 8.92% | 8.62% |

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B3-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table boldface entries indicate that a demographic restriction has been imposed. For the age variables the coefficient shows what would be observed if health expenditure were driven by the age structure of the population. The coefficient for mortality indicates what would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted, while in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influences.

**Table B3-5 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050**

| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 8.89% | 8.61% | 8.35% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 9.48% | 9.19% | 8.90% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 9.36% | 9.03% | 8.70% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 10.14% | 9.82% | 9.50% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 10.15% | 9.81% | 9.48% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 8.87% | 8.60% | 8.34% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 9.45% | 9.16% | 8.88% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 8.59% | 8.27% | 7.96% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 10.21% | 9.88% | 9.56% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 9.91% | 9.59% | 9.27% |

Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.

The importance of the interactions between the coefficients can be deduced from this table. When the GDP elasticity is not limited, the restriction of the elasticity for the both age-groups to zero has the effect of raising projected expenditure (model 1 compared to model 0). However, if the life expectancy effects are restricted to zero so

that death-related costs are the only demographic influence, then projected expenditure is reduced by 0.16 percentage points (model 2 compared to model 1). In contrast when expenditure is assumed to be age related (model 3) the health care spending will rise by 1.2 percentage points compared to the base model. an additional restriction if life expectancy (model 4) lead not to a significant change in the result.
If GDP elasticity is restricted to 1 the results are not quite different from the results of the unrestricted GDP elasticity. However, if also the life expectancy was restricted to zero the increase the health care expenditure would be 0.34 percentage points below the base model (model 7 compared to model 0) respectively 0.76 percentage points compared to model 2.

### *Conclusions*

The exercise has indicated a number of key influences on health spending in Denmark. Estimates of the influence of demographic effects are crucially dependent on the interaction between these effects and the estimated GDP elasticity of health spending.

According to the Danish projections, raising the GDP elasticity from its unrestricted value of 1.0071 1.2 results in rising projected expenditures due to offsetting movements in the effects of the demographic variables. Out of the other variables the life expectancy of people aged 65 is important; a projected rise in this increases the total expenditure by 0.91 percentage points in 2050. The structure of GP remuneration and the basis on which GDP services are provided are also important influences

# B4 Finland

Hannu Piekola, ETLA

### *Health care expenditure, 1980-2003*

Health care expenditure in Finland grew by an estimated 2.1 percentage points from 5.7 per cent to 7.8 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 (OECD, 2006) this compares with a growth of 2.5 percentage points for the EU15 member states over the same period with health care expenditure in 2003 reaching 9.0 per cent of GDP.

Finnish health care expenditure can be broadly divided into public spending, which is mainly spent on the National Health Service, and private spending, which is defined as expenditure by the household and corporate sector on health care. Estimated public health expenditure as a share of the total fell by an estimated 7.2 percentage points to 82.2 per cent between 1980 and 2003.

### *Health care expenditure projections, 2004-2050*

The projected data for Finland assume that female labour force participation (*FLFPR*) will continue to grow until 2050, whilst the unemployment rate (*UNEMP*) is expected by 2 %-points to 6%. Both, the amount of alcohol consumption per capita (*ALCCON*) and the number of acute care beds (*BEDS*) will rise until 2050. Finally, private health care expenditure is expected to rise considerably, with the level of public health care expenditure (*PUHES*) falling to under seventy per cent by the end year of the projections.

(i) Mortality rates are adjusted for population structure. The original data suggested a decrease from 1 to 0.66 and the latter figure is now 0.93. I also used the calculated figures until 2050, pointing to an increase up to 1.41 by 2050.

(ii) Unemployment rate follows Etla's calculation, where it is projected to decrease to 6% in the long run, which is not very far from structural unemployment rate.

(iii) Gdp growth follows now AWG estimates (growth decreasing gradually to 1.6%) but steady 1.5% is also explored.

Following elasticity restrictions were used.

(i) LR Income Elasticity: we have applied the unit elasticity in some of the models. This moderates expenditures up a little.

(ii) LR Age 65-74 Semi-Elasticity: The health care expenditure allocated for this age group in the projection year, 2003, is 1449 million and share is 13.57%. The percentage of the population in this age group in the same initial projected period year, 2003, is 8.53%. Hence we have, 0.1357/8.53 = 0.01591. We, however, use the same restriction 0.009 in Table B6.7 as imposed in other countries. Without the restriction we rely on manually inserted projection of the demographic variables.

(iii) LR Age 75+ Semi-Elasticity: The health care expenditure allocated for this age group in the projection year, 2003, is 3464 million and share is 32.43% and population share is 7.03%. Hence we have, 0.3243/7.03 = 0.0461. We, however, use the same restriction 0.020 in Table B6.7 as imposed in other countries.

(iv) LR Mortality Semi-Elasticity: Miller (2001) and Yang et. al (2003) suggested that one-quarter or more of life-time health care expenditure may be consumed, on average, in the last year of life. The figure in Finland in 2004 would be 0.246/0.9287 or around 0.27 (in UK 0.25/0.8896 = 0.28). We hare experimented with commonly decided semi-elasticity restriction 0.31 on LR Mortality, which is close to the figure obtained for health care expenditure for last four years before death.

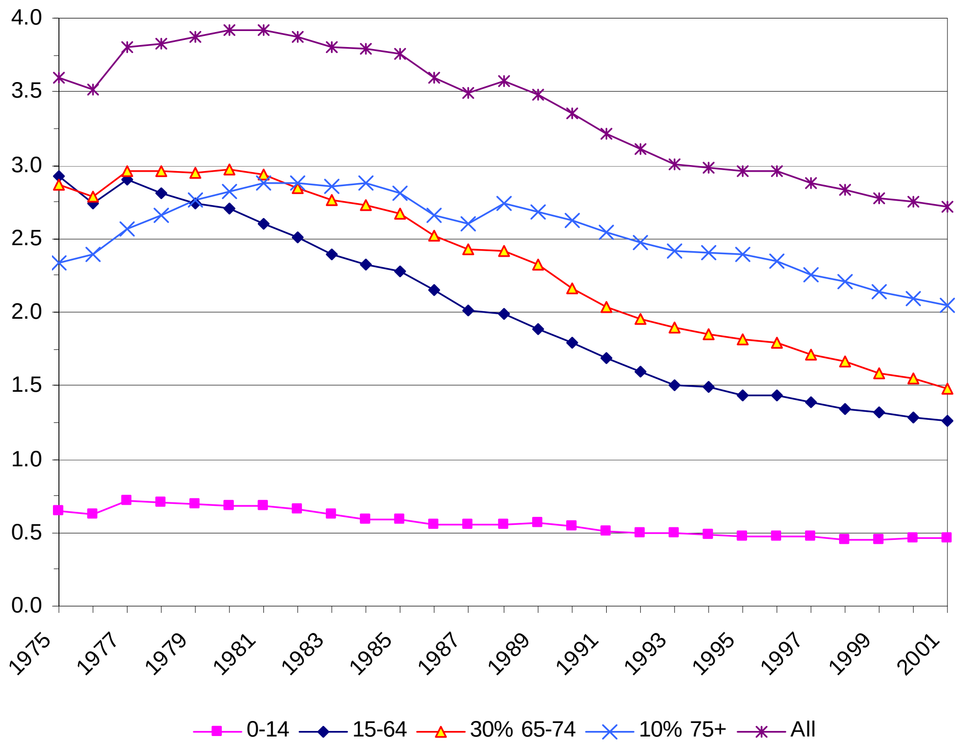
Stakes (2006) evaluated this from a 40% sample of 65+ population (285,000 obs) allowing health expenditures to differ depending how long time it takes for a person to die. They obtained following results

**Table B4-1 Health and long-term care expenditures depending on death year for 1998 sample for population 65+**

| 1998 | 1999 | 2000 | 2001 | 2002 | Alive at the end of 2003 | All |
|---|---|---|---|---|---|---|
| 14.2% | 17.1% | 12.3% | 9.3% | 7.8% | 39.3% | 100% |

The 65+ share of health care expenditures of total population is 46% so that expenditures from last four years before death is 0.46*53.5% = 24.6%.

(v) We experimented with projecting number of beds to follow roughly Hospital Days per Age Cohort, All as shown below.



Here, the average decrease in last years 1996-2001 was -1.7%. A more rapid decrease over such long period is not viable assumptions as ageing will offset part of the increase in efficiency. The assumptions regarding this variable have significant effects.

The source or method of derivation is indicated in Table B4-2.

| **Table B4-2 Demographic, economic and institutional variables included in our model** | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 8.61 | 12.27 | 0.79 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 7.20 | 15.77 | 1.73 |
| AVELE65 | Life expectancy at aged 65 Source: WHO. | 18.22 | 23.48 | 0.57 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO. | 0.93 | 1.41 | 0.91 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: OECD and AWG. | 47.50 | | |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 8.83 | 6 | -0.8 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend. | 8.28 | | |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD and AWG. | 73.8 | | |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen et. al (2006) | 0.00 | 0.00 | Na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen et. al (2006) . | 0.00 | 0.00 | Na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen et. al (2006) . | 0.00 | 0.00 | Na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen et. al (2006). | 1.00 | 1.00 | Na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen et. al (2006) . | 1.00 | 1.00 | Na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen et. al (2006) . | 1.00 | 1.00 | Na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen et. al (2006) . | 1.00 | 1.00 | Na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen et. al (2006) | 2.24 | 1.41 | -1.0 |

It is important to note that many of the variables, such as those representing the public share in health spending may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one. Finland does not fit perfectly into this framework.

### *Simulation models of health care expenditure in Finland, 2004-2050: Influences of Driving Variables*

Table B4-3 shows the base-line expenditure on health as a proportion of GDP, with expenditure on health care expected to increase to 9.20% of GDP in 2050 from 7.3% in 2003. Table, however, shows the degree of uncertainty surrounding our estimates. It is also seen in our last table that imposing demographic effects based on observed current age-specific expenditure shares would considerably raise the estimates.

The projected changes in the share of health spending match well most people's intuition and it is important to understand the factors driving it. It is obviously the outcome of both the model parameters and the paths assumed for the exogenous variables. We explore the key aspects of both of these.

In Table B4-3 we show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. Comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection.

**Table B4-3 The Influence of Socio-Economic Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Base | | | 9.20% | 0.00% |
| GDP | 25936 | 59568 | 9.44% | 0.24% |
| GDP (1.5% p.a. growth) | 25936 | 52216 | 9.45 % | 0.25% |
| AGE65-74 | 8.53 | 12.27 | 9.22 % | 0.02% |
| AGE75+ | 7.03 | 15.77 | 9.22% | 0.02% |
| AVELE65 | 18.22 | 23.48 | 7.34 % | -1.86% |
| FLFPR | 47.50 | 47.50 | 9.20% | 0.00% |
| MORTALITY | 0.93 | 1.41 | 9.27% | 0.07% |
| UNEMP | 9.01 | 6.00 | 9.03% | -0.17% |
| ALCCON | 8.28 | 8.28 | 9.20% | 0.00% |
| PUHES | 73.78 | 73.78 | 9.20% | 0.00% |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

Table B4-3 shows that some of our projections have a powerful influence on the share of spending. With GDP constant the projected value is 0.24 percentage points higher than the base on account of the dynamic effects in the model. The share of the population in each age group is not very important given the restrictions in the model for the share of people aged 65-74 and 75+ . The mortality rate is expected to rise. This has the influence of raising projected expenditures very little. The share of the public sector in health spending is of minor importance, with a projected decline in the share not reducing the expenditure total. However the increase in life expectancy has a powerful effect.

We next use a similar approach to look at the effects of the variables, which can be regarded as health policy variables. The only continuous variable of this type is the number of beds. The other variables are dummy variables and we explore these differently. We do this exercise first with no restrictions imposed on GDP elasticity as the model appeared to yield more realistic projections. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives. Thus if a dummy took the value of 1 in the base it is switched to 0 in the alternative projections and vice versa. Finland has significant co-payment for GPs (COPAYGP=1), also in inpatient hospital treatment (COPAYHO=1). Finland is also characterized by free choice of GP or primary care physician (FREEGP=1) and overall ceiling of hospitals (FREEHO=1). Thus the idea is to see what would be the expenditures in the converse case (taking the model used in Table B4-3). These results are shown in Table B4-4

**Table B4-4 The Influence of Policy Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Beds | 2.26 | 1.41 | 9.46% | 0.26% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 9.20% | 0.00% |
| CapGP | 0 | 1 | 10.58% | 1.38% |
| CaseHO | 0 | 1 | 9.05% | -0.15% |
| CoPAyGP | 1 | 0 | 7.63% | -1.57% |
| CoPayHO | 1 | 0 | 9.83% | 0.63% |
| FreeGP | 1 | 0 | 7.97% | -1.23% |
| FreeHO | 1 | 0 | 8.57% | -0.63% |

Note: The entry for beds has the same interpretation as in Table B6.2. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa.

Table B4-4 shows that maintaining the hospital beds at current higher level would have increased expenditure projects by around 0.26 percentage points. Thus decreasing number of hospital bed in the future as such has only a minor impact. It is also seen that it is the management of GPs such as co-payment for GP rather than the management of hospitals which has an important effect on health spending. Salaried GPs and Capitation-paid GPs both add to costs as does failing to charge the public for visiting their doctors. However, as we have noted there are questions about the precise interpretation of these dummy variables.

### *Influences of Expenditure Elasticities*

Table B4-5 provides further information on the effect of the income elasticity. As we have already observed when decreasing it from the unrestricted value to 1, there is a mild positive overall change.

| **Table B4-5. Scenarios of different restrictions on long run income elasticity on health care expenditure in Finland** | | | |
|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
| Unrestricted | 9.59 % | 9.20 % | 8.83 % |
| 1 | 9.60 % | 9.21 % | 8.84 % |
| 1.1 | 9.33 % | 8.94 % | 8.57 % |
| 1.2 | 8.98 % | 8.58 % | 8.20 % |

Table B4-5 shows that increases in the elasticity of health spending with respect to GDP results in a moderate fall in total expenditure as a proportion of GDP. As we nave noted, this arises because of the impact of the restriction on the coefficient on life expectancy.

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B4-6 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table the boldface entries indicate that a demographic restriction has been imposed. For the age variables it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population using the prevailing age-specific expenditure share observed. For mortality it is the coefficient which would be expected if the demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

| Table B4-6 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 9.59 % | 9.20 % | 8.82 % |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 11.71% | 11.24% | 10.79% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 9.92% | 9.50% | 9.11% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 11.16% | 10.71% | 10.27% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 10.48% | 10.06% | 9.65% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 9.60% | 9.21% | 8.84% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 11.72% | 11.26% | 10.82% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 9.04% | 8.65% | 8.27% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 11.05% | 10.60% | 10.17% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 10.24% | 9.82% | 9.42% |
| Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions. In mortality coefficients are -0.1 for lag zero, and 0.41 for lag one. | | | | | | | | |

The importance of the interactions between the coefficients can be deduced from this table. The coefficient of GPP elasticity is in general lower when demographic restrictions are imposed. When the mortality restriction is imposed, it can be seen that the additional imposition of a zero restriction on the long-run effect of life expectancy has a very marked influence on the out-turn. Without restriction to life expectancy if spending is driven by mortality costs, health expenditure share would rise to 11.71% of GDP. When the effect of life expectancy is restricted to zero, the increase, to 9.92% of GDP, is much smaller. We observe the restrictions to exert much the same effect with assuming unit GDP elasticity. Thus, the projections are now very similar with or without the unit elasticity assumption. It is seen that the coefficient for life expectancy is higher with unit income elasticity.

It is finally seen that health care expenditure share would rise to around 11.16% of GDP when imposing a coefficient 0.006 for age 65-74 share and coefficient 0.03 for age 75+ share, depending on whether or not the GDP elasticity is left unrestricted. In both cases the effect is considerably smaller if life expectancy effects are suppressed.

We can thus expect up to 2% higher share of health care expenditures when the demographic effects are included in the model, when not based on historical trends but on the recent estimates of distribution of costs over ages. Note also that the true expenditure share in recent estimates for Finland was 0.01591 for age 65-74 share (instead of 0.006 used in Table B4-6 ) and 0.0461 for age 75+ share (instead of 0.03 in Table B4-6)..

### *Conclusions*

Our final Table B4-6 indicates large sensitivity to assumptions regarding Age 65-74, Age 75+ and mortality effects. Mechanical calculations based on earlier expenditure shares would give much steeper rise in expenditures. In Table B4-6 the rise would be around 2%-point higher using the standard assumption that reflect the age-specific expenditure shares at European level or slightly greater assuming the Finnish age-specific health expenditure distribution. Thus, the expected substantial increase in costs should be given due attention. It is also noteworthy that the expected increase in expenditures would be higher assuming unit elasticity of GDP. Some of the modest rise in expenditures is explained by health expenditures being an inferior good. Less is spent on health as wealth goes up. Estimates of the influence of demographic effects are still fairly robust in the interaction between these and the estimated GDP elasticity of health spending. With the figures for the Finnish projections, raising the GDP elasticity from its unrestricted value of 1.007 to 1.2 decreases expenditures only by 0.8 percentage points. Generally, imposing restriction in GDP elasticity also matters less when not restricting coefficients for demographic effects such as life expectancy.

It is clear that cost management in health sector to lower the sensitivity to GDP growth is very important. Of the other variables the share of public expenditure in the total volume of expenditure is not very important; a projected decrease in this takes negligible effect on total expenditure by 2050. The decrease in the number of hospital beds turns out to be only somewhat important explanatory factor for the moderate cost increase in the past. The projected halving of hospital beds by 2050 saves costs only by 0.26%-points. This is a bit surprising given that large cost savings are to expected by more productive use of the facilities.

In Finland about 27% of health care expenditures accrue to the last four years before death. Moderating these costs are also important, although our model by and large fails to extrapolate the costs from rising share of 75+. The structure of GP remuneration and the basis on which GDP services are provided have also important influences. In countries with significant co-payment for inpatient hospital treatment health expenditure costs are generally higher.

# B5 France

### *Health care expenditure, 1980-2003*

Health care expenditure in France grew by an estimated 2.5 percentage points from 7.1 per cent to 9.6 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 (OECD, 2006) this is precisely the growth for the EU15 member states over the same period with health care expenditure in 2003 reaching 9.0 per cent of GDP.

French health care expenditure can be broadly divided into public and private spending. Estimated of public health expenditure as a share of the total fell by an estimated 4 percentage points between 1980 and 2003: 80% in 1980 to 76% in 2003.

### *Health care expenditure projections, 2004-2050*

The dependent variable used in this paper is total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and for inflation, although this is converted to a percentage of GDP in presenting the results.

The variables are listed in Table B5-1 have been collected from Eurostat, INSEE, INED, the OECD Health Data 2006 and the AWG. The projected data are either derived from the OECD, AWG, INSEE, INED or evaluated by extrapolating the trend over the period 1980-2003.

The projected data for France assume that female labour force participation (*FLFPR*) will continue to grow slightly until 2015 and will go down until 2050 (see annex at the end of the document). The unemployment rate (*UNEMP*) is expected to fall slightly. The amount of alcohol consumption per capita (*ALCCON*) and the number of acute care beds (*BEDS*) will also fall until 2050. Private health care expenditure is (*PUHES*) is kept constant by the end year of the projections. The shares of elderly age-groups and life expectancies are growing over the projection period. Mortality, measured by crude death rate, will grow from 0.84% in 2004 to 1.11% in 2050.

Dummy variables are assumed unchanged. The source or method of derivation is indicated in the table.

**Table B5-1 Demographic, economic and institutional variables included in our**

| model | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat and INSEE and INED. | 8.46 | 12.21 | 0.82 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat and INSEE and INED. | 7.87 | 17.97 | 1.82 |
| AVELE65 | The average life expectancy at aged 65 for males and females. Source: WHO and INSEE and INED. | 19.42 | 23.81 | 0.44 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO and INSEE and INED. | 0.84 | 1.11 | 0.61 |
| GDP | Gross domestic product per capita. US$ in nominal prices and adjusted for PPP. This variable is taken in log in the model. Source: OECD and AWG | 26770.49 | 54744.41 | 1.57 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: OECD and INSEE. | 46.18 | 45.85 | -0.02 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and INSEE and OFCE. | 9.97 | 9.42 | -0.12 |
| ALCCON | Alcohol consumption. litres per capita (15+) (in logs). Source: OECD and non linear model. | 10.57 | 8.31 | -0.52 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD. | 76.12 | 76.12 | 0.00 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 0.00 | 0.00 | na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 0.00 | na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 0.00 | na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 0.00 | na |
| BEDS | Acute care beds per 1 000 inhabitants (in logs). Source: Christiansen *et. al* (2006) and non linear model. | 4.03 | 3.39 | -0.38 |

It is important to note that many of the variables, such as those representing the public share in health spending may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one. France does not fit perfectly into this framework.

### *Simulation models of health care expenditure in France, 2004-2050: Influences of Driving Variables*

Table B5-2 shows the base-line expenditure on health as a proportion of GDP, with expenditure on health care expected to rise to 11.3% of GDP in 2050 from 9.6% in 2003. In Table B5-2 we show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. Comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection.

**Table B5-2 The Influence of Socio-Economic Variables on Projected Health Spending**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Base | | | 11,30% | |
| GDP | 26770.49 | 54744.41 | 11,68% | 0,39% |
| GDP (1.5% p.a. growth) | 26770.49 | 54641.20 | 11,33% | 0,04% |
| AGE65-74 | 8.57 | 17.97 | 11,34% | 0,05% |
| AGE75+ | 7.74 | 25.74 | 11,12% | -0,17% |
| FLFPR | 46.28 | 45.85 | 11.43% | 0,138 |
| AVELE65 | 19.32 | | 9,51% | -1,79% |
| MORTALITY | 0.92 | 1.11 | 11,32% | 0,03% |
| UNEMP | 9.22 | 9.42 | 11,31% | 0,01% |
| ALCCON | 10.70 | 8.31 | 11,27% | -0,02% |
| PUHES | 76.12 | 76.12 | 11,30% | 0,00% (same scenario as base) |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted. Demographic parameters are restricted as in the model 0 (see Table B5-5 below).

Because the health spending elasticity with respect to GDP is very close to one, rising GDP has slight effect on share of health spending. With GDP constant the projected value is over 0.39 percentage points higher than the base.

Despite the large rising of the share of old age groups over the period, the effect of the demographic structure on health expenditure is very weak. With constant demographic structure the health spending is 0.12 percentage points lower than the base. The mortality rate has also very slight effect. Quite evidently, the average life expectancy at aged 65 (AVELE65) captures entirely the demographic influence on health spending: with constant life expectancy at 65 the health expenditure is 1.79 lower than the base. The other socio-economic variables, including the share of public sector, have no impact on projected heath spending because they are held constant in the forecast period.

Finally we use a similar approach to look at the effects of the variables which can be regarded as health policy variables in Table B5-3. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives. Thus if a dummy took the value of 1 in the base it is switched to 0 in the alternative and vice versa.

| Table B5-3 The Influence of Policy Variables on Projected Health Spending | | | | |
|---|---|---|---|---|
| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
| Beds | 3.75 | 3.39 | 11,37% | 0,07% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 11,30% | 0,00% |
| CapGP | 0 | 1 | 13,00% | 1,70% |
| CaseHO | 0 | 1 | 11,11% | -0,18% |
| CoPAyGP | 1 | 0 | 9,38% | -1,92% |
| CoPAyHO | 1 | 0 | 12,07% | 0,77% |
| FreeGP | 1 | 0 | 9,79% | -1,50% |
| FreeHO | 1 | 0 | 10,52% | -0,77% |
| Note: The entry for beds has the same interpretation as in Table B5-1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa. The GDP elasticity is unrestricted. Demographic parameters are restricted as in the model 0 (see Table B5-5 below). | | | | |

Management of GPs seems to have an important effect on French health spending. Capitation-paid GPs in particular have a large effect; this is rather a surprising result knowing that this type of GPs payment can be considered as a regulation device. More naturally Removal of free choice of GP or primary care physician (FreeGP becomes 0) reduces the health spending. Otherwise, co-payment for GPs increases the health spending which is again quite surprising except if co-payment for GPs is in fact a response to an inefficient regulation of out-patient spending. Thus, although the dummy variables are important it is questionable whether they represent the effects attributed to them.

### *Influences of Expenditure Elasticities*

Table B5-4 shows small effects on French health spending of income elasticity increasing. The mechanical effect of rising GDP is compensated by the change of the other coefficients of the regression (implied by the restriction of GDP coefficients). The projections are not much affected by income-elasticity restrictions.

| Table B5-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in France | | | |
|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
| Unrestricted | 11.57% | 11.30% | 11.03% |
| 1 | 11.57% | 11.30% | 11.03% |
| 1.1 | 11.44% | 11.16% | 10.89% |
| 1.2 | 11.22% | 10.92% | 10.64% |

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B5-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table the boldface entries indicate that restrictions have been imposed. For the age variables it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

Table B5-5 shows that, compared to the base model, imposing restrictions on demographic variables so that health spending is directly linked to age structure increases noticeably forecast health spending (even if coefficient on the life expectancy at 65 is restricted to zero). The same effect, though weaker, is observed when the same type of restriction is imposed on mortality coefficient. This reflects the fact that the coefficients on the age and mortality terms are not strongly correlated with other parameters, so that an increase in these terms is not offset by other coefficients evolutions.

Unit income-elasticity restriction does not noticeably modify the results even though it depresses the health spending when the coefficient on life expectancy at 65 is restricted to zero. This emphasizes a correlation between GDP and life expectancy at 65.

**Table B5-5 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050**

| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 11.57% | 11.30% | 11.03% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 13.04% | 12.72% | 12.42% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 11.52% | 11.26% | 11.01% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 14.36% | 14.02% | 13.69% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 13.71% | 13.38% | 13.06% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 11.57% | 11.30% | 11.03% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 13.05% | 12.74% | 12.43% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 10.26% | 10.06% | 9.87% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 14.30% | 13.96% | 13.63% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 13.34% | 13.03% | 12.71% |

Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.

### *Conclusions*

The projections for France lead to a rather slight increase of the health spending. The effect of demographic terms is real but moderate (less than 2 points, Table B5-2). Certain policy variables (Table B5-3) have a comparable influence. The projections appear not to be very sensitive to income elasticity restriction. More generally, the projections are rather robust to the restrictions imposed and react in suitable way.

## B6 Germany

Erika Schulz, DIW

### *Health care expenditure, 1980-2003*

The total health care expenditures (public and private) in Germany grew by an estimated 2.7 percentage points from 8.7 per cent to 11.4 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 (OECD, 2006) this compares with a growth of 2.5 percentage points for the EU15 member states over the same period with health care expenditure in 2003 reaching 9.0 per cent of GDP.

The health care expenditures in Germany can be broadly divided into public spending, which is mainly spent on the statutory Health Care Insurance System, and private spending, which is defined as expenditure of households and corporate sector on health care. The public health expenditure as a share of the total grew by an estimated 0.7 percentage points to 79.4 per cent between 1980 and 2003. The public health care expenditure as a percentage of GDP grew from 6.6 percent in 1980 to 8.5 per cent in 2003.

### *Health care expenditure projections, 2004-2050*

The projected data for Germany assume that the unemployment rate (*UNEMP*) is expected to fall slightly. In the past the alcohol consumption as well as the number of beds decreased markedly by 1.7 per cent (ALCCON) respectively 2.1 per cent (BEDS). It is assumed that the further decline is restricted to 0.5 per cent per year. In view of the demographic development with a decline in the number of inhabitants and an increase in the share of the older people the crude mortality rate will increase markedly.

The dependent variable used in this paper is total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and inflation, in addition this is converted to a percentage of GDP in presenting the results. The variables included in our model are listed in Table B6-1. They have been collected from both the OECD Health Data 2006 and the AWG. The projected data are either derived from the OECD, AWG or evaluated by extrapolating the trend over the period 1980-2003. Dummy variables are assumed to be unchanged. The source or method of derivation is indicated in the table.

| Table B6-1 Demographic, economic and institutional variables included in our model | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| FLFPR | Proportion of females in total labour force. Source: OECD, AWG | 44.2 | 45.74 | 0.06 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: EUROSTAT, AWG. | 10.27 | 11.98 | 0.36 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: EUROSTAT, AWG. | 7.74 | 18.50 | 1.92 |
| AVELE65 | Life expectancy at aged 65 for females and males. Source: WHO, AWG. | 17.80 | 21.80 | 0.44 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO, AWG. | 1.08 | 1.62 | 0.89 |
| GDP | Gross domestic product per capita in US$ PPP Source: OECD and AWG. | 24368,15 | 47328,85 | 1.45 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 9.54 | 7.00 | -0.66 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend. | 10.59 | 8.41 | -0.5 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD and AWG. | 79.40 | 80.97 | 0.04 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 0.00 | 0.00 | na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et. al* (2006) | 6.14 | 4.88 | -0.5 |

Note: It is important to note that many of the variables, such as those representing the public share in health spending may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one.

### *Simulation models of health care expenditures in Germany, 2004-2050: Influences of driving variables*

Table B6-2 shows the base-line expenditure on health as a proportion of GDP, with expenditure on health care expected rise to 12.9 per cent of GDP in 2050 from 11.4 per cent in 2003. In Table B6-2 we also show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. A comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection. These are calculated using model 0 of Table B3.

**Table B6-2 The Influence of Socio-Economic Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
|---|---|---|---|---|
| Base | | | 12.93% | |
| GDP | 24103 | 47329 | 13.35% | 0.42 |
| GDP (1.5% p.a. growth) | | | 12.96% | 0.03 |
| AGE65-74 | 9.96 | 11.98 | 12.86% | -0.07 |
| AGE75+ | 7.54 | 18.50 | 12.93% | 0.00 |
| AVELE65 | 18.55 | 21.80 | 11.40% | -1.53 |
| FLFRP | 44.20 | 45.75 | 12.36% | -0.57 |
| MORTALITY | 1.03 | 1.62 | 13.10% | 0.17 |
| UNEMP | 9.00 | 7.00 | 12.77% | -0.16 |
| ALCCON | 10.64 | 8.41 | 12.90% | -0.03 |
| PUHES | 79.36 | 80.97 | 12.74% | -0.19 |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

This table shows that some of our projections have a powerful influence on the share of spending. Because the health spending elasticity with respect to GDP is 1.0071, a reduction in the growth rate of GDP increases the share of health spending in GDP. With constant GDP the projected value is 0.42 percentage points higher than the base. While a constant value in the proportion of the elderly in total population (AGE65-74 and AGE75+) has no significant effect on the health care spending, the increase in life expectancy has a markedly impact. If the life expectancy of people aged 65 will be held constant, the health care expenditure will decline by 1.5 percentage points
.

The sharp increase in the crude death rate shows an adverse effect. A constant death rate lead to an increase in health care expenditures by 0.17 percentage points. A net demographic effect can be calculated by adding together the deviations of all the demographic terms. If all of these stayed at their 2003 values, spending would decline by 1.43 percentage points. The share of the public sector in health spending is also important. The projected expansion in the share increases the total expenditures by 0.19 percentage points.

To look at the effects of the variables which can be regarded as health policy variables, we use a similar approach. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives. Thus, if a dummy take the value of 1 in the base it is switched to 0 in the alternative and vice versa. These results are shown in Table B6-3 using our model 0.

**Table B6-3 The Influence of Policy Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
|---|---|---|---|---|
| Base | | | 12.93% | |
| Beds | 6.17 | 4.88 | 13.11% | 0.18 |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 12.93% | 0.00 |
| CapGP | 0 | 1 | 14.88% | 1.95 |
| CaseHO | 0 | 1 | 12.72% | -0.21 |
| CoPAyGP | 0 | 1 | 15.57% | 2.64 |
| CoPayHO | 1 | 0 | 13.81% | 0.88 |
| FreeGP | 1 | 0 | 11.20% | -1.73 |
| FreeHO | 1 | 0 | 12.04% | -0.89 |

Note: The entry for beds has the same interpretation as in Table B1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa.

The table shows that it is the management of GPs rather than the management of hospitals which has an important effect on health spending. Capitation-paid GPs add to costs as does failing to charge the public for visiting their doctors. Copayment for visiting a GP increases the total health care expenditures due to a rise in private spending. Limiting the access to GP's would lead to a decline in health spending. There is, however, a question particularly whether the copayment dummy in fact represents the effect attributed to it since copayments might be expected to depress spending.

### *Influences of Expenditure Elasticities*

Table B6-4 shows that reduction in the elasticity of health spending with respect to GDP to 1 result in a rise and an increase up to 1.1 and 1.2 results in a decline in total expenditures as a proportion of GDP. Allowing for the fact that the AWG figure covers only public health spending and grossing up on the basis of the 2003 share, the comparable AWG figure, with a unit elasticity of 1 is 13.1 per cent of GDP which lies 0.6 percentage points above our figure.

Table B6-4 provides further information on the effect of the income elasticity. As we have already observed when reducing it from the unrestricted value to 1, there is little overall change because of offsetting changes in the other parameters of the model. It can be seen that the impact of the elasticity is particularly weak for values just above 1.

| **Table B6-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in Germany** | | | |
|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
| Unrestricted | 13.41% | 12.93% | 12.46% |
| 1 | 13.42% | 12.94% | 12.48% |
| 1.1 | 13.08% | 12.60% | 12.13% |
| 1.2 | 12.60% | 12.10% | 11.62% |

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B6-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table boldface entries indicate that a demographic restriction has been imposed. For the age variables the coefficient shows what would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influences.

| **Table B6-5 The impact of restrictions on the demographic parameters on the projected share of health expenditure in 2050** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 13.41% | 12.93% | 12.46% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 17.12% | 16.49% | 15.90% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 14.79% | 14.24% | 13.72% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 17.65% | 16.99% | 16.36% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 16.55% | 15.96% | 15.39% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 13.42% | 12.94% | 12.48% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 17.17% | 16.56% | 15.97% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 13.59% | 13.08% | 12.59% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 17.47% | 16.82% | 16.20% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 16.24% | 15.67% | 15.12% |
| Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions. | | | | | | | | |

The importance of the interactions between the coefficients can be deduced from this table. When the GDP elasticity is not restricted, the restriction that spending is driven by death-related costs in the manner set out in section 3-2 has the effect of raising projected expenditure. However, if the life expectancy effects are restricted to zero so that death-related costs are the only demographic influence, then projected expenditure increases by 1.31 percentage points. When expenditure is assumed to be age related expenditure is raised by 4.03 percentage points, falling to 3.03 percentage points when life expectancy effects are also suppressed.

If GDP elasticity is also restricted these effects are altered. In particular, when demographic effects are assumed to come only through mortality effects, a unit elasticity has the effect of reducing age projected expenditure fairly sharply by more than one percentage point.

### *Conclusions*

The exercise has indicated a number of key influences on health spending in Germany. Estimates of the influence of demographic effects are crucially dependent on the interaction between these effects and the estimated GDP elasticity of health spending. With the figures for the German projections, raising the GDP elasticity from its unrestricted value of 1.0071 to 1.2 has the effect of reducing projected expenditures by 0.8 percentage points because of offsetting movements in the effects of the demographic variables. Out of the other variables the life expectancy of people aged 65 is important; a constant life expectancy would lead to a reduction by almost 1.5 percentage points of total expenditures by 2050. The structure of GP remuneration and the basis on which GDP services are provided are also important influences.

# B7 Ireland

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### *Health care expenditure, 1980-2003*

Health care expenditure in Ireland grew by an estimated 3.4 percentage points from 4.1 per cent to 7.5 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 (OECD, 2006) the only EU15 member states that experienced a larger increase in health care expenditure over this period were Greece and Portugal. The relatively strong expansion of health spending in Ireland may in part be explained by the low level from which it has risen.

The majority of health care expenditure in Ireland is accounted for by public spending. Over the period 1980-2003 public spending has accounted for 71 to 82 per cent of total health care expenditure. Taken over this period as a whole, public health expenditure as a share of the total fell by an estimated 4.1 percentage points to 77.5 per cent between 1980 and 2003.

### *Health care expenditure projections, 2004-2050*

The projected data for Ireland assume that the unemployment rate (*UNEMP*) falls slightly. Female labour force participation is expected to continue to grow more quickly than male labour force participation, resulting in a rise in the share of women in the labour force (*FLFPR*) until 2050. Both, the amount of alcohol consumption per capita (*ALCCON*) and the number of acute care beds (*BEDS*) rise over the projection period. Finally, private health care expenditure is expected to rise considerably, with the share of public health care expenditure (*PUHES*) falling further than observed at any time since 1980.

The dependent variable used in this paper is total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and for inflation, although this is converted to a percentage of GDP in presenting the results. The variables are listed in Table B7-1. Demographic, economic and institutional variables included in our model have been collected from both the OECD Health Data 2006 and the AWG. The projected data are either derived from the OECD or AWG, unless otherwise stated. Dummy variables are assumed unchanged. The source or method of derivation is indicated in the table.

| Table B7-1 Demographic, economic and institutional variables included in our model | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 6.26 | 12.94 | 1.59 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 4.89 | 13.21 | 2.19 |
| AVELE65 | The average life expectancy at age 65 for males and females. Source: WHO. | 16.97 | 21.93 | 0.56 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO. | 0.76 | 1.11 | 0.82 |
| FLFPR | Female share of labour force (female share of active population aged 15-64). Source: OECD and AWG. | 42.45 | 45.63 | 0.16 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 4.30 | 3.40 | -0.49 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend until 2008, level maintained thereafter. | 12.65 | 14.05 | 0.23 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD and Annual Growth Trend. | 77.36 | 69.91 | -0.22 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006). | 0.00 | 0.00 | na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006). | 1.00 | 1.00 | na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006). | 0.00 | 0.00 | na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006). | 1.00 | 1.00 | na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006). | 1.00 | 1.00 | na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006). | 1.00 | 1.00 | na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006). | 1.00 | 1.00 | na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et al* (2006); 20% growth between 2003 and 2015, level maintained thereafter. | 3.07 | 3.63 | 0.37 |

It is important to note that many of the variables, such as those representing the public share in health spending, may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one. Ireland does not fit perfectly into this framework.

### *Simulation models of health care expenditure in Ireland, 2004-2050: Influences of Driving Variables*

Table B7-2 shows the base-line expenditure on health as a proportion of GDP, with expenditure on health care expected to rise to 12.1% of GDP in 2050 from 7.5% in 2003. The projected rise in the share of health spending is substantial and it is important to understand the factors driving it. It is obviously the outcome of both the model parameters and the paths assumed for the exogenous variables. We explore key aspects of both of these.

In Table B7-2 we show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. Comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection.

This table shows that some of our projections have a powerful influence on the share of spending. The single most important factor driving the rise in health spending over the projection period is the expected increase in the average life expectancy for men and women at age 65, which rises from 16.9 years in 2003 to 21.9 years in 2050, adding 2.2 percentage points to the share of health spending in GDP. In comparison, the share of the population in each age group is less important. Given the coefficients in the estimated model, the rapid increase in the share of people aged 65-74 over the projection period raises health spending by just 0.1 per cent of GDP; the rise in the share of people aged 75+ raises the expenditure share by 0.3 percentage points. Given the necessary correlations between developments in the share of older age people in the population, life expectancy, and mortality, the influence of these demographic changes on health spending are perhaps best viewed in conjunction with each other. A net demographic effect can be calculated by adding together the deviations of all the demographic terms. If all of these stayed at their 2003 values spending would be reduced by 2.5 percentage points.

| Table B7-2. The Influence of Socio-Economic Variables on Projected Health Spending (Model 0) | | | | |
|---|---|---|---|---|
| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
| Base | | | 12.07% | 0.00% |
| GDP | 32869 | 92134 | 12.32% | 0.25% |
| GDP (1.5% p.a. growth) | 32869 | 92134 | 11.96% | -0.11% |
| AGE65-74 | 6.26 | 12.94 | 11.97% | -0.10% |
| AGE75+ | 4.87 | 13.21 | 11.73% | -0.34% |
| AVELE65 | 16.87 | 21.93 | 9.92% | -2.15% |
| MORTALITY | 0.70 | 1.11 | 12.20% | 0.13% |
| FLFPR | 42.50 | 45.63 | 11.05% | -1.02% |
| UNEMP | 4.30 | 3.40 | 12.01% | -0.06% |
| ALCCON | 12.32 | 14.05 | 12.09% | 0.02% |
| PUHES | 77.53 | 69.91 | 12.93% | 0.86% |
| Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted. | | | | |

Another significant influence on the share of spending is the relatively sharp increase in the female labour force participation rate. As a result, the share of women in the labour force is projected to rise by 3.1 percentage points over the projection period. If instead the gender distribution of the labour force were held constant at 2003 levels health spending would be 1 percentage point less than given by the base projection. The share of the public sector in health spending also influences total health spending, with a projected decline in the share reducing the expenditure total by 0.9 percentage points.

| Table B7-3. The Influence of Policy Variables on Projected Health Spending (Model 0) | | | | |
|---|---|---|---|---|
| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
| Beds | 3.02 | 3.63 | 11.94% | -0.13% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 12.07% | 0.00% |
| CapGP | 1 | 0 | 10.49% | -1.58% |
| CaseHO | 0 | 1 | 11.88% | -0.19% |
| CoPayGP | 1 | 0 | 10.02% | -2.05% |
| CoPayHO | 1 | 0 | 12.90% | 0.83% |
| FreeGP | 1 | 0 | 10.47% | -1.60% |
| FreeHO | 1 | 0 | 11.25% | -0.82% |
| Note: The entry for beds has the same interpretation as in Table B1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa. | | | | |

Finally we use a similar approach to look at the effects of the variables which can be regarded as health policy variables. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives. Thus if a dummy took the value of 1 in the base it is switched to 0 in the alternative and vice versa. These results are shown in Table B7-3 for model 0.

These tables show that it is primarily the management of GPs rather than the management of hospitals which has an important effect on health spending. Capitation-paid GPs add to costs as does failing to charge the public for visiting their doctors.

### *Influences of Expenditure Elasticities*

Table B7-4 shows that increases in the elasticity of health spending with respect to GDP result in a rise in total expenditure as a proportion of GDP.

**Table B7-4. Scenarios of different restrictions on long run income elasticity on health care expenditure in Ireland**

| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
|---|---|---|---|
| Unrestricted | 12.63% | 12.07% | 11.54% |
| 1 | 12.54% | 12.02% | 11.51% |
| 1.1 | 13.58% | 12.96% | 12.37% |
| 1.2 | 14.94% | 14.19% | 13.48% |

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B7-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table boldface entries indicate that a demographic restriction has been imposed. For the age variables, where the restrictions are not set to zero, it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

| Table B7-5. The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 12.63% | 12.07% | 11.54% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 14.20% | 13.58% | 12.99% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 16.00% | 15.13% | 14.31% |
| 3 | 0.9653 | **0.006** | **0.030** | 0.0227 | **0** | 14.34% | 13.70% | 13.09% |
| 4 | 1.0403 | **0.006** | **0.030** | **0** | **0** | 15.26% | 14.51% | 13.79% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 12.54% | 12.02% | 11.51% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 14.03% | 13.45% | 12.89% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 14.39% | 13.60% | 12.85% |
| 8 | **1** | **0.006** | **0.030** | 0.0163 | **0** | 14.69% | 14.04% | 13.43% |
| 9 | **1** | **0.006** | **0.030** | **0** | **0** | 14.71% | 14.01% | 13.34% |
| Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions. | | | | | | | | |

The restriction that spending is driven by death-related costs in the manner described has the effect of increasing projected expenditure (compare models: 1 and 2 to 0; 6 and 7 to 5). This occurs mainly, given the rising mortality rate, because of the increase in the elasticity of health spending with respect to mortality. In the case where the GDP elasticity of health spending is unrestricted there is an additional effect that comes from the increase in the GDP elasticity when the other demographic terms are restricted to zero (from 1.0071 in model 0 to 1.1738 in model 2). Given the rise in GDP over the projection period this has the effect of raising projected health expenditure as a share of GDP. We also note that when the parameters on the age variables are restricted so that health spending is linked to the age structure of the population, there are significant increases in forecast spending (compare models: 3 and 4 to 0; 8 and 9 to 5). Again the estimated elasticity of health spending with respect to GDP is sensitive to the restrictions on average life expectancy, so that the rise in health spending is greater when the entire demographic effect occurs through the age structure.

### *Conclusions*

The exercise has indicated a number of key influences on health spending in Ireland. The influences on health spending of demographic changes associated with an aging population are significant. Taken together, the effect on health spending of rising mortality rates, longer life expectancy and a rising population share of people above age 65 is to raise health spending by 2.5 per cent of GDP, the most significant factor behind this increase being rising life expectancy. Rising female labour force participation also contributes to rising health spending, adding 1 percentage point to the total over the projection period.

Another influence is the share of public expenditure in the total volume of expenditure; a projected decrease in this takes 0.9 percentage point off total expenditure by 2050. The structure of GP remuneration and the basis on which GP services are provided are also important influences.

We note the sensitivity of our projections to restrictions on the demographic parameters of our model, which partly arise through the effect of these restrictions on the estimated elasticity of health spending with respect to GDP.

# B8 Italy

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### *Health Care Expenditure, 1980-2003*

Health care expenditure in Italy grew by an estimated 1.6 percentage point from 6.9 per cent to 8.5 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 (OECD, 2006) this compares with a growth of 2.5 percentage points for the EU15 member states over the same period with health care expenditure in 2003 reaching 9.0 per cent of GDP. Italian health care expenditure can be broadly divided into public spending, which is spent on the National Health Service (*Servizio Sanitario Nazionale*, SSN), and private spending, which is defined as expenditure by the household and corporate sector on health care. Estimated of public health expenditure as a share of the total slightly reduced since 1980 until 75.3 per cent in 2003.

### *Health Care Expenditure Projections, 2004-2050*

The projected data for Italy assume that the unemployment rate (*UNEMP*) is expected to continue to fall until 6.5%, while female labour force participation (*FLFPR*) will continue to grow until 2050. In line with recent trends, both the amount of alcohol consumption per capita (*ALCCON*) and the number of acute care beds (*BEDS*) will decrease until 2050. Finally, private health care expenditure is expected to rise slightly, with the level of public health care expenditure (*PUHES*) reaching seventy per cent in 2014 and keeping then constant up to the end year of the projections.
The dependent variable used in this paper is total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and for inflation, although this is converted to a percentage of GDP in presenting the results. The variables are listed in Table B8-1 have been collected from both the OECD Health Data 2006 and the AWG. The projected data are either derived from the OECD, AWG or evaluated by extrapolating some trends. In particular, in order to take into account recent dynamics, for the alcohol consumption per capita (*ALCCON*) and the number of acute care beds (*BEDS*) we refer, respectively, to the 1999-2003 and the 2000-2003 trends; for the level of public health care expenditure (*PUHES*) we assume a 0.5 percentage points decrease until 2014; then, reached the 70% level, this variable is kept constant until 2050. Dummy variables are assumed unchanged. The source or method of derivation is indicated in the table.

| Table B8-1 Demographic, economic and institutional variables included in our model | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 10.4 | 13.4 | 0.55 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 8.8 | 20.6 | 1.86 |
| AVELE65 | The average life expectancy at aged 65 for males. Source: WHO. | 18.7 | 24.1 | 0.56 |
| FLFPR | Share of females in total labour force (% ratio to active population aged 15-65). Source: OECD and AWG. | 38.8 | 40.6 | 0.10 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO. | 1.0 | 1.6 | 0.94 |
| GDP | Gross domestic product in US $ PPP. Source: OECD. | 24886.04 | 47873.25 | 1.43 |
| FLFPR | Share of females in total labour force (% ratio to active population aged 15-65). Source: OECD and AWG. | 38.8 | 40.6 | 0.10 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: Eurostat and AWG. | 8.4 | 6.5 | -0.55 |
| ALCCON | Pure alcohol consumption, litres per capita (15+) (in logs). Source: WHO and Annual Growth Trend. | 7.9 | 6.4 | -0.45 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD and AWG and Annual Growth Trend.. | 75.0 | 70.0 | -0.15 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 0.0 | 0.0 | Na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.0 | 1.0 | Na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.0 | 1.0 | Na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.0 | 0.0 | Na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.0 | 0.0 | Na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.0 | 1.0 | Na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.0 | 1.0 | Na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et. al* (2006) and Annual Growth Trend. | 4.2 | 2.9 | -0.77 |

It is important to note that many of the variables, such as those representing the public share in health spending may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one. Italy does not fit perfectly into this framework.

### *Simulation models of health care expenditure in Italy, 2004-2050: Influences of Driving Variables*

Table B8-2 shows the base-line expenditure on health as a proportion of GDP, with expenditure on health care expected to rise to 10.0% of GDP in 2050 from 8.5% in 2003. The Ageing Working Group (AWG) projections value for 2050 in the baseline scenario (pure ageing scenario, with an unitary income elasticity) is 7.2%. But AWG projects only public expenditure, that, as  shows, currently is about 75% of the total and is projected to fall to 70% of the total in 2050. Correcting AWG value according to the 2050 share, the AWG value in 2050 for total (i.e. public and private spending) becomes 10.3%, approximately the same value predicted by our model.  The trend in the share of health spending is the outcome of both the model parameters and the paths assumed for the exogenous variables. We explore key aspects of both of these.

In Table B8-2 we show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. Comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection. These are calculated using model 0 of tables 3, 4 and 7.

**Table B8-2 The Influence of Socio-Economic Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
|---|---|---|---|---|
| Base | | | 9.96% | |
| GDP | 24886.04 | 47873.25 | 10.29% | 0.33% |
| GDP (1.5% p.a. growth) | 24886.04 | 47873.25 | 9.98% | 0.02% |
| AGE65-74 | 10.4 | 13.4 | 10.27% | 0.31% |
| AGE75+ | 8.8 | 20.6 | 9.61% | -0.35% |
| AVELE65 | 18.7 | 24.1 | 8.34% | -1.62% |
| FLFRP | 38.8 | 40.6 | 9.40% | -0.56% |
| MORTALITY | 1.0 | 1.6 | 10.12% | 0.16% |
| UNEMP | 8.4 | 6.5 | 9.84% | -0.12% |
| ALCCON | 7.9 | 6.4 | 9.94% | -0.02% |
| PUHES | 75.0 | 70.0 | 10.47% | 0.51% |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

This table shows that some of our independent variables projections have a powerful influence on the share of spending. Although the steady state elasticity with respect to GDP is very close to 1, a reduction in the growth rate affects the dynamics of the process and thus the projected value for 2050. The share of the population in each age group is slightly important, causing, respectively for AGE65-74 and AGE75+, an increase and a decrease in spending around 0.3 percentage points. Mortality has a lower influence. The bigger effect on spending is induced by life expectancy; rising average life expectancy of men and of women each adds 1.6 percentage points to the expenditure share.

The share of the public sector in health spending is also important, with a projected decline in the share (around 5 percentage points up to 2014 and then constant) increasing the total expenditure by 0.5 percentage points, while the increase in the share of female on total labour force raises spending by 0.6 percentage points.

We use a similar approach to look at the effects of the variables which can be regarded as health policy variables. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives. Thus if a dummy took the value of 1 in the base it is switched to 0 in the alternative and vice versa. These results are shown in Table B8-3.

**Table B8-3 The Influence of Policy Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Beds | 4.2 | 2.9 | 10.18% | 0.22% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 9.96% | 0.00% |
| CapGP | 1 | 0 | 8.66% | -1.30% |
| CaseHO | 1 | 0 | 10.14% | 0.18% |
| CoPAyGP | 0 | 1 | 12.00% | 2.04% |
| CoPayHO | 0 | 1 | 9.32% | -0.64% |
| FreeGP | 1 | 0 | 8.64% | -1.32% |
| FreeHO | 1 | 0 | 9.28% | -0.68% |

Note: The entry for beds has the same interpretation as in Table B1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa.

The table shows that it is the management of GPs rather than the management of hospitals which has much more important effect on health spending (SalaryGP value is restricted to zero in model 0, so that changing its value does not change spending) .

### *Influences of Expenditure Elasticities*

Table B8-4 shows the effect of long run income elasticity on total health spending. Allowing for the fact that the AWG figure covers only public health spending and grossing up on the basis of the 2003 share, the comparable AWG figure, with a unit elasticity is 10.3% of GDP.

Since in model 0 the GDP elasticity is very close to one, it is no surprise that the result is scarcely changed by imposing an elasticity of 1. A higher elasticity results in lower expenditure shares. This is because of the interaction between the elasticity and the coefficient on life expectancy as discussed in the main body of the paper.

| Table B8-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in Italy | | | |
|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
| Unrestricted | 10.45% | 9.96% | 9.50% |
| 1 | 10.46% | 9.99% | 9.55% |
| 1.1 | 9.96% | 9.52% | 9.11% |
| 1.2 | 9.45% | 9.02% | 8.62% |

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B8-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table the boldface entries indicate that a demographic restriction has been imposed. For the age variables it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

| Table B8-5 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 10.45% | 9.96% | 9.50% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 12.76% | 12.16% | 11.59% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 10.60% | 10.16% | 9.75% |
| 3 | 0.9893 | **0.009** | **0.020** | 0.0271 | **0** | 12.35% | 11.73% | 11.14% |
| 4 | 1.0776 | **0.009** | **0.020** | **0** | **0** | 11.16% | 10.68% | 10.23% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 10.46% | 9.99% | 9.55% |
| 6 | **1** | 0 | 0 | 0.0564 | **0.313** | 12.83% | 12.25% | 11.69% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 10.10% | 9.68% | 9.27% |
| 8 | **1** | **0.009** | **0.020** | 0.0252 | **0** | 12.26% | 11.67% | 11.11% |
| 9 | **1** | **0.009** | **0.020** | **0** | **0** | 10.88% | 10.42% | 9.99% |
| Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions. | | | | | | | | |

The importance of the interactions between the coefficients can be deduced from this table. The restriction that spending is driven by death-related costs in the manner set out in section 3.2 has the effect of raising projected expenditure by more than 2 percentage points. However, if the life expectancy effects are restricted to zero so that death-related costs are the only demographic influence, then projected expenditure increase is slight (+0.2%). By contrast when expenditure is assumed to be age related expenditure is raised by nearly 1.8 percentage points, falling to 0.72 percentage points when life expectancy effects are also suppressed. If the GDP elasticity is also restricted to one these effects are not altered very significantly; however a strong reduction is observed in models 2 and 4 compared, respectively, with models 7 and 9.

# B9 Netherlands

### *Health care expenditure, 1980-2003*

Health care expenditure in the Netherlands grew by an estimated 1.2 percentage points from 7.5 per cent to 8.7 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 (OECD, 2006) this compares with a growth of 2.5 percentage points for the EU15 member states over the same period with health care expenditure in 2003 reaching 9.0 per cent of GDP.

### *Health care expenditure projections, 2004-2050*

The dependent variable used in this paper is total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and for inflation, although this is converted to a percentage of GDP in presenting the results. The variables listed in Table B9-1 have been collected from both the OECD Health Data 2006 and the AWG. The projected data are either derived from the OECD, AWG or evaluated by extrapolating the trend over the period 1980-2003. Dummy variables are assumed unchanged. The source or method of derivation is indicated in the table.

The projected data for the Netherlands assume that female labour force participation (*FLFPR*) will continue to grow until 2050, whilst the unemployment rate (*UNEMP*) is expected to fall slightly. The amount of alcohol consumption per capita (*ALCCON*) is assumed to be constant over time and the number of acute care beds (*BEDS*) will fall until 2050. Finally, a change in the health care system caused the public health care expenditures to rise to around 75 per cent in 2006. After that, public health care expenditures are assumed to be unchanged.

| **Table B9-1 Demographic, economic and institutional variables included in our model** | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: AWG. | 7.61 | 10.09 | 0.64 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: AWG. | 6.24 | 14.29 | 1.82 |
| AVELE65 | The average life expectancy at aged 65 for males and females. Source: WHO. | 17.18 | 19.31 | 0.25 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100) (in logs). Source: AWG. | 0.93 | 1.35 | 0.80 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: AWG. | 44.65 | 47.30 | 0.13 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: AWG. | 3.66 | 3.23 | -0.27 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD. | 8.24 | 8.24 | 0.00 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: AWG. | 62.00 | 75.00 | 0.46 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 0.00 | 0.00 | na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| GLOBALHO | Dummy variable taking the value of one for countries with global budget reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et. al* (2006) | 3.13 | 1.90 | -1.08 |

It is important to note that many of the variables, such as those representing the number of beds may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one. The Netherlands do not fit perfectly into this framework. For example, while the dummy for capitation of GP's takes on the value zero, for all publicly insured patients (about two thirds of all patients) GP's were paid by capitation until 2006. For privately insured patients there was a fee-for-service system. With the health care reform of 2006, a mixed system was introduced for all patients.

### *Simulation models of health care expenditure in the Netherlands, 2004-2050: Influences of Driving Variables*

Table B9-2 shows the base-line expenditure on health as a proportion of GDP, with expenditure on health care expected to rise from 8.7% of GDP in 2003 to 9.94% in 2050. In Table B9-2 we show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. Comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection.

Given the restrictions on some of the demographic variables the most powerful influences on the projection are the average life expectancy and the share of public expenditure. A higher life expectancy at 65 and a higher share of public financing are associated with higher health care spending. The effect of the increase in GDP is not very large, since the estimated income elasticity is close to unity.

For the Netherlands there is no a priori reason to expect that the rise in the share of public financing that took place, will lead to higher health care expenditure. The share of public financing increased in 2006 because the health care reform introduced public health insurance for everybody including the higher incomes. Since before 2006 practically all the higher incomes were voluntarily insured anyway with about the same basic package as the publicly insured lower incomes, there is no reason this reform should increase health care expenditure. On the contrary, the reform was meant to make the health care market more efficient.

| Table B9-2 The Influence of Socio-Economic Variables on Projected Health Spending (Model 0) | | | | |
|---|---|---|---|---|
| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
| Base | | | 9.94% | 0.00% |
| GDP | 28414 | 57725 | 10.34% | 0.40% |
| GDP (1.5% p.a. growth) | 28414 | 57725 | 10.04% | 0.10% |
| AGE65-74 | 7.54 | 10.09 | 10.09% | 0.15% |
| AGE75+ | 6.17 | 14.29 | 9.89% | -0.05% |
| FLLPR | 43.35 | 47.30 | 10.19% | 0.25% |
| AVELE65 | 17.55 | 19.31 | 9.28% | -0.66% |
| MORTALITY | 0.88 | 1.35 | 9.97% | 0.03% |
| FLFPR | 43.35 | 47.30 | 10.19 | 0.25% |
| UNEMP | 3.7 | 3.23 | 10.08% | 0.14% |
| ALCCON | 8.24 | 8.24 | 9.94% | 0.00% |
| PUHES | 63.00 | 75.00 | 8.88% | -1.06% |
| Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted. | | | | |

We use a similar approach to look at the effects of the variables which can be regarded as health policy variables. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives (from 2004 on). Thus if a dummy took the value of 1 in the base it is switched to 0 in the alternative and vice versa. These results are shown in Table B9-3.

| Table B9-3 The Influence of Policy Variables on Projected Health Spending (Model 0) | | | | |
|---|---|---|---|---|
| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
| Base | | | 9.94% | |
| Beds | 3.13 | 1.90 | 10.26% | 0.32% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 9.94% | 0% |
| CapGP | 0 | 1 | 11.44% | 1.50% |
| CaseHO | 0 | 1 | 9.78% | -0.16% |
| CoPAyGP | 0 | 1 | 11.98% | 2.04% |
| CoPayHO | 0 | 1 | 9.30% | -0.64% |
| FreeGP | 1 | 0 | 8.62% | -1.32% |
| FreeHO | 1 | 0 | 9.26% | -0.68% |
| Note: The entry for beds has the same interpretation as in Table B1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa. | | | | |

The table shows that it is the management of GPs rather than the management of hospitals which has an important effect on health spending. Capitation-paid GPs and significant co-payments for GP services both add considerably to costs, though these effects seem not very plausible for the Netherlands. An increase in costs because of co-payments for the GP instead of a decrease could possibly be explained by patients going directly to the hospital or waiting to ask for medical care until their condition is more serious. As in the Netherlands GPs act as gatekeepers and the fee for a consultation is only €9, it is not very likely that health care costs would increase considerably. The magnitude of the change suggests that the variable may in fact be representing some other institutional difference between countries.

### *Influences of Expenditure Elasticities*

Table B9-4 shows that increases in the elasticity of health spending with respect to GDP result in a relatively modest rise in total expenditure as a proportion of GDP.

**Table B9-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in the Netherlands**

| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
|---|---|---|---|
| Unrestricted | 10.73% | 9.94% | 9.21% |
| 1 | 10.79% | 10.00% | 9.28% |
| 1.1 | 11.23% | 10.45% | 9.72% |
| 1.2 | 11.63% | 10.83% | 10.09% |

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B9-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table boldly printed coefficients are restricted. In the base run the only non-restricted demographic variable is the average life expectancy at age 65. The other demographic variables are restricted to zero, a restriction that is not rejected by the data. Under these circumstances an increase in the average life expectancy is associated with a higher share of health care expenditures in GDP, as we have seen. We also explore what would happen if the age variables would have the coefficient that would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs.

If we add the influence of death related costs to the model, health expenditure in 2050 is considerably higher; this result is hardly influenced by the inclusion or exclusion of life expectancy as an independent influence. In the cases were the coefficients for the older age groups are fixed and death-related costs are excluded (a pure ageing scenario) health expenditure is higher than in the base run but lower than in the death cost scenario.

A restriction of the long term income elasticity to unity does not have a large influence for most demographic scenarios. The pure death related cost scenario is an exception: in that case a decrease of the income elasticity from 1.17 to 1 leads to 2 percentage point lower expenditure.

| Table B9-5 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 10.73% | 9.94% | 9.21% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 13.46% | 12.46% | 11.53% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 13.49% | 12.50% | 11.59% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 13.14% | 12.16% | 11.25% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 13.19% | 12.23% | 11.34% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 10.79% | 10.00% | 9.28% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 13.46% | 12.46% | 11.54% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 11.32% | 10.42% | 9.59% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 13.32% | 12.35% | 11.46% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 12.70% | 11.77% | 10.91% |
| Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions. | | | | | | | | |

Compared to CPB projections and scenarios the base line projection of about 10% in 2050 is low. In a recent study of the effect of ageing, the share of *public* health care expenditure was projected to rise from 8.8% of GDP in 2006 to 13.1% in 2040 and 12.5% in 2060.[2] Earlier a number of long term economic scenarios were developed and detailed for the health care sector. Total health care expenditure increased from 8.7% in 2001 to between 13.3% and 14.6% in 2040 depending on the scenario.[3] However, in the CPB scenarios the effect of the changing age structure of the population was taken into account. In that sense they are more comparable to model 9 that yields a projection of 11.8%. The resulting projection of model 9, though considerably higher than the base line projection, is still substantially lower than the results of the comparable CPB scenarios. The base run model for the EU-15 that is used in Table B9-2, where the effect of several demographic variables is restricted to zero, may give rise to an underestimation of the effect of ageing for the Netherlands.

## *Conclusions*

In the next 40 years health care expenditure in the Netherlands will increase because of ageing, in the model represented by increasing life expectancy of the elderly. The increase of 1.2 percentage point of GDP found in this analysis is low compared to other projections for the Netherlands. As the estimated income elasticity is close to unity, the effect of increasing GDP on the *share* of health expenditure is small.

A number of policy variables appear to be important, like the organisation and payment of primary care and the share of public financing of health care. However,

[2] Van Ewijk et al. (2006), Ageing and the sustainability of Dutch public finances, Den Haag, Centraal Planbureau

[3] The definition of health care in this case excluded pharmaceuticals and included some parts of long term care that fall outside the OECD definition. See Bos, F., R. Douven and E. Mot, Four Long-term scenarios for the Dutch government and the health care sector, Proceedings of the Banca d'Italia workshop, Perugia, 2005

the effects of these policy variables that resulted from the analysis do not seem to fit the situation in the Netherlands. Dummies cannot completely describe the complex workings of a health care system and furthermore the restriction is used that the effects of the policy variables are homogeneous across countries. This may be the reason why some of the results found for the influence of these variables in the Netherlands are difficult to accept.

# B10 Portugal

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### *Health care expenditure, 1980-2003*

During the period, 1980-2003, per-capita health care expenditure (as a share of per-capita GDP) in Portugal has increased by 75% from 5.56% to 9.60%. It appears that population ageing may have been a factor contributing to this increase. Elderly population share has increased substantially during this period, from 7.45% to 9.63% for those aged 65 to 74 and from 3.73% to 7.05% for those aged 75 and more. Other variables have not changed much. However, given that the share of elderly population is still relatively small in 2003, the main driver of the increase in health care expenditure may be the increasing coverage of public health care system during this period in Portugal.

### *Health care expenditure projections, 2004-2050*

Some important features of the final data we used for the projections are shown in Table B10-1. Due to persistently low fertility rate and continuous increase in longevity, the share of elderly (65 and older) population is projected to double during the period from 16.8% to 32.1%, posing as a potential driver of increased health care demand.

On the other hand, the number of death per 100,000 habitants is projected to stay more less the same during the same period. Other variables, such as female labour share, unemployment rate, alcohol consumption and the share of public health expenditure, are predicted to be more or less stable during the projection period.

**Table B10-1 Demographic, economic and institutional variables included in the model**

| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 (%) |
|---|---|---|---|---|
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 9.65 | 14.59 | 0.90 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 7.17 | 17.52 | 1.96 |
| AVELE65 | The average life expectancy at aged 65 for males and females. Source: WHO. | 17.33 | 23.05 | 0.62 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO. | 1.03 | 1.01 | -0.04 |
| GDP | Gross domestic product in US $ PPP. Source: OECD. | 18587.36 | 35178.98 | 1.40 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: OECD and AWG. | 46.35 | 47.20 | 0.04 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 6.19 | 5.55 | -0.24 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend. | 11.28 | 11.50 | 0.04 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD. | 69.88 | 69.88 | 0.00 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen et. al (2006) | 1.00 | 1.00 | n.a. |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen et. al (2006) . | 0.00 | 0.00 | n.a. |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen et. al (2006) . | 0.00 | 0.00 | n.a. |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen et. al (2006). | 1.00 | 1.00 | n.a. |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen et. al (2006) . | 0.00 | 0.00 | n.a. |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen et. al (2006) . | 1.00 | 1.00 | n.a. |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen et. al (2006) . | 1.00 | 1.00 | n.a. |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen et. al (2006) | 3.10 | 2.33 | -0.62 |

***Simulation models of health care expenditure in Portugal, 2004-2050: Influences of Driving Variables***

We carried out projections under different assumptions of different variables. Base-line model predicts the increase of HCE from 9.60% in 2003 to 13.8% in 2050.

Table B10-2 shows the projection results when the specified variable in each row is held at 2003 level during the entire projection period while other variables follow the base-line scenario shown in Table B10-1. Hence, we can compare the relative contribution of each factor in health expenditure during the projected period.

Obviously, constant GDP increases the share of HCE in GDP, while 1.5% annual growth in GDP leads to a very similar HCE to the base-line result. Higher life expectancy increases HCE by 2.77 percentage points, while other demographic variables have small effects. The overall effect of population ageing (higher life expectancy, greater share of elderly and smaller number of deaths) amounts to an increase of 3.13 percentage points in health care expenditure as a share of GDP. Other variables are not important.

**Table B10-2 Influence of Socio-Economic Variables on Projected Health Spending**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
|---|---|---|---|---|
| Base | - | - | 13.79% | 0.00% |
| GDP | 18587.36 | 35178.98 | 14.18% | 0.38% |
| GDP (1.5% p.a. growth) | 18587.36 | 35178.98 | 13.76% | -0.04% |
| AGE65-74 | 9.65 | 14.59 | 13.88% | 0.08% |
| AGE75+ | 7.17 | 17.52 | 13.36% | -0.44% |
| AVELE65 | 17.33 | 23.05 | 11.02% | -2.77% |
| FLFRP | 46.35 | 47.20 | 13.32% | -0.47% |
| MORTALITY | 1.03 | 1.01 | 13.79% | 0.00% |
| UNEMP | 6.19 | 5.55 | 13.74% | -0.06% |
| ALCCON | 11.28 | 11.50 | 13.79% | 0.00% |
| PUHES | 69.88 | 69.88 | 13.77% | -0.02% |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

Table B10-3 shows the projection results where we can examine the effect of policy variables on health expenditure. It shows that changing the pay system from salary to capitation would increase HCE by more than 2 percentage points. Two changes which will result in an important saving of HCE are the elimination of free choice of GP and the elimination of co-pay for GP. On the other hand, adoption of co-pay for hospital treatment or elimination of overall ceiling of hospitals will result in a decrease in HCE by about 0.9 percentage points each.

| Table B10-3 Influence of Policy Variables on Projected Health Spending. Unit GDP Elasticity | | | | |
|---|---|---|---|---|
| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
| Beds | 3.10 | 2.33 | 14.04% | 0.25% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 1.00 | 0.00 | 13.79% | 0.00% |
| CapGP | 0.00 | 1.00 | 15.87% | 2.08% |
| CaseHO | 0.00 | 1.00 | 13.57% | -0.22% |
| CoPAyGP | 1.00 | 0.00 | 11.45% | -2.34% |
| CoPayHO | 0.00 | 1.00 | 12.91% | -0.88% |
| FreeGP | 1.00 | 0.00 | 11.96% | -1.84% |
| FreeHO | 1.00 | 0.00 | 12.85% | -0.94% |
| Note: The entry for beds has the same interpretation as in Table B1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa. | | | | |

### *Influences of Expenditure Elasticity*

It is often said that one of the most important factors which will determine future health care expenditure is income elasticity of health care expenditure. Table B10-4 shows the projection results under different income elasticity for Portugal. Contrary to the previous findings, higher income elasticity results in lower health expenditure in Portugal.

| Table B10-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in Portugal | | | |
|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
| Unrestricted | 14.75% | 13.79% | 12.90% |
| 1 | 14.76% | 13.81% | 12.92% |
| 1.1 | 14.58% | 13.58% | 12.65% |
| 1.2 | 14.42% | 13.32% | 12.31% |

### *Influences of Restrictions on Demographic Parameters*

Finally, we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table R indicates that a demographic restriction has been imposed. For the age variables it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

We can see that the restriction on the parameters of age structure variables increases substantially health care expenditure while imposing no effect of life expectancy variables mitigates this effect.

**Table B10-5 Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050**

| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 14.75% | 13.79% | 12.90% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 15.60% | 14.56% | 13.59% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 14.11% | 12.97% | 11.93% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 17.84% | 16.69% | 15.61% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 16.95% | 15.86% | 14.83% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 14.76% | 13.81% | 12.92% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 15.62% | 14.59% | 13.64% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 12.96% | 11.93% | 10.98% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 17.72% | 16.58% | 15.51% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 16.54% | 15.47% | 14.47% |

Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.

### *Conclusions*

According to our projection for Portugal, population ageing (higher life expectancy, greater share of elderly and smaller number of deaths) could increase substantially national health care expenditure, by 3.24 percentage points as a share of GDP.

Some institutional variables could also affect health expenditure in the future. For example, a switch of paying system of GPs from salary to capitation will increase HCE by about 3 percentage points while the elimination of free choice of GP will save by a similar magnitude.

Another important factor seems to be income elasticity health care expenditure. Even a small increase in the elasticity could result in a substantial rise in health expenditure in the future.

# B11 Spain

Namkee Ahn and Juan Ramon García (FEDEA, Madrid)

### *Health care expenditure, 1980-2003*

During the period, 1980-2003, per-capita health care expenditure (as a share of per-capita GDP) in Spain has increased by 42% from 5.41% to 7.68%. It appears that population ageing may have been a factor contributing to this increase. Elderly population share has increased substantially during this period, from 6.91% to 9.32% for those aged 65 to 74 and from 3.91% to 7.58% for those aged 75 and more. Other variables have not changed much. However, given that the share of elderly population is still relatively small in 2003, the main driver of the increase in health care expenditure may be the increasing coverage of public health care system during this period in Spain.

### *Health care expenditure projections, 2004-2050*

Some important features of the final data we used for the projections are shown in Table B11-1. Due to persistently low fertility rate and continuous increase in longevity, the share of elderly (65 and older) population is projected to more than double during the period from 16.7% to 35%, posing as a potential driver of increased health care demand.

Similarly, the number of death increases over time as the number of the elderly population increases.  The number of death per 100,000 habitants is projected to increase from 0.93 to 1.23 (in logarithm) during the same period, which can be another potential driver of health expenditures due to death related costs.

Other variables are also expected to change although not so dramatically as demographic variables. Female labour share is projected to increase from 41% to 45%, and unemployment rate to decrease from 11% to 7%. Alcohol consumption is also projected to decrease substantially.

| Table B11-1 Demographic, economic and institutional variables included in the model | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 9.14 | 15.36 | 1.14 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 7.73 | 19.64 | 2.05 |
| AVELE65 | The average life expectancy at aged 65 for males and females. Source: WHO. | 18.69 | 22.13 | 0.37 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO. | 0.93 | 1.23 | 0.62 |
| GDP | Gross domestic product in US $ PPP. Source: OECD. | 24177.72 | 47620.68 | 1.48 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: OECD and AWG. | 41.10 | 44.90 | 0.19 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 10.83 | 7.00 | -0.94 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend. | 10.59 | 5.95 | -1.25 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD. | 70.80 | 63.94 | -0.22 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 1.00 | 1.00 | n.a. |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | n.a. |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | n.a. |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006). | 0.00 | 0.00 | n.a. |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | n.a. |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | n.a. |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | n.a. |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et. al* (2006) | 3.09 | 2.68 | -0.31 |

***Simulation models of health care expenditure in Spain, 2004-2050: Influences of Driving Variables***

We carried out projections under different assumptions of different variables. Base-line model predicts the increase of HCE from 7.68% in 2003 to 11.10% in 2050.

Table B11-2 shows the projection results when the specified variable in each row is held at 2003 level during the entire projection period while other variables follow the base-line scenario shown in Table B11-1. Hence, we can compare the relative contribution of each factor in health expenditure during the projected period.

Obviously, constant GDP increases the share of HCE in GDP, while 1.5% annual growth in GDP leads to a very similar HCE to the base-line scenario. Higher life expectancy increases HCE by 1.4 percentage points, while the number of deaths (MORT) has a very small effect. The overall effect of population ageing (higher life expectancy, greater share of elderly and more deaths) amounts to an increase of 1.69 percentage points in health care expenditure as a share of GDP. Increasing female labour force participation is expected to increase health expenditure by 1.16 percentage points.

**Table B11-2 Influence of Socio-Economic Variables on Projected Health Spending**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
|---|---|---|---|---|
| Base | - | - | 11.10% | 0.00% |
| GDP | 24177.72 | 47620.68 | 11.39% | 0.29% |
| GDP (1.5% p.a. growth) | 24177.72 | 47620.68 | 11.05% | -0.05% |
| AGE65-74 | 9.14 | 15.36 | 11.28% | 0.18% |
| AGE75+ | 7.73 | 19.64 | 10.61% | -0.50% |
| AVELE65 | 18.69 | 22.13 | 9.69% | -1.42% |
| FLFRP | 41.10 | 44.90 | 9.94% | -1.16% |
| MORTALITY | 0.93 | 1.23 | 11.16% | 0.05% |
| UNEMP | 10.83 | 7.00 | 10.81% | -0.29% |
| ALCCON | 10.59 | 5.95 | 11.04% | -0.07% |
| PUHES | 70.80 | 63.94 | 11.89% | 0.78% |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

Table B11-3 shows the projection results where we can examine the effect of policy variables on health expenditure. It shows that changing the pay system from salary to capitation would increase HCE by about 1.7 percentage points. A change that is projected to result in an important saving of HCE is the elimination of free choice of GP, whose effect is projected to be about 1.5 percentage points of HCE. On the other hand, contrary to our intuition, adoption of co-pay system is predicted to increase HCE by 2.3 percentage points. Adoption of case-based reimbursement of hospital is predicted to decrease HCE by 0.2 percentage points while adoption of overall ceiling of hospitals will result in a increase of HCE by about 0.8 percentage points.

| **Table B11-3 Influence of Policy Variables on Projected Health Spending (Model 0)** | | | | |
|---|---|---|---|---|
| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
| Beds | 3.09 | 2.68 | 11.21% | 0.10% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 1.00 | 0.00 | 11.10% | 0.00% |
| CapGP | 0.00 | 1.00 | 12.78% | 1.67% |
| CaseHO | 0.00 | 1.00 | 10.93% | -0.18% |
| CoPAyGP | 0.00 | 1.00 | 13.38% | 2.27% |
| CoPayHO | 0.00 | 1.00 | 10.39% | -0.71% |
| FreeGP | 1.00 | 0.00 | 9.63% | -1.48% |
| FreeHO | 0.00 | 1.00 | 11.92% | 0.81% |
| Note: The entry for beds has the same interpretation as in Table B2-1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa. | | | | |

### *Influences of Expenditure Elasticity*

It is often claimed that one of the most important factors which will determine future health care expenditure is income elasticity of health care expenditure. Table B11-4 shows the projection results under different income elasticity. An increase of income elasticity from 1 to 1.2 raises the HCE in 2050 by almost full one percentage point.

| **Table B11-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in Spain** | | | |
|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
| Unrestricted | 11.49% | 11.10% | 10.73% |
| 1 | 11.46% | 11.09% | 10.72% |
| 1.1 | 11.89% | 11.46% | 11.04% |
| 1.2 | 12.54% | 12.02% | 11.53% |

### *Influences of Restrictions on Demographic Parameters*

Finally, we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table we indicate demographic restrictions that have been imposed. For the age variables it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

We can see that the restriction on the parameters of age structure variables increases substantially health care expenditure while imposing no effect of life expectancy variables decreases it substantially.

**Table B11-5 Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050**

| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 11.49% | 11.10% | 10.73% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 12.62% | 12.16% | 11.72% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 13.50% | 12.91% | 12.34% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 15.04% | 14.54% | 14.05% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 15.29% | 14.77% | 14.27% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 11.46% | 11.09% | 10.72% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 12.56% | 12.11% | 11.68% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 13.16% | 12.60% | 12.06% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 15.18% | 14.67% | 14.18% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 15.05% | 14.54% | 14.05% |

Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.

### *Conclusions*

According to our projection for Spain, population ageing (higher life expectancy, greater share of elderly and more deaths) could increase substantially national health care expenditure, by 1.7 percentage points as a share of GDP.

Some institutional variables could also affect health expenditure in the future. For example, a switch of paying system of GPs from salary to capitation or adoption of co-pay will increase substantially the health spending while the elimination of free choice of GP will save it substantially.

Contrary to the cases of other countries, income elasticity seems to play a relatively minor role in Spain in determining future health care expenditure.

## B12 Sweden

Report produced by Johan Jarl and Ulf-G Gerdtham, Health Economics Program (HEP), Lund University.

### *Health Care Expenditure, 1980-2003*

The health care expenditures in Sweden increased from 9.0 per cent of GDP in 1980 to 9.3 per cent in 2003, i.e. a marginal increase of 0.3 percentage points (OECD, 2006b). This compares to a much higher growth in the EU15 countries of 2.5 percentage points (OECD, 2006). However, the gap between health care expenditures in Sweden and the rest of EU15 have decreased as the health care expenditure for EU15 was 9.0 per cent of GDP in 2003, i.e. only 0.3 percentage points lower than Sweden.

The share of public spending on total health care expenditure decreased in Sweden during 1980-2003, from 93 to 84 percent, i.e. 9 percentage point decrease. The public spending is mainly focused on the county councils while households and the corporate sector mainly make up the private expenditures.

### *Health Care Expenditure Projections, 2004-2050*

The projected data for Sweden and the years 2004-2050 assumes a continuous growth in the alcohol consumption variable (ALCCON) while female labour force participation rate (FLFPR) are assumed to remain more or less constant around 48 percent of the active population aged 15-65. The unemployment rate (UNEMP) are assumed to decrease by one percentage point over the projected period while a larger decrease is expected in the share of public health expenditures (PUHES). The later is assumed to decrease to just below 70 percent in 2050 following the trend of increased private expenditure.

The number of acute care beds (BEDS) declined rather steeply in Sweden during the period 1980-2003. It can not, however, be assumed to continue in the future as it would rapidly converge toward zero. Lacking any relevant projections for the future, this variable have been set to zero growth rate during the projected period.

The dependent variable is total health care expenditures per capita (THEPC), measured in US dollars (PPP) adjusted for inflation. This variable is for the sake of simplicity presented in the results as percentage of GDP. In Table B12-1 are the independent variables listed. The data are mainly collected from both the OECD Health Data 2006 and the AWG, with partial exception to ALCCON and UNEMP where additional sources have been used as supplements. Regarding ALCCON have unrecorded consumption, e.g. private import and bootlegging, been added to the recorded consumption. The reason for this is that an unrecorded consumption stand for a large fraction of total consumption in Sweden and, looking at recent years, the total consumption has increased while the recorded consumption has actually decreased. It would therefore result in a serious bias if unrecorded consumption was left outside the ALCCON variable for the case of Sweden. The source or method of derivation is indicated in the table below. It should be noted that the use of dummy variables as controls for institutional setting results in a somewhat oversimplified model, thus not fitting the Swedish system completely.

| Table B12-1. Demographic, economic and institutional variables included in our model | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 8.3 | 10.2 | 0.47 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 8.9 | 14.1 | 1.02 |
| AVELE65 | The average life expectancy at aged 65 for males and females. Source: WHO. | 18.25 | 21.39 | 0.35 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO. | 1.10 | 1.22 | 0.22 |
| GDP | Gross domestic product in US $ PPP. Source: OECD. | 26440.47 | 64119.00 | 1.95 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: OECD and AWG. | 48.03 | 47.86 | -0.008 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: Eurostat and SCB. | 5.3 | 4.3 | -0.42 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: Gustafsson & Trolldal (2004), WHO and Annual Growth Trend. | 8.57 | 15.30 | 1.26 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD, AWG and Annual Growth Trend. | 83.98 | 69.79 | -0.40 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 0 | 0 | Na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 1 | 1 | Na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0 | 0 | Na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 1 | 1 | Na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 1 | 1 | Na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1 | 1 | Na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 1 | 1 | Na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et. al* (2006) | 0.63 | 0.63 | 0 |

***Simulation models of health care expenditure in Sweden, 2004-2050: Influences of Driving Variables***

The baseline estimation of health care expenditure as proportion of GDP in 2050 is shown in Table B12-2. It is expected to fall to 8.7 percent of GDP by the year 2050. Table B12-2 also shows the results of simulations in which each socio-economic variable is held constant at its value in 2003, one variable at a time. This is done in order to investigate the importance of the projected path of the exogenous variables on the baseline estimation.

**Table B12-2 The Influence of Socio-Economic Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Base | | | 8.73% | 0.00 |
| GDP | 25987 | 64119 | 9.03% | 0.30 |
| GDP (1.5% p.a. growth) | 25987 | 52594 | 8.76% | 0.03 |
| AGE65-74 | 8.3 | 10.2 | 8.83% | 0.10 |
| AGE75+ | 8.9 | 14.1 | 8.67% | -0.06 |
| FLFPR | 47.43 | 47.86 | 8.62 | -0.09 |
| AVELE65 | 18.88 | 21.39 | 7.92% | -0.81 |
| MORTALITY | 1.10 | 1.22 | 8.74% | 0.01 |
| UNEMP | 5.3 | 4.3 | 8.66% | -0.07 |
| ALCCON | 8.57 | 15.30 | 8.78% | 0.05 |
| PUHES | 83.98 | 69.79 | 9.95% | 1.22 |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

Some of our projections have a rather large influence on the share of health spending. Especially the expected decrease in the public share of health expenditures (PUHES) leads to a decrease of the estimation by 1.2 percentage points. This is important when comparing with the AWG figure above as one of the differences between the estimates is removed when not projecting a decrease in PUHES. The variable for average life expectancy at aged 65 (AVELE65) have also a non-negligible impact, in this case by increasing the estimate by 0.8 percentage points. Setting the GDP growth rate to zero increases the share of health spending in 2050 by 0.3 percentage points and with a growth rate of 1.5 (below baseline) is the projected share of health spending in 2050 8.8 percent of GDP.

No other variables have any larger impact on the estimation although taking all demographic variables together, their projections increase the estimation by 0.77 percentage points, mainly due to AVELE65. All sensitivity analyses in Table B12-2 fall within one standard deviation of the baseline estimation (9.10 – 8.38%) except PUHES and AVELE65.

We will now use a similar approach as above to investigate the effects of the health policy variables. The health policy variables are the dummy variables and BEDS, the only continuous health policy variable. For reasons stated above, the BEDS-variable have been assumed to have a zero growth rate in the baseline model and will thus not be included in this analysis. In the previous analysis are the variables kept at the 2003 value for the whole projected period while the opposite is true for the current analysis. All dummy variables will be switched one at a time, from zero to one or one to zero, for the projected period. The results are shown in Table B12-3.

**Table B12-3 The Influence of Policy Variables on Projected Health Spending (Model 0)**

| | Value in Base Run | Value in Alternative | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
|---|---|---|---|---|
| Base | | | 8.73% | 0.00 |
| SalaryGP | 0 | 1 | 8.73% | 0.00 |
| CapGP | 1 | 0 | 7.59% | -1.14 |
| CaseHO | 0 | 1 | 8.59% | -0.14 |
| CoPayGP | 1 | 0 | 7.25% | -1.48 |
| CoPayHO | 1 | 0 | 9.33% | 0.60 |
| FreeGP | 1 | 0 | 7.57% | -1.16 |
| FreeHO | 1 | 0 | 8.14% | -0.59 |

Note: The entries show the impact of each dummy in turn changing from 0 to 1 or vice versa.

Table B12-3 shows that the largest effect of health policies on the estimate are those targeting GPs rather than hospitals. Capitation payments GPs (CapGP), significant co-payment GPs (CoPayGP) and free choice of GPs (FreeGP) all add to the cost rather substantially (increase by more than one percentage point each). For policies targeting hospitals do case-based reimbursement of hospitals (CaseHO) and significant co-payment inpatient hospital treatment (CoPayHO) give a lower cost while overall ceiling of hospitals (FreeHO) gives a higher cost.

### *Influences of Expenditure Elasticities*

In Table B12-4 are the effects of increases in health spending elasticity with respect to GDP shown. For the case of the Swedish estimate, the health care expenditures increase with increased elasticity. The model does not, however, seem to be overly sensitive to restrictions on the long run income elasticity as the change is rather moderate. Further is an increase in health care expenditure expected with increasing elasticity, holding all else equal, given a positive GDP growth rate.

**Table B12-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in Sweden**

| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 |
|---|---|---|---|
| Unrestricted | 9.10% | 8.73% | 8.38% |
| 1 | 9.08% | 8.71% | 8.36% |
| 1.1 | 9.36% | 9.00% | 8.65% |
| 1.2 | 9.67% | 9.30% | 8.94% |

### *Influences of Restrictions on Demographic Parameters*

Table B12-5 below shows the effects of restrictions (boldface) on the demographic variables. In each case when a demographic restriction is imposed, two alternative models are estimated (with and without unit elasticity). For the age variables the coefficient is what would be observed if health expenditure were driven by the age structure of the population, while for mortality the coefficient is what would be expected if the only demographic influence were death-related costs.

**Table B12-5 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050**

| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 9.10% | 8.73% | 8.38% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 9.21% | 8.82% | 8.45% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 9.36% | 8.99% | 8.63% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 9.61% | 9.19% | 8.79% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 9.71% | 9.31% | 8.94% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 9.08% | 8.71% | 8.36% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 9.17% | 8.78% | 8.40% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 8.62% | 8.27% | 7.93% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 9.70% | 9.29% | 8.89% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 9.47% | 9.10% | 8.74% |

Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.

Assuming that only death-related costs have an demographic influence (model 2) increases the health care expenditure compared to the baseline (model 0) when using an unrestricted income elasticity. However, unit elasticity (model 7) reduces the costs compared to the baseline (model 5). Weakening the restriction and allowing average life expectancy at age 65 to also have an influence takes an intermediate position for unrestricted income elasticity (model 1) and increases the costs compared to baseline when restricted to unit income elasticity (model 6). When restricting so that only age structures have an influence on health expenditures, the costs increases (model 4 & 9). Relaxing the restriction on average life expectancy at 65 further increases the costs when the GDP elasticity is restricted to unity (model 8) and takes an intermediate position otherwise (model 3). It is noteworthy that no large differences exist between models, irrespective of the restrictions imposed.

### *Conclusions*

The health care expenditure for Sweden in 2050 as share of GDP is estimated to 8.7 percent, i.e. a decrease by 0.6 percentage points compared to 2003. The results for Sweden are rather stable and it is mainly the variable for public health expenditures as share of the total health expenditure (PUHES) and health policy variables regarding GPs that have a larger effect on the results.

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## B13 United Kingdom

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### *Health Care Expenditure, 1980-2003*

Health care expenditure in the United Kingdom grew by an estimated 2.1 percentage points from 5.7 per cent to 7.8 per cent of GDP between 1980 and 2003. According to the OECD Health Data 2006 (OECD, 2006) this compares with a growth of 2.5 percentage points for the EU15 member states over the same period with health care expenditure in 2003 reaching 9.0 per cent of GDP.

The United Kingdom health care expenditure can be broadly divided into public spending, which is mainly spent on the National Health Service, and private spending, which is defined as expenditure by the household and corporate sector on health care. Estimated of public health expenditure as a share of the total fell by an estimated 7.2 percentage points to 82.2 per cent between 1980 and 2003.

### *Health Care Expenditure Projections, 2004-2050*

The projected data for the United Kingdom assume that the unemployment rate (*UNEMP*) is expected to fall slightly whilst both, the amount of alcohol consumption per capita (*ALCCON*) and the number of acute care beds (*BEDS*) will rise until 2050. Finally, private health care expenditure is expected to rise considerably, with the level of public health care expenditure (*PUHES*) falling to under seventy per cent by the end year of the projections.

The dependent variable used in this paper is total health care expenditure per capita (*THEPC*) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and for inflation, although this is converted to a percentage of GDP in presenting the results. The variables are listed in Table B13-1 in our model have been collected from both the OECD Health Data 2006 and the AWG. The projected data are in all cases except one, either derived from the OECD, AWG or evaluated by extrapolating the trend over the period 1980-2003. However, the BEDS variable shows erratic movement suggesting that its definition may have changed, and we therefore use the 2003 value in the projection. Dummy variables are assumed unchanged. The source or method of derivation is indicated in the table.

| Table B13-1 Demographic, economic and institutional variables included in our model | | | | |
|---|---|---|---|---|
| Variable | Definitions and Sources | Projected Value in 2004 | Projected Value in 2050 | Average Annual Growth Rate, 2004-2050 |
| AGE65-74 | Population aged 65-74 as a share of the total population. Source: Eurostat. | 8.41 | 11.12 | 0.62 |
| AGE75+ | Population aged 75+ as a share of the total population. Source: Eurostat. | 7.58 | 15.36 | 1.55 |
| AVELE65 | The average life expectancy at aged 65 for males and females. Source: WHO. | 17.61 | 22.83 | 0.57 |
| MORTALITY | Mortality from any cause of death. Calculated as the simple ratio of number of registered deaths/mid-year population (per 100,000) (in logs). Source: WHO. | 0.99 | 1.12 | 0.28 |
| GDP | Gross domestic product in US $ PPP. Source: OECD. | 27319.01 | 61822.06 | 1.79 |
| FLFPR | Female labour force participation rate (% ratio to active population aged 15-65). Source: OECD and AWG. | 45.43 | 46.07 | 0.03 |
| UNEMP | Unemployed individuals as a share of the total labour force. Source: OECD and AWG. | 4.90 | 4.59 | -0.14 |
| ALCCON | Alcohol consumption, litres per capita (15+) (in logs). Source: OECD and Annual Growth Trend. | 11.34 | 19.93 | 1.23 |
| PUHES | Public health expenditure in US$ PPP per capita as a share of the total health expenditure in US$ PPP per capita. Source: OECD. | 81.90 | 69.43 | -0.36 |
| SALARYGP | Dummy variable taking the value of one for countries with salaried GPs; zero otherwise. Source: Christiansen *et. al* (2006) | 0.00 | 0.00 | na |
| CAPGP | Dummy variable taking the value of one for countries with capitation payment GPs; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| CASEHO | Dummy variable taking the value of one for countries with case-based reimbursement of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| COPAYGP | Dummy variable taking the value of one for countries with significant co-payment for GPs; zero otherwise. Source: Christiansen *et. al* (2006). | 0.00 | 0.00 | na |
| COPAYHO | Dummy variable taking the value of one for countries with significant co-payment for inpatient hospital treatment; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| FREEGP | Dummy variable taking the value of one for countries with free choice of GP or primary care physician; zero otherwise. Source: Christiansen *et. al* (2006) . | 1.00 | 1.00 | na |
| FREEHO | Dummy variable taking the value of one for countries with overall ceiling of hospitals; zero otherwise. Source: Christiansen *et. al* (2006) . | 0.00 | 0.00 | na |
| BEDS | Acute care beds per 1,000 inhabitants (in logs). Source: Christiansen *et. al* (2006) | 4.61 | 4.61 | 0 |

It is important to note that many of the variables, such as those representing the public share in health spending may seem arbitrary, and we subsequently explore the importance of our assumptions. In addition, the differences between institutional arrangements of different countries are not usually as simple and clear-cut as implied by the use of dummy variables which take on values of zero or one. The United Kingdom does not fit perfectly into this framework.

### *Simulation models of health care expenditure in the United Kingdom, 2004-2050: Influences of Driving Variables*

Table B13-2 shows the base-line expenditure on health as a proportion of GDP, with expenditure on health care expected to rise to 9.5% of GDP in 2050 from 7.8% in 2003. In Table B13-2 we show, along with the base value, the results of simulations in which each socio-economic variable is set to the value that it held in 2003. Comparison of the results of these simulations with the base therefore indicates the importance of the projected path of the variable as an influence on the base projection. These are calculated using model 0 of tables 3, 4 and 7.

**Table B13-2 The Influence of Socio-Economic Variables on Projected Health Spending (Model 0)**

| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base (% pts) |
|---|---|---|---|---|
| Base | | | 9.41% | 0.00% |
| GDP | 26719 | 61822 | 9.70% | 0.29% |
| GDP (1.5% p.a. growth) | 26719 | 61822 | 9.41% | 0.00% |
| AGE65-74 | 8.21 | 11.12 | 9.42% | 0.01% |
| AGE75+ | 7.29 | 15.36 | 9.32% | -0.09% |
| AVELE65 | 17.61 | 22.83 | 7.75% | -1.66% |
| FLFRP | 44.46 | 46.07 | 8.99% | -0.42% |
| MORTALITY | 0.99 | 1.12 | 9.44% | 0.03% |
| UNEMP | 4.80 | 4.59 | 9.40% | -0.01% |
| ALCCON | 11.20 | 19.93 | 9.46% | 0.05% |
| PUHES | 82.20 | 69.43 | 10.56% | 1.21% |

Note: Except in the case above where the GDP growth rate is set to 1.5% p.a., the table shows the share of health spending in GDP resulting if each variable in turn is held to its 2003 value instead of moving to the 2050 value during the simulation. The GDP elasticity is unrestricted.

This table shows that some of our projections have a powerful influence on the share of spending. Although the steady state elasticity with respect to GDP is very close to 1, a reduction in the growth rate affects the dynamics of the process and thus the projected value for 2050. The share of the population in each age group is not very important, which is not very surprising since the variables are specified to have no long-run effect. Mortality likewise has little influence. However rising average life expectancy adds 1.7 percentage points to the expenditure share. The share of the public sector in health spending is also important, with a projected decline in the share decreasing the expenditure total by 1.2 percentage points.

We use a similar approach to look at the effects of the variables which can be regarded as health policy variables. The only continuous variable of this type is the number of beds; we treat this as in the earlier simulations, showing what would have happened if it had been held at its 2003 value. The other variables are dummy variables and we explore these differently. We carry out a set of simulations in which the value of each in turn is switched between the base run and the alternatives. Thus if a dummy took the value of 1 in the base it is switched to 0 in the alternative and vice versa. These results are shown in Table B13-3.

| **Table B13-3. The Influence of Policy Variables on Projected Health Spending (Model 0)** | | | | |
|---|---|---|---|---|
| | Value in 2003 | Value in 2050 in Base Run | Projected Share of Health Spending in 2050 (% GDP) | Difference from Base |
| Beds | 4.61 | 4.61 | 9.41% | 0.00% |
| | Value in Base Run | Value in Alternative | | |
| SalaryGP | 0 | 1 | 9.41% | 0.00% |
| CapGP | 0 | 1 | 10.83% | 1.42% |
| CaseHO | 0 | 1 | 9.26% | -0.15% |
| CoPAyGP | 0 | 1 | 11.34% | 1.93% |
| CoPayHO | 0 | 1 | 8.81% | -0.60% |
| FreeGP | 1 | 0 | 8.16% | -1.25% |
| FreeHO | 0 | 1 | 10.10% | -0.69% |
| Note: The entry for beds has the same interpretation as in Table B1. The other entries show the impact of each dummy in turn changing from 0 to 1 or vice versa. | | | | |

The table shows that it is the management of GPs rather than the management of hospitals which has an important effect on health spending. However, while the effects are large, there are questions how far the circumstances of any one country is adequately represented by dummy variables since any classification of this type inevitably has an arbitrary element to it.

### *Influences of Expenditure Elasticities*

Table B13-4 shows the effects of different elasticities of health spending with respect to GDP on total expenditure as a proportion of GDP. Since in model 0 the GDP elasticity is very close to one, it is no surprise that the result is scarcely changed by imposing an elasticity of 1. Higher elasticities result in lower expenditure shares. This is because of the interaction between the elasticity and the coefficient on life expectancy as discussed in the main body of the paper.

| **Table B13-4 Scenarios of different restrictions on long run income elasticity on health care expenditure in the United Kingdom** | | | | |
|---|---|---|---|---|
| Restriction on long run income elasticity | +1% s.d. of Health Care Expenditure in 2050 | Health Care Expenditure in 2050 (% GDP) | -1% s.d. of Health Care Expenditure in 2050 | AWG Scenarios |
| Unrestricted | 9.78% | 9.41% | 9.06% | 9.3% |
| 1 | 9.78% | 9.42% | 9.07% | 9.7% |
| 1.1 | 9.76% | 9.37% | 9.00% | n.a. |
| 1.2 | 9.74% | 9.31% | 8.91% | n.a. |

### *Influences of Restrictions on Demographic Parameters*

Finally, in Table B13-5 we explore the effects of restrictions on the demographic parameters, both with the long run elasticity with respect to GDP left unrestricted and with it set equal to 1. In the table the boldface entries indicate that a demographic restriction has been imposed. For the age variables it is that the coefficient on them is what would be observed if health expenditure were driven by the age structure of the population. For mortality it is the coefficient which would be expected if the only demographic influence were death-related costs. In each case where demographic-related restrictions are imposed on parameters we are interested in two sub-cases. In the first the other parameters on the other demographic variables related to old people are left unrestricted and in the second they are restricted to zero. Thus the second sub case of each type tells us what would happen if expenditure were age or mortality related and if that were the only demographic influence.

**Table B13-5 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050**

| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 9.78% | 9.41% | 9.06% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 10.08% | 9.71% | 9.35% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 9.32% | 8.90% | 8.50% |
| 3 | 0.9653 | **0.006** | **0.030** | 0.0227 | **0** | 10.90% | 10.49% | 10.09% |
| 4 | 1.0403 | **0.006** | **0.030** | **0** | **0** | 10.57% | 10.14% | 9.74% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 9.78% | 9.41% | 9.07% |
| 6 | **1** | 0 | 0 | 0.0564 | **0.313** | 10.09% | 9.72% | 9.36% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 8.61% | 8.22% | 7.84% |
| 8 | **1** | **0.006** | **0.030** | 0.0163 | **0** | 10.89% | 10.47% | 10.06% |
| 9 | **1** | **0.006** | **0.030** | **0** | **0** | 10.31% | 9.91% | 9.52% |

Note: Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.

The importance of the interactions between the coefficients can be deduced from this table. The restriction that spending is driven by death-related costs in the manner set out in section 3.2 has the effect of raising projected expenditure by 0.3 percentage points. However, if the life expectancy effects are restricted to zero so that death-related costs are the only demographic influence, then projected expenditure is reduced by 0.5 percentage points. By contrast when expenditure is assumed to be age related expenditure is raised by nearly one percentage point, falling to 0.7 percentage points when life expectancy effects are also suppressed. If the GDP elasticity is also restricted to one these effects are altered. In particular, when demographic effects are assumed to come only through mortality effects, a unit elasticity has the effect of reducing age projected expenditure fairly sharply.

### *Conclusions*

The exercise has indicated a number of key influences on health spending in the United Kingdom. Estimates of the influence of demographic effects are crucially dependent on the interaction between these and the estimated GDP elasticity of health spending. The extent to which the public sector provides health care is an important influence on total spending and there is evidence that other institutional arrangements are also important, although the crude nature of the measures used makes it difficult to come up with any firm conclusions about these.

# Appendix C The Effects of Copayments to GPs in Austria[1]

Martin Weale NIESR

We noted in section 7 the substantial effect that the change in 2005 to copayments to GPs has on the projections for Austria. Because of the concerns that the dummy variable reflects only this and not also a range of other institutional factors, we reproduce Table B1-5 but on the assumption that there is no institutional change in the forecast period. This is shown in Table C1 below.

**Table C1 The Impact of Restrictions on the Demographic Parameters on the Projected Share of Health Expenditure in 2050. No changes to Copayments to GPs**

| Model | GDP Elasticity | AGE65-74 | AGE75+ | AVELE65 | MORT | +1 S.D | Health Expenditure in 2050 (% GDP) | -1 S.D | Results from report on Austria Table B1-5 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0071 | **0** | **0** | 0.0419 | **0** | 11.41% | 10.81% | 10.24% | 8.98% |
| 1 | 1.0151 | **0** | **0** | 0.0538 | **0.313** | 14.28% | 13.49% | 12.74% | 10.43% |
| 2 | 1.1738 | **0** | **0** | **0** | **0.313** | 13.19% | 12.34% | 11.55% | 9.11% |
| 3 | 0.9653 | **0.006** | **0.03** | 0.0227 | **0** | 14.62% | 13.78% | 12.99% | 10.61% |
| 4 | 1.0403 | **0.006** | **0.03** | **0** | **0** | 14.22% | 13.34% | 12.52% | 9.92% |
| 5 | **1** | **0** | **0** | 0.0431 | **0** | 11.40% | 10.81% | 10.24% | 9.06% |
| 6 | **1** | **0** | **0** | 0.0564 | **0.313** | 14.27% | 13.48% | 12.74% | 10.44% |
| 7 | **1** | **0** | **0** | **0** | **0.313** | 11.81% | 10.99% | 10.21% | 7.84% |
| 8 | **1** | **0.006** | **0.03** | 0.0163 | **0** | 14.62% | 13.78% | 12.98% | 10.59% |
| 9 | **1** | **0.006** | **0.03** | **0** | **0** | 13.87% | 13.00% | 12.18% | 9.53% |

**Note:** Boldface entries indicate numerical values of restrictions. Other entries are the long-run coefficients implied by the restrictions.

It is clear that the impact of the institutional change on the projection is of the order of 2-3 percentage points. However, if the remainder of the health system in Austria remains unchanged, there is a risk that the predicted benefits of this may not be realised. Table C1 points to a risk that Austria may face greater upward pressure on its health expenditure than the results in Appendix B suggest.

[1] This Appendix was prepared by Martin Weale of NIESR

# About AHEAD

In February 2004, a CEPS-led consortium of research institutes launched the implementation of a three-year project called AHEAD (Ageing, Health Status and the determinants of Health Expenditure). Most of the consortium's 18 partner institutes are members of the European Network of Economic Policy Research Institutes (ENEPRI – see http://www.enepri.org for details). As specified in the call for proposals, the main task of the project is to carry out an "Investigation into different key factors driving health care expenditures and in particular their interaction with particular reference to ageing" in the (enlarged) European Union.

The strategic objectives of AHEAD are to:

- assess pressures on health spending in the existing EU and in selected candidate countries, looking both at those arising directly from ageing and at those affected by changing incomes, social change and methods of expenditure control;
- develop models for projecting future health spending and
- estimate confidence limits for these projections.

Expenditure on medical treatment has tended to rise as a proportion of national income throughout the European Union. A particular concern is that an ageing population and therefore the presence of more old people will create further pressures for expenditure on health care. This issue is of concern both in its own terms and because of its fiscal implications. Rising health expenditures put pressure on the targets of the Stability and Growth Pact. They also raise the question whether budgetary targets should be tightened ahead of projected growth in public expenditures, so as to 'save up' for future spending and keep expected future tax rates reasonably constant.

This project has aimed to refine existing estimates of the links between reported states of health and use of medical services. As well as looking at the effects of ageing on health care, the research has taken account of the link between health expenditure and fertility rates and the demands on health services made by non-native populations. Particular attention is paid to the costs of care near death. One study examined factors other than demand (such as methods of financial control) that may influence health spending. An important aspect of this research is that the work is carried out so as to be able to provide not only the familiar projections and scenarios but also standard deviations and confidence limits for predictions of key variables, such as healthy life expectancy and demand-driven expenditure levels. These will allow policy-makers to judge not only possible outcomes but also the risks surrounding them and to assess their implications.

### Participating Research Institutes

Centre for European Policy Studies, CEPS, Belgium
National Institute for Economic and Social Research, NIESR, UK
Netherlands Bureau for Economic Policy Research, CPB, The Netherlands
Deutsches Institut für Wirtschahftsforschung, DIW, Germany
Economic and Social Research Institute, ESRI, Ireland
Research Institute of the Finnish Economy, ETLA, Finland
Federal Planning Bureau, FPB, Belgium
Istituto di Studi e Analisi Economica, ISAE, Italy
Institute for Advanced Studies, HIS, Austria
Institute for Public Health, IPH, Denmark
Laboratoire d'Economie et de Gestion des Organisations de Santé, LEGOS, France
Personal Social Services Research Unit, PSSRU, UK
Fundación de Estudios de Economía Aplicada, FEDEA, Spain
Centre for Social and Economic Research, CASE, Poland
Institute of Slovak and World Economy, ISWE, Slovak Republic
Institute of Economics at the Bulgarian Academy of Sciences, IE-BAS, BG
Social Research Centre, TARKI, Hungary
Department of Public Health, University of Tartu, Estonia

# About ENEPRI

The European Network of Economic Policy Research Institutes (**ENEPRI**) is composed of leading socio-economic research institutes in practically all EU member states and candidate countries that are committed to working together to develop and consolidate a European agenda of research. **ENEPRI** was launched in 2000 by the Brussels-based Centre for European Policy Studies (CEPS), which provides overall coordination for the initiative.

While the European construction has made gigantic steps forward in the recent past, the European dimension of research seems to have been overlooked. The provision of economic analysis at the European level, however, is a fundamental prerequisite to the successful understanding of the achievements and challenges that lie ahead. **ENEPRI** aims to fill this gap by pooling the research efforts of its different member institutes in their respective areas of specialisation and to encourage an explicit European-wide approach.

**ENEPRI** is composed of the following member institutes:

| | |
|---|---|
| CASE | Center for Social and Economic Research, Warsaw, Poland |
| CEE | Center for Economics and Econometrics, Bogazici University, Istanbul, Turkey |
| CEPII | Centre d'Études Prospectives et d'Informations Internationales, Paris, France |
| CEPS | Centre for European Policy Studies, Brussels, Belgium |
| CERGE-EI | Centre for Economic Research and Graduated Education, Charles University, Prague, Czech Republic |
| CPB | Netherlands Bureau for Economic Policy Analysis, The Hague, The Netherlands |
| DIW | Deutsches Institut für Wirtschaftsforschung, Berlin, Germany |
| ESRI | Economic and Social Research Institute, Dublin, Ireland |
| ETLA | Research Institute for the Finnish Economy, Helsinki, Finland |
| FEDEA | Fundación de Estudios de Economía Aplicada, Madrid, Spain |
| FPB | Federal Planning Bureau, Brussels, Belgium |
| IE-BAS | Institute of Economics, Bulgarian Academy of Sciences, Sofia, Bulgaria |
| IER | Institute for Economic Research, Bratislava, Slovakia |
| IER | Institute for Economic Research, Ljubljana, Slovenia |
| IHS | Institute for Advanced Studies, Vienna, Austria |
| ISAE | Istituto di Studi e Analisi Economica, Rome, Italy |
| NIER | National Institute of Economic Research, Stockholm, Sweden |
| NIESR | National Institute of Economic and Social Research, London, UK |
| NOBE | Niezalezny Osrodek Bana Ekonomicznych, Lodz, Poland |
| PRAXIS | Center for Policy Studies, Tallinn, Estonia |
| RCEP | Romanian Centre for Economic Policies, Bucharest, Romania |
| SSB | Research Department, Statistics Norway, Oslo, Norway |
| SFI | Danish National Institute of Social Research, Copenhagen, Denmark |
| TÁRKI | Social Research Centre Inc., Budapest, Hungary |

ENEPRI publications include three series: Research Reports, which consist of papers presenting the findings and conclusions of research undertaken in the context of ENEPRI research projects; Working Papers, which constitute dissemination to a wider public of research undertaken and already published by ENEPRI partner institutes on their own account; and thirdly, Occasional Papers (closed series) containing a synthesis of the research presented at workshops organised during the first years of the network's existence.

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