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DEMOGRAPHIC CHANGES AND AGGREGATE HEALTH-CARE EXPENDITURE IN EUROPE

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Demographic Changes and Aggregate Health-Care Expenditure in Europe

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Abstract

Background. While an increasing absolute number of elderly (or any other age group) will inevitably increase total health care expenditure, expenditure per capita will not necessarily increase. No firm conclusion on this point can be drawn from the existing literature. When analysing the determinants of health care spending, a distinction should be made between individual-based analyses (micro-level studies), which are usually restricted to a single country, and analyses based on aggregated health care spending with countries as the unit of observation (macro-level studies). Micro-level studies are often used to make predictions about health care spending, based on assumptions of age-specific utilisation rates, while macro-level studies are used to identify economic, demographic and institutional determinants of expenditure based on historical data. While micro-level studies are based on the demand side alone, macro-level studies allow for both demand and supply factors to be included.

Purpose. The main purpose of this paper is to investigate the relationship between ageing and the development in the aggregate health care expenditure in EU countries on a macroeconomic level when economic and institutional variables are included. Model results will be used to extrapolate the total health care expenditure for the next 10 years.

Data. Unbalanced panel data from 26 countries covering up to a 24 year period. The countries included were the old 15 EU member countries (EU15) and the 10 new member countries (of which Cyprus and Malta were omitted from the final analysis) plus two anticipated members (Romania and Bulgaria) and one potential member (Turkey). This group is referred to as EU11 in this paper. The data include economic, social, demographic and institutional variables as well as variables related to capacity and production technology in the health care sector.

Method. Analyses were made separately for EU15 and EU11 countries. We hypothesise that ageing affects health care expenditures directly as well as indirectly through a political process in which institutional variables in a broad sense are amended due to demand pressure from an ageing population. A sequence of models was estimated in order to examine the impact of ageing as well as the mediating effects of other variables.

Results. In both groups of countries, ageing appears to be associated with increasing health care expenditure per capita. The importance of adjusting for confounding variables was evident throughout the exercise. We have estimated semi-elasticities showing the percentage increase in health care spending associated with a 1% unit increase of the population in a given age group. For EU15 countries, we found evidence that the elasticity of health care spending with respect

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to the age group 0-5 years is negative. For the age group 65-74 years a positive elasticity was found, while the elasticity for the age group 75+ years was negative. These results were obtained after control for unconditional country differences and a time trend. They are robust towards controlling GDP and other population characteristics, but they lose significance and magnitude when adjustment for health system characteristics was made, indicating that the direct effect of ageing on total health care expenditure is mediated by institutional variables. For the EU11 countries, significantly positive effects for the age groups 0-5 years and 65-74 years were found. A significantly positive effect for the age group 75+ was also found, but this effect turned out to be insignificant when controlling for health system characteristics.

In both groups of countries it seems that it is the presence of specific institutional structures and health care technology benefiting old people, rather than the proportion of older people, that governs health care expenditure. While this supports the hypothesis of an indirect effect of ageing through institutional and health care technology variables, this should be interpreted cautiously.

Discussion. Our conclusion is that the direct effect of demand for health care due to ageing is very small and insignificant in EU15 countries, whereas there is a positive association in EU11 countries. An apparent association between ageing and expenditure may be explained by income: richer countries have a bigger share of the ageing population and can afford to invest in expensive technology.

The distinction between various age groups among the elderly modifies earlier findings by showing the specific effect of age group 65-74 years. The incomplete data with respect to long-term care in total health care expenditures should be taken into account when interpreting the results, in particular for results for the EU11 countries.

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Demographic Changes and Aggregate Health Care Expenditure in Europe

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1. Introduction

An increasing number of international analyses of health care expenditure have been conducted out the past 40 years. Such analyses are highly relevant for policy makers for a number of reasons: Over this period there has been a substantial increase in demand for health care; health-care spending has increased in most countries; forecasts indicate increasing spending on health and long-term care; there has been and still is a substantial variation in health-care expenditure across countries; health care is to a large extent publicly financed and the size of its budget is therefore an ever-present political issue.

Various determinants from both the demand and supply side have been included in previous studies, including economic, demographic, social, behavioural and institutional variables. Attention has been paid, in particular, to the impact of Gross Domestic Product (GDP) per capita on aggregate health care expenditure. Among other determinants, age composition has been included in many studies.

The term 'ageing' is often understood to mean a change in the age distribution leading to an increased share of the population being elderly. 'Ageing' is defined in different ways, but the tag is most often applied to people aged 65 and over. This use of the term is somewhat imprecise, however, as 'ageing' strictly speaking is connected with an increase in life expectancy, while a changed age distribution leading to an increasing share of the population being elderly may be caused by a combination of reduced fertility and/or increased life expectancy. Still, the term 'ageing' is used below as synonymous with an increased share of the population being defined as elderly.

While an increasing absolute number of elderly (or any other age group in the EU) will inevitably increase total health care expenditure, expenditure per capita per year will not necessarily increase, although it is a widely held view that it will[1]. Thus it has been assumed that as individual health care expenditure in general increases by age, health care expenditure per capita can be predicted to increase with an ageing population. However, this type of assumption has not been unanimously supported in previous studies for at least three reasons. First, health care expenditures are determined not only by demographic factors, but also by non-demographic variables, such as technology, economic and institutional characteristics, which are subject to political and managerial decisions. The direct demand effect of ageing may be mediated by indirect institutional responses regulating the supply of health care services. A

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* Data for this study have been collated by Dr. Erika Schulz, DIW – German Institute for Economic Research, Berlin. We are grateful to Professor Tom Getzen for his comments when the paper was presented at the Nordic Health Economics Study Group (NHESG) meeting, Copenhagen, 16-17 August, 2006.

[1] This consideration should not be mixed up with the question of whether or not an increasing share of elderly citizens will lead to an extra 'financial burden' on younger generations through, for example, increases in taxes to pay for their health care.

partial view on the demand pressure may therefore bias and exaggerate the effects of ageing. Second, it may be explained to a certain extent by the lack of accounting for high costs of dying. While cross-sectional studies on individual data show increasing expenditure by age, longitudinal studies reveal that health care expenditure increases at a lower rate by increasing age – or, in an extreme version, even increases insignificantly, but increases rapidly with proximity to death. The disputed conclusion from cross-section analyses may thus to a certain extent be explained by the fact that the risk of dying increases by age, and if death is postponed, the high costs will occur at a later age. Third, even if ageing means higher costs for this population group, total budgets might simply be re-allocated within a certain ceiling – at least in countries where there is a strong political influence on health care budgets as is the case in most EU countries.

1.1 Longevity and health scenarios

Various scenarios for longevity and health status and the derived costs of health and long-term care have been formulated. In an optimistic scenario, morbidity is compressed, that is, while life expectancy is assumed to have reached a maximum, the time in good health increases. As a consequence, the time people spend in bad health and in need of health care at the end of their lives becomes shorter. This has been called the ‘compression of morbidity’ scenario (Fries, 1980). By contrast, in a pessimistic scenario, life expectancy is assumed to increase. It is furthermore assumed that the age-specific risks of health problems are constant. This implies that the time spent in bad health increases with increasing life expectancy - the ‘expansion of morbidity’ scenario (Grunenberg, 1977). Combinations of these two scenarios are possible of course. Thus, Manton (1982) formulated a ‘dynamic equilibrium hypothesis’ implying that longevity increases result in more years spent in good health (‘healthy ageing’ scenario). As a consequence of this scenario, the number of years spent in bad health is constant. The ‘dynamic equilibrium’ hypothesis is associated with an extreme version of the death-related cost hypothesis as both imply that longevity gains are translated into years of good health (OECD 2006). Over time, a country may change from a state of expanded to a state of compressed morbidity (Michel & Robine, 2004). These scenarios may be used as either a framework for interpreting empirical results or for forecasting purposes.

1.2 Review of the empirical literature

When analysing the determinants of health care spending, a distinction should be made between individual-based analyses (micro-level studies) and analyses based on aggregated health care spending with countries as the unit of observation (macro-level studies). Both types of studies are briefly reviewed below.

1.2.1 Review of micro-level studies

In most micro-level studies individual health care costs are regressed on a number of explanatory variables, especially demographic variables, and they are analysed as either cross sectional or time series data. As micro-level studies are normally based on data from a single country or region within a country, variation in supply side variables cannot be taken into account. This variation can be taken into account in macro-level studies.

Most studies have found increasing age-specific costs. Some have found that the age profile of costs tend to peak and decline after a certain age level (Bains 2003, OECD 2006).

The focus in many micro-level studies has been to test whether increasing health care costs associated with age is explained by age *per se* or rather by proximity to death. Increasing expenditure on acute health care as death draws nearer has been found in a large number of micro-level studies (Roos & Roos, 1987; Lubitz & Riley, 1993; Lubitz et al. 1995; Spillmann &

Lubitz, 2000; Zweifel et al. 1999; Felder et al. 2000; Hogan et al. 2001; Hoover et al. 2002, Seshamani & Gray, 2004a, b; Serup-Hansen et al. 2002; Stearn et al. 2004; Schulz & Leidl König, 2004, Breyer et al., 2006). One study found no association between proximity to death and use of (General Practitioner) GP services (Madsen et al., 2002) while another found only a minor association between proximity to death and use of prescribed drugs (Kildemoes et al. 2006). By contrast, expenditure on long-term care as a function of proximity to death has not been studied as much.

Turning to the age profile of the costs of dying, a few studies have found that the acute health care cost of dying decreased above a certain age (Lubitz et al. 1995, Serup-Hansen et al. 2002, Seshamani & Gray, 2004a, b), which reflects the decreasing probability of the oldest being hospitalised and/or the reduced probability of initiating intensive treatment.

Finally, some studies on longitudinal data concluded that there was an insignificant or no effect of ageing *per se* on aggregate health care spending per capita (Lubitz et al. 1993; Zweifel et al. 1999; Hogan et al. 2001; Spillman & Lubitz, 2000; Hoover et al. 2002; Stearn et al., 2004) while others did find an effect of ageing (Roos & Roos, 1987; Lubitz et al., 1995; Seshamani & Gray, 2004a, 2004b). Other studies predicted increasing health care expenditure due to ageing *per se* (Serup-Hansen et al., 2002; Schulz & Leidl König, 2004, Breyer et al. 2006). In a simulation, based on micro-data, Dormont et al., (2006) found that the increase in health care expenditure due to ageing is relatively small and that the impact of change in practice style is 3.8 times larger.

A further development in the literature has been to look into the various factors that change with age and affect aggregate health care expenditure differently at different age levels. Thus, Chernichovsky & Markowitz, (2004) found that ageing and its correlates produce a complex picture of the potential effect of ageing on the total costs of medical care. Among such factors, they studied age-specific changes in morbidity and mortality, growth in income and insurance coverage, rising levels of education and changing technology. They concluded that shifting morbidity and mortality to older ages do not necessarily imply increasing cost of care.

A number of studies forecast health care or long term care expenditure on the basis of population forecasts and a number of assumptions, especially with respect to time spent in good health. Forecasts have been made by, among others, Nutall et al. (1994), Spillmann & Lubitz, (2000), Serup-Hansen et al. (2002), Madsen et al. (2002), Stearns et al. (2004), Kildemoes et al. (2006), Karlsson et al. (2006), Breyer et al. (2006) and the OECD (2006).

The results from studies on historical data are dependent on both demand side changes and possible supply side reactions, and consequently the observed health care expenditure can be interpreted as utilisation rather than demand for health care. By contrast, results from projections are dependent on the specific assumptions with respect to future age-specific health problems that have been applied and the supply side reaction. Most projections are based on an unchanged age-specific utilisation rate and unchanged health care rationing and can thus be interpreted as projections of demand.

The aforementioned shape of the age-related cost curve, which tends to peak and then decline at old ages, may be explained by a combination of the increasing probability of dying and the decreasing cost of dying by increasing age. While increased longevity may imply a move upwards on the cost curve, the adjustment for death-related costs may move the (peak of) the curve rightwards. Non-demographic factors such as new technology and increases in relative prices may move the curve upwards (OECD, 2006). The effect of policy variables that affect the level of costs (see below) may be added to this model. Thus, with different factors at play over time, a forecast of health care costs must take these factors and their strength into consideration.

1.2.2 Review of macro-level studies

Turning to macro-level studies, the determinants of health care expenditure is an area that requires a specific understanding of the mechanisms that determine health care expenditure at a national level. In particular, the health care budgets are to a large extent determined in a political process. Most studies that have been carried out hitherto have been based on a weak theoretical foundation (Roberts 1999, Gerdtham & Jönsson, 2000). The choice of model as well as explanatory variables appear more or less a-theoretical, and studies that have used a theoretical foundation have apparently not succeeded in doing this in a satisfactory way. In addition, the quality of data has been far from perfect (Gerdtham & Jönsson, 2000) as they have been generated from different countries with different principles for national accounting and definitions of health care expenditure, despite the efforts by the OECD to produce commensurable data (OECD 2005). In particular, the extent to which care for the elderly has been included varies between countries. One more problem is that the characteristics of each country are not unequivocally described by a limited number of variables as no country has based its health care system entirely on a single model. Rather, institutional characteristics are more often a mixture from different models. For instance, co-payment may be the general rule, but there may be exceptions for specific types of medicine or patient groups, or global budgets may be the general rule, but some activity based payment may exist alongside the global budget.

The lack of a theoretical framework becomes obvious when analyses of variation in health care spending use demographic variables along with supply side variables which are subject to political or managerial decisions. Thus, statistically, the effect of increased demand due to a greying population may be channelled either directly through age composition variables or, indirectly, through supply side variables. Still, these variables may also vary over time for other reasons.

According to Gerdtham & Jönsson, (2000), it is possible to distinguish between two generations of studies which are briefly reviewed as follows. Most studies are limited to OECD countries. The first generation of studies can be characterised as being based on cross-sectional data alone. In his pioneering article, Newhouse (1977) carried out a bivariate regression of health care expenditure in 13 countries, based on 1971 data. He found that income (GDP per capita) accounted for 92% of the variation in health care expenditure per capita, leaving only little room for other explanatory variables. Leu (1986) carried the analysis one step further by including a multivariate regression with economic, demographic and institutional variables that were founded in public choice theory. Thus, besides income, he used age composition, resource variables and system variables to characterise each country's health care system. In a pooled cross-section time series analysis Gerdtham (1992) used GDP, inflation rate, percentage of public health care expenditure to total health care expenditure and age composition, which explained between 83 and 98 percent of the variation.

The second generation of analyses is characterised by using panel data that allow more observations to be included (among others, Gerdtham et al., 1992b, Hitiris & Posnett, 1992, Gerdtham et al., 1998). This also allows for dynamic aspects to be included and for the inclusion of dummy variables to express country - as well as time-specific effects that allows for unobservable variables which are correlated with the explanatory variables. The latest development uses specific methods to test for stationarity of data as it has been demonstrated that non-stationarity can produce spurious results (Philips, 1986, Engle, 1987). Roberts (1999) addressed, in particular, issues related to dynamics and heterogeneity of data, and lack of sensitivity testing. She dealt with these three issues by adopting recently developed techniques for analysing dynamic heterogeneous data fields containing non-stationary variables.

While later studies can be characterised by gradually refining the econometric methods, the main conclusions from previous studies still seem valid. A number of studies confirm that GDP per capita is the most important determinant of health care expenditure within OECD countries and that the effect of demographic and institutional variables is limited although measurable. Some of the results of age composition as well as economic and institutional variables are reviewed much in the following sections.

The apparent puzzle that the income elasticity on a macro-economic level, which seems high and possibly greater than one, while close to zero at the individual level, has been explained by Getzen (2000) by the lack of recognition that behaviour and policy context differ between the average individual and a group. Thus, income elasticity differs for an individual, a risk-pooling group and a national health care system.

1.2.3 Age as a determinant of health care expenditure in macro-level studies

Age composition as a determinant of health care expenditure was absent from the often quoted work by Newhouse (1977) but has been included in most macro-level studies since then. In his study of health care expenditure Leu (1986) included age composition and found that the share of the population below 15 years old, but not those above 65, was positively associated with health care expenditure per capita. The last finding was unexpected.

Getzen (1992) used OECD data from 20 countries in the period 1960-88 and performed various cross-section analyses. He found no effect of age and claimed that this finding is consistent with the hypothesis that need, as measured by changing age composition, will affect the allocation of expenditure between age groups in a population rather than the total budget. The hypothesis rests on the assumption that total health care spending is a result of political and professional choices, rather than trends in demography, morbidity or technology.

Hitiris & Posnett, (1992) used data from 20 OECD countries for the period 1960-87. They regressed health care expenditure as a function of GDP per capita, share of population above 65 years old and public finance share of total health care spending. The elasticity of health spending with respect to the proportion of the population over 65 was around 0.55 and significant. This is a relatively high estimate, but the authors do not discuss this result.

Gerdtham et al (1992a) used data from 19 OECD countries for 1987 and replicated Leu’s study. In one regression specification they found a significant but small positive effect of ageing. In other specifications the estimates were insignificant and close to zero. Gerdtham et al. (1992b) used data from 19 OECD countries in the years 1994, 1987 and 1980 in a pooled cross-section regression analysis and used economic, demographic and institutional variables. The age variable, measured by the ratio of 65+ year olds/15-64 year olds, showed a measurable positive effect with an elasticity of about 0.2. In a later panel data analysis, Gerdtham et al. (1998) applied data from 22 OECD countries for the period 1970-91 to examine the effect of a number of institutional and non-institutional variables on health care expenditure. Here, age composition was not found to have any significant effect. In all model specifications the elasticity of health care expenditure with respect to the proportion above 75 years was negative but close to zero. With the inclusion of the 65+ year old age group, Jönsson & Eckerlund, (2003) found a positive and significant effect of age, based on OECD data from 1998.

Barros (1998) used data from 24 OECD countries from 1960-90 and estimated growth rates rather absolute levels of health care expenditure. The explanatory variables included economic, demographic and institutional variables. One conclusion was that ageing has not contributed to the growth of health care expenditure.

Roberts (1999) based her study on data from 20 OECD countries from 1960-93 and included the following variables: GDP per capita, public spending as a percentage of the total, the percentage of population aged over 65 and the relative price of health care. She found a negative but insignificant effect of ageing in alternative approaches. The negative effect was unexpected.

Moïse & Jacobzone, (2003) found in a simple regression of health expenditure as a share of GDP and the share of population aged 65 and over, based on OECD data from 1997, that there was only a weak, but non-significant positive relationship when three outliers were excluded.

A further number of macro analyses are reviewed in Gerdtham & Jönsson, (2000). They conclude that the effect of age structure is usually insignificant.

In his essay on ageing and health care costs, Reinhardt (2003) draws on research literature and concludes that ageing is not the strongest driver of demand for health care anywhere in the US. Dominant drivers in the past as well as in the future are increases in per capita income, costly medical technology, increasing workforce costs due to shortage and asymmetric distribution of market power in health care in favour of the supply side (this relates to the US, but not necessarily to Europe with a lower level of health care expenditure, stronger political regulation and other institutional structures compared to the US). Reinhardt further points out that the prevailing age-specific health care utilisation pattern can be changed and that age-specific spending does not necessarily have to increase for all age groups in the future.

1.2.4 Other determinants of health care expenditure in macro-level studies

Other determinants that have been used are variables that can be classified as either economic, social, behavioural, institutional or technology variables, although a distinction between these types is not clear-cut. From a public choice perspective, Leu (1986) included, among other variables, public provision and financing as a share of total expenditure and he expected a positive association with health care expenditure.[2] These hypotheses have been challenged though, by, among others, Culyer (1989) who claimed that private sector bureaucrats are not necessarily better controlled than the public sector ones, that costs in the private sector may be larger due to advertising and selling costs (or more generally transaction costs), and that market pressure may be less reliable than professional ethics and regulation. Leu also included public financing as a share of the total assuming that this share would lower the price to the consumer. This hypothesis was also challenged by Culyer (1989) who claimed that increased consumption would require two conditions to be fulfilled: that a reduced price would increase demand and that taxpayers would be willing to finance increased supply in response to this increase in demand. Leu included a dummy for National Health Services (UK and NZ) with a significant negative effect, and a dummy for direct democracy (Switzerland), also with a significant negative effect.

Further economic and institutional variables that have been used to describe a health care system are gate-keeping by GPs, the number of doctors per population and the number of beds. Case-mix has been accounted for by the ratio of in-patient spending to total spending. Female labour force participation has been seen as an indicator of substitution of formal care for informal care, leading to higher health care expenditure (Gerdtham et al., 1992a, b).

Among the institutional variables are variables that catch the incentives built into the payment to providers or variables that regulate total expenditure. Thus, fee-for-service versus capitation payment of GPs or payment of salaries, open-ended versus close-ended budgets (or global budgets) of hospital payment, and budget ceilings have been used (Gerdtham et al. 1992b,

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[2] Leu (1986) presented a number of arguments from the public choice literature that would suggest that increased public financing and provision will increase health care expenditure. One argument is that increased public financing increases the number of people insured and that this will lead to increased health care expenditure because of moral hazard effects. Secondly, public provision may lead to increased health care expenditure through increased production costs because of the weaker incentives to minimise costs or through increased production levels based on Nikanan's budget maximisation hypothesis.

1998). On the demand side co-payment is assumed to affect utilization. In the framework by Hurst (1991) and later OECD publications (1992, 1994) health care systems are classified as either public contract systems, public integrated systems or a mix of these. Urbanisation has been included as an indicator of the travel costs of health care utilisation. Finally, unemployment rates have been used in some studies (Gerdtham et al., 2000).

In a review, Gerdtham et al. (2000) summarised the existing empirical results with specific reliance on the comprehensive study by Gerdtham et al. (1998) as follows. Variables that consistently show a positive association with health care expenditure are GDP/capita while age structure of the population, unemployment rate and female labour force participation are usually insignificant. Six results from their 1998 study seemed reasonably strong and corresponded to expectations. Hence, expenditure seems lower where primary care gatekeepers are used, patients pay the provider and get reimbursed afterwards, capitation systems are used as compared to use of fee-for-service systems, there is high reliance on out-patient visits as compared to in-patient care, there is public sector provision of health care (although with some reservations) while the total supply of doctors may be positively associated with health care expenditure. Other results did not correspond to expectations. Budget ceilings on in-patient care seemed unexpectedly to be associated with higher expenditure while systems with public reimbursement tended to have lower expenditure than contract systems, and public integrated systems may be more costly than public contract systems. The authors assume that the last finding may be explained by the fact that countries in the public integrated system “also tend to have higher fractions of high cost in-patient care and fewer gate-keeping arrangements” (p. 47). They found it difficult, though, to explain the result for public reimbursement systems.

The overview reveals that the majority of the macro-level studies apply OECD data, which has the advantage that data is easily available and that the OECD has also made a major effort to provide consistent measures. Furthermore, there seems to be considerable variation in the health care system characteristics and in the other explanatory variables across OECD countries, which are important in the regression analysis. However, the OECD may also differ from other, non-OECD countries and it may not therefore be possible to say that the data also applies to them. The review also shows that no clear-cut conclusion can be inferred with respect to the effect of ageing.

2. Purpose

As set out in the preceding review, health care utilisation can be explained by both demand and supply side variables. Hitherto, a large number of studies have been performed on a micro-level with inadequate consideration of the restrictions on utilisation due to changes to supply factors that may take place when demand shifts due to demographic changes. To better incorporate supply side variables, the study needs a design that allows for variation in supply side variables. Such variation exists between each country’s health care systems. Several studies have already been made, but none based exclusively on EU countries and none including the new EU member states.

The purpose of this paper is to investigate the relationship between ageing and the development in health care expenditure on a macro-level when including economic and institutional variables. The choice of variables is based on previous experience in the literature.

Our hypothesis is that ageing affects health care expenditures directly as well as indirectly through a political process where institutional variables are amended due to demand pressure from an ageing population. A sequence of models was estimated in order to examine the impact of ageing as well as the mediating effects of other variables.

Model results will be used to extrapolate total health care expenditure for the next 10 years.

3. Data

The data used in this paper is an unbalanced panel data set covering 26 countries, of which 23 are EU member states, two are due to join the EU in 2007 (Bulgaria and Romania) and one is a potential member state (Turkey). In this paper, a distinction is made between the 'old' 15 member states (EU15) and the new member states, which include the expected and potential member states (EU11). The EU15 covers Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom while the EU11 covers the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Bulgaria, Romania and Turkey. Cyprus and Malta have been excluded from the final analyses due to missing information on health expenditure. There are several reasons for making a distinction between these two groups of countries, the most important being that the development in institutional set-ups have been different during the period studied and that data are less complete for the EU11 countries.

The panel spans a time period of 24 years (1980-2003), but for the EU11 countries in particular the data set was incomplete for the period 1980-90. Therefore, the panel data for these countries applied to the final analyses covers only the period 1990-2003.

The dependent variable used in this paper is total health care expenditure per capita (THCEPC) measured in US dollars in nominal prices, adjusted for purchasing power parities (PPP) and for inflation. The data are from the OECD Health Data 2004 for OECD countries and from the WHO (European health for all database, WHO Regional Office for Europe, Copenhagen, Denmark) for non-OECD countries.

The explanatory variables are listed in Table 1. The first group of variables are considered 'demand variables' and include the economic variable GDP per capita, two behavioural variables (tobacco and alcohol consumption) and two social variables (female labour force participation and unemployment rate). The age structure variables and life expectancy are included as demographic variables. Age composition is of particular interest for this paper and will therefore be analysed in detail. Thus, we distinguish between two age groups of older people. These variables have been collected from a variety of sources including OECD Health Data, WHO and Eurostat.

The second group of variables may loosely be labelled 'supply variables' which include characteristics of each country's health care system in the period 1980-2003. This list includes variables that describe institutional factors assumed to affect utilisation. These variables are generated from the review of the literature, including the HiT reports from the European Observatory. Changes in the institutional characteristics are traced over time. The last group of variables includes variables that are used as indicators of capacity and production technology in health care.

Definitions and sources of the variables used in the analyses are listed in Table 1. It is worth noting that some variables listed as institutional can also be considered as economic variables. More detailed descriptions of some of the variables are given below.

Institutional variables are included to catch incentives and regulatory factors on the supply side. Classification of countries according to category of each variable is shown in Appendix 1. The dummy variables PUBCONTR and PUBINT classify health care systems as public contract, public integrated health care system or countries having a mix of these, following the terminology by Docteur & Oxley, 2003, Hurst 1991, OECD 1992, OECD 1994). A number of the included countries have been in transition from one health care system to another during the observation period, and these countries are classified accordingly with different classifications over time. GATE indicates whether the country has a gatekeeper system, e.g. the GP refers patients to in-patient hospital care. The variables COPAYGP and COPAYHO indicate whether there is significant co-payment for GP visits or in-patient hospital treatment. It has not been possible to collect data on the exact degree of co-payment and this qualitative dummy variable is therefore a crude indication for restriction in demand because of co-payment. The dummy variables GLOBALHO and CASEHO indicate whether countries remunerate their hospitals mainly by global budget (GLOBALHO) or by case-based remuneration (CASEHO). The reference level is countries remunerating their hospitals per diem, FFS and countries with mixed systems.

Table 1. Explanatory variables

	Name	**Description**	**Data source**	**Hypothesised influence**
Economic, social and demographic variables	GDP	Gross domestic product per capita, US dollars in nominal prices and adjusted for PPP	OECD/WHO/Eurostat	+
	POP05	Proportion of the population aged 0-5 (%)	EUROSTAT	+
	POP65	Proportion of the population aged 65-74 (%)	EUROSTAT	+
	POP75	Proportion of the population aged 75-84 (%)	EUROSTAT	+
	POP85	Proportion of the population aged 85+ (%)	EUROSTAT	+
	ALCCON	Alcohol consumption (litres of pure alcohol per capita per year)	OECD/WHO	+
	TOBCON	Tobacco consumption (cigarettes per capita per year)	OECD/WHO	+
	FLFPR	Female labour force participation rate (% ratio to active population aged 15-65)	OECD	+
	UNEMP	Unemployment rate (% ratio to labour force)	ILO	+
	LE65T	Life expectancy at age 65	WHO	+
	LE65F	Life expectancy at age 65 for females	WHO	+
	LE65M	Life expectancy at age 65 for males	WHO	+
Institutional variables	PUBCONTR	Dummy variable for countries characterised as having a public contract health care system, zero otherwise	Own	+
	PUBINT	Dummy variable for countries characterised as having a public integrated health care system, zero otherwise	Own	+
	PUHES	Public health expenditure as share of total health expenditure	OECD/WHO	+
	GATE	Dummy variable for countries with physicians as gatekeepers, zero otherwise	Own	÷
	COPAYGP	Dummy variable for countries with significant co-payment for GP, zero otherwise	Own	÷

	COPAYHO	Dummy variable for countries with significant co-payment for inpatient hospital treatment, zero otherwise	Own	÷
	GLOBALHO	Dummy variable for countries with global budget reimbursement of hospitals, zero otherwise	Own	÷
	CASEHO	Dummy variable for countries with case-based reimbursement of hospitals, zero otherwise	Own	-
	SALARYGP	Dummy variable for countries with salaried GPs, zero otherwise	Own	÷
	CAPGP	Dummy variable for countries with capitation payment GPs, zero otherwise	Own	÷
	CEILHO	Dummy variable for countries with overall ceiling of hospitals, zero otherwise	Own	÷
	FREEHO	Dummy variable for countries with free choice of hospital, zero otherwise	Own	+
	FREEGP	Dummy variable for countries with free choice of GP or primary care physician, zero otherwise	Own	+
Tech. and capacity variables	PHYSH	Physicians per 100 hospital beds	OECD/WHO	+
	BEDS	Acute care beds per 1,000 inhabitants	OECD/WHO	+
	DIALY	Patients undergoing dialysis per 100,000 inhabitants	OECD	+
	TOMSCA	Tomographic scanners per 1,000,000 inhabitants	OECD	+

SALARYGP and CAPGP indicate whether countries remunerate their GP mainly by salary (SALARYGP) or by capitation (CAPGP). The reference level is countries remunerating their GP by FFS. CEILHO indicates countries that have put a ceiling on the overall budget for hospitals. The variables FREEHO and FREEGP indicate whether countries allow patients to make a choice between hospitals (FREEHO) and whether citizens are allowed to make a choice between GPs (FREEGP).

The data set consists of an unbalanced panel data set. In our case it does not cause any serious problem since the models we are using impose restrictions on the effects from either the group or time dimension, which allows us to proceed with the estimates.

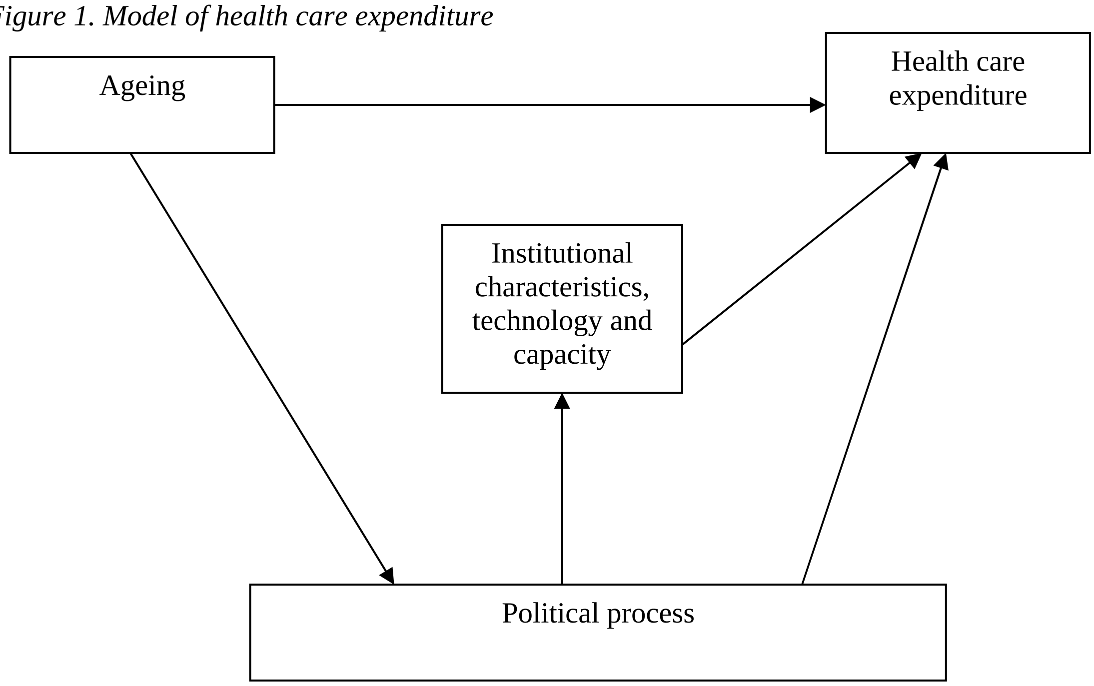
The data set had several cases with missing data. In order to make it possible to carry out estimates, these missing data cases were interpolated using the available information from the non-missing cases. The strategy for the replacement of missing cases was as follows. First, for each country, a regression was run of the variable in question on a time trend and a time trend squared. Missing cases were then replaced by the predicted value from this regression. For a few cases, where the beginning (or the end) of a series was missing, this strategy led to nonsense predictions. In these cases, the missing sequence was replaced with the first observed value (or the last observed value) from the country in question. Further, a few variables were missing for entire countries. In these cases, we imputed the annual average of the variable for the group of countries (i.e. EU15 or EU11) to which the country in question belonged. Finally, some dummy variables contained missing values at the beginning (or the end) of the period considered. These were imputed with the first observed (or the last observed) value for the country in question.

4. Model and hypotheses

As described in Section 1.1, various models for longevity and health at the end of life have been formulated (see Michel & Robine, 2004). If the 'healthy ageing' hypothesis is assumed, health care may be expected to be either constant or increase as an increasing share of the population becomes older. By contrast, decreasing cost may be derived from the 'compression model' whilst the 'expansion model' would imply increasing costs. We assume that ageing increases demand per capita. Still, these considerations do not take the supply side into consideration.

Our underlying thinking is illustrated in Figure 1. We assume that ageing increases demand for health care and that this demand leads both directly to a change in expenditure (within given institutional set-ups and given capacity) and indirectly to changed expenditure through changes in institutional and capacity variables. The changes of institutional variables are assumed to take place in a political process which may mediate the direct influence of ageing. The specific relationships are considered a 'black box' in this paper.

Figure 1. Model of health care expenditure



Technology changes may affect the cost of care for all age groups, but may do so in different ways. It is an empirical question whether improved technology will affect the older age groups more than the rest. Consequently, the indicator of technology is assumed to increase the level of spending in general.

While the main aim of this paper is to study the effect of various age compositions of the population, other variables have been included. The hypotheses of the effect of these variables on health care expenditure have been formulated as indicated in Table 1. Some of these follow from the review of the literature while others are described briefly below.

The behavioural and social variables are included as possible confounders that may affect demand for health care. Alcohol and tobacco consumption are life style variables that are expected to influence demand for health care per capita positively. Higher female labour force participation may be associated with a lower extent of informal care leading to a higher demand.

A link is made between unemployment and bad health in most health surveys (Kjøller et al., 2000) and consequently unemployment is assumed to lead to higher demand for health care.

Life expectancy at a given age is included as a confounder with an expected positive association with utilisation. It may be argued that in societies with a high level of expenditure, life expectancy will tend to be high. On the other hand, there may be a propensity to invest more in health when life expectancy is high as the pay-off is higher (Zweifel et al., 1999).

Institutional factors include variables that either restrict health care expenditure or influence incentives by those whose decisions affect health care utilisation. The institutional variables *per se* may explain part of the variation in health care expenditure but may also indirectly mediate the direct effect of aging. The hypothesised direction of each of the institutional variable's influence *per se* is described in the review of the literature. Finally, high values of capacity and technology variables are assumed to be positively associated with utilisation.

5. Econometric models

The major purpose of this paper is to reveal the relationship between age and health expenditures. In order to resolve this question properly, it is essential to control for confounding effects in a structured and sequential fashion.

An initial regression establishes the simple relationship between age and health expenditures. Next, as it is well known that there are considerable differences between countries, fixed effects for countries are included.

Further, the unconditional increase in health expenditures is controlled for. An optimal solution would be to include a fixed effect for each year. Although this would enable an optimal model fit to be obtained, it prevents the model from being applicable for forecasting beyond the time horizon of the data. Therefore, the unconditional increase is controlled for by adding a linear time trend to the model (with 1980=1).

Economy (GDP) and additional population characteristics are also controlled for. Finally, institutional variables and health production technology variables are added to the specification.

This generates a set of five models:

- Model 1: Age variables only
- Model 2: Age variables + country effects
- Model 3: Age variables + country effects + time trend
- Model 4: Age variables + country effects + time trend + GDP and population characteristics
- Model 5: Age variables + country effects + time trend + GDP and population characteristics + institutional and technology variables

The model sequence is estimated independently for EU15 and EU11 countries. For the former, data for the full period 1980 to 2003 are applied, while for the latter only data for 1990 to 2003 are included.

For any regression, THEPC and GDP were log transformed prior to the regression.

Model 5 is considered to be the final model. Within each country group (EU15 and EU11), this model is used for prediction ten years ahead, i.e. 2004-2013. The independent variables for this forecast were obtained in the following way:

- For the continuous variables, an ARMA (1,1) (Maddala, 2001) extrapolation of each variable was constructed within each country. This extrapolation merely serves as a proxy.

Future studies may find it relevant to use more authoritative extrapolations or to investigate the effects of using alternative extrapolation scenarios.

- For the dummy variables, the value of 2003 within each country was extrapolated. This is a choice of convenience. Future papers may find it relevant to investigate the consequences of policy changes as represented by shifting values of these dummy variables.

The forecasts are supplied by 95 percent forecast intervals.

6. Results

6.1 General results

The descriptive statistics of the variables are shown in Table 2 for the countries included. Table 2 shows that there is a considerable variation in the dependent variable, total health care expenditure per capita (THEPC), as well as the traditional key variable Gross Domestic Product (GDP). The share of the population in the age groups 0-5, 65-74 and 75+ years old varies both across time and across countries. There is generally a trend toward a larger share of the population in the age groups 65-74 and 75+ years old.

Only the most important variables are briefly summarised here. More extensive descriptive statistics are reported in the work package VI Part A report, see (Schulz 2005).

From the correlation matrix of key variables shown in Table 3 there appears to be a rather high correlation between GDP per capita and health care expenditure per capita (THEPC), in particular for EU15 countries. It also appears that there is a substantial negative correlation between age groups 0-5 years on the one hand and 65-74 years as well as 75+ years on the other in both groups of countries. That is, countries with a high share of elderly in their populations tend to have a small share of young children. In both groups of countries, there is a tendency towards richer countries having a higher percentage elderly of their populations. Most remarkable is that richer countries in EU15 and EU11 tend to have a higher share being among the oldest old. For the 65-74 year-old age group, the association with GDP per capita seems to be much stronger for the EU11 countries compared with the EU15 countries. This may indicate that GDP is not that important for the share of the population in the 65-74 year-old age group in the richer EU15 because they have increased life expectancy whereas GDP is still an important determinant of the share of the population in the 65-74 year-old age group in the less wealthy EU11 countries.

Table 2. Descriptive statistics of key variables (including interpolates)

	THEPC			**GDP**			**0-5 (%)**			**65-74 (%)**			**75+ (%)**		
	1980	**1990**	**2003**	**1980**	**1990**	**2003**	**1980**	**1990**	**2003**	**1980**	**1990**	**2003**	**1980**	**1990**	**2003**
Austria	1592	1771	2239	20897	24926	28117	6.93	6.98	5.98	9.61	7.92	8.04	5.88	6.98	7.46
Belgium	1310	1765	2463	20343	23732	26539	7.31	7.12	6.66	8.70	8.16	9.33	5.59	6.65	7.68
Denmark	1970	2047	2495	21622	24097	28745	7.66	6.61	7.44	8.75	8.65	7.79	5.59	6.93	7.02
Finland	1220	1863	1644	19122	23754	25360	8.01	7.53	6.58	7.92	7.69	8.46	3.96	5.61	6.87
France	1461	2049	2563	20535	23935	26770	8.17	8.01	7.49	8.30	7.12	8.56	5.72	6.78	7.73
Germany	1996	2278	2740	23031	26830	24103	6.06	6.57	5.60	9.86	7.67	9.95	5.82	7.23	7.53
Greece	969	1104	1818	14704	14919	17797	8.96	6.66	5.52	8.23	7.70	10.79	4.87	5.95	6.73
Ireland	1068	1042	2255	12733	17023	32869	14.10	9.86	8.53	6.88	6.85	6.25	3.83	4.53	4.86
Italy	2061	1841	2096	19348	22970	24664	8.10	5.96	5.86	8.51	8.21	11.54	5.54	6.49	8.02
Luxembourg	1331	2020	2982	22387	32997	50184	6.71	7.12	7.51	8.71	7.33	8.04	4.94	6.05	5.98
Netherlands	1567	1870	2474	20826	23335	28414	7.60	7.41	7.52	6.98	7.36	7.54	4.48	5.42	6.16
Portugal	591	871	1766	10640	14094	17974	10.30	7.04	6.29	7.44	7.99	9.62	3.72	5.22	7.04
Spain	758	1139	1650	14005	17094	21078	10.36	6.60	5.73	6.91	7.90	9.33	3.90	5.52	7.56
Sweden	1931	2063	2342	21292	24591	25987	7.26	7.46	6.20	9.90	9.82	8.28	6.29	7.97	8.86
UK	986	1287	2074	17475	21386	26719	7.28	7.93	6.94	9.27	8.77	8.21	5.59	6.90	7.28
Cyprus	-	1257	1257	-	8316	20976	10.50	10.83	7.26	7.17	6.39	6.84	3.96	4.04	5.02
Czech	-	728	1015	-	14611	14923	10.53	7.62	5.29	9.07	7.14	8.02	4.53	5.32	5.87
Estonia	-	306	769	-	5861	12658	17.08	8.71	5.47	7.84	6.46	9.73	4.69	5.09	6.12
Hungary	-	803	1061	-	10365	14106	9.75	7.11	5.67	8.99	7.68	8.99	4.53	5.55	6.38
Latvia	-	212	551	-	8316	10729	8.28	9.36	4.93	8.10	6.37	9.73	4.92	5.44	6.11
Lithuania	-	213	648	-	6596	11814	9.12	9.48	5.88	6.95	5.97	9.00	4.37	5.84	5.71
Malta	-	1304	1141	-	8316	19168	9.72	9.32	6.51	7.54	7.02	7.52	3.95	3.95	5.15
Poland	-	392	647	-	7970	10965	10.79	9.71	5.94	6.80	5.81	7.87	3.38	4.14	4.91
Slovakia	-	930	706	-	7414	11851	11.65	9.55	6.03	7.02	6.00	6.92	3.52	4.26	4.66
Slovenia	-	409	1497	-	8316	19891	10.70	7.59	5.41	3.84	5.87	9.01	5.58	4.72	5.74
Bulgaria	-	321	249	-	7346	7836	9.32	7.78	4.93	8.00	8.14	10.50	3.75	4.81	6.52
Rumania	-	103	323	-	8708	7836	10.89	9.25	6.01	7.10	6.20	9.15	3.18	4.06	4.60
Turkey	-	217	511	-	5972	6308	14.58	10.55	9.49	1.86	2.72	4.25	2.28	1.84	1.85
Mean	1129	1150	1570	14365	16291	19875	9.56	8.06	6.38	7.72	7.17	8.55	4.55	5.44	6.27
S.d.	612	706	825	6007	7648	9608	2.53	1.33	1.07	1.69	1.31	1.48	0.96	1.30	1.41

Note. GDP and THEPC were deflated (2000 prices) prior to interpolation.

Table 4 shows regression results for EU15 and Table 6 for EU11 countries. For each country group explanatory variables have been added stepwise in five models. The final model (5) shows a slight improvement over models 4 and 3 as measured by the adjusted R-square. Apparently, a lot of variation has been included in the country-specific dummy variables. R^2 increases markedly for both country groups when these are included (compare models 1 and 2). This is to be expected, as the country dummies account for any (time invariant) variation in health expenditures across countries, to the extent that this variation is not captured by the explanatory variables. Furthermore, the time trend accounts for (country invariant) drifts in health expenditures (model 3). For the EU15, a significantly positive drift is found, which increases the R^2 by approximately 8 percent units, but the time trend is not significant for the EU11 countries. Although the supply- and demand variables that are included do play a role, the high significances and R^2 values caused by the inclusion of the country dummies and the time trends demonstrate that there are many reasons for variation in the health expenditures which cannot be explained by the explanatory variables observed.

Table 3. Correlation matrix for key variables. EU15 countries (upper right) and EU11 countries (lower left)

Variables	THEPC	GDP	AGE 0-5	AGE 65-74	AGE 75+
THEPC	1	0.86	-0.43	0.30	0.62
GDP	0.79	1	-0.31	0.12	0.49
AGE 0-5	-0.36	-0.52	1	-0.60	-0.58
AGE 65-74	0.17	0.35	-0.87	1	0.59
AGE 75+	0.27	0.49	-0.76	0.81	1

The coefficients in the tables should be interpreted as elasticities. For variables which are measured as percentages (the age group variables, FLFPR and UNEMPL) the coefficient should be interpreted as semi-elasticities (Woodridge 2002), that is, the percentage increase in health care expenditure per capita associated with a one percent unit increase in the variable. It appears that some of the coefficients are rather small. Thus, a one percent unit increase in the 65-74 year-old age group is associated with an increase of 0.03 percent in expenditure in the EU15 (model 4). However, the corresponding figure of 0.35 percent for the EU11 is substantial.

6.2 Results from EU15 countries

6.2.1 Demographic variables

Table 4 provides mixed evidence as regards the impact of age structures for the EU15. Model (1) indicates a negative effect of the 0-5 year-old age group. This effect seems to remain when controlling for country heterogeneity (model 2) and further for the time trend (model 3). The effect is still negative, but loses significance, when account is taken of the effects of GDP and population characteristics (model 4) and further when account is taken of the effects of institutional and health technology characteristics (model 5).

Turning to the 65-74 year-old age group, the simple model (1) indicates a negative association. However, when accounting for country heterogeneity (model 2), the effect becomes positive. This is an important observation, as it seems to indicate a potentially spurious cross-country relation between age 65-74 and health expenditure. The point is that countries with high proportions of 65-74 year-olds have low health expenditures for reasons unrelated to age. The effect remains positive when accounting for the time trend (model 3) and GDP and population characteristics (model 4), but loses significance when account is taken of institutional and technology variables (model 5). Presumably, some of the age-related effects are subsumed in the institutional variables. In particular, it can be observed that the indicators' of use of technology (DIALY, TOMSCA and capacity (BEDS) have positive statistical signs. Still, PHYSH as a capacity variable is weakly negative.

Considering the 75+ year-old age group, the simple model (1) reports a positive effect. This effect remains positive when controlling for country heterogeneity (model 2), but changes to significantly negative when the time trend of health expenditure is taken into account (model 3). This is an important observation as it seems to indicate the presence of a spurious correlation over time between age 75+ and health expenditure: Both have been increasing throughout the period, so that an unconditional positive relationship seems to exist. But when controlling for the common time trend – by adding the time trend as in model (3) – the conditional relationship turns out to be negative. This negative effect is robust towards the inclusion of GDP and population characteristics (model 4), but turns insignificant when controlling for institutional and technology variables.

Thus, to summarise, when properly controlling for unconditional country heterogeneity and increasing health expenditure over time, there is evidence of negative relationships between health expenditure and the 0-5 and 75+ age groups, while a positive relationship between health expenditure and age 65-74 seems to be present. These effects are robust toward control for GDP and population characteristics, but they seem to be related to institutional and technology characteristics, as they lose significance when these are controlled for.

6.2.2 Other demand side variables

Income, measured by GDP per capita, shows a high association with expenditure per capita with an income elasticity of 0.56 in the final model (5). The unemployment rate has a small, but statistically significant negative association with expenditure while the female labour force participation rate seems positively associated with expenditure. Alcohol consumption shows no significant association with expenditure, while tobacco consumption has an insignificant association with expenditure.

6.2.3 Supply side variables

Among variables that are loosely named 'supply side' variables, the following showed a positive and significant association with health care spending: indicators of capacity (number of beds per 1000 inhabitants), indicators of high technology (number of patients undergoing dialysis and tomography scanners per million inhabitants) and public health care expenditure as a share of the total. Negative associations were found for payment of GPs by salary and capitation payment of GPs (as opposed to fee-for-service payment), case-based payment of hospitals and number of physicians per 1000 inhabitants. A number of variables were omitted due to no variation within countries, which in effect means that these variables are indirectly captured in the fixed effects.

To understand why the age variable turns out to be insignificant when including the institutional variables in model 5, the simple correlations between the key variables and the institutional variables are provided in Table 5. Those institutional variables, which were significant for THEPC in model 5, have simple correlations with one or more age variables of magnitudes comparable to their correlations with THEPC. In particular, this holds true for the indicators of use of technology (DIALY and TOMSCA). There also appears to be a negative association between use of global hospital budgets and the share of population over 65 years. This indicates that the relationship between THEPC and the institutional variables are to a considerable extent confounding with the age variables. It seems reasonable to assume that a considerable part of the total effect of age on THEPC is of an indirect nature (via the institutional variables) rather than of a direct nature.

*Table 4. Regressions for EU15 countries (N=15, T=24, N*T=360). Dependent variable: log THEPC*

	(1)	(2)	(3)	(4)	(5)
INTERCEPT	7.09(0.23)***	6.43(0.17)***	7.65(0.15)***	0.35(0.76)	-0.51(0.55)
AGE 0-5	-0.049(0.014)***	-0.045(0.011)***	-0.045(0.008)***	-0.013(0.007)*	-0.007(0.005)
AGE 65-74	-0.059(0.018)***	0.044(0.011)***	0.017(0.008)**	0.030(0.008)***	0.007(0.005)
AGE 75-	0.192(0.016)***	0.152(0.013)***	-0.059(0.016)***	-0.050(0.013)***	-0.011(0.010)
LOG GDP				0.714(0.087)***	0.559(0.061)***
LE65F				0.021(0.020)	0.067(0.014)***
LE65M				-0.038(0.024)	-0.029(0.016)*
FLFPR				0.001(0.004)	0.005(0.002)*
UNEMP				-0.002(0.002)	-0.004(0.001)***
ALCCON				-0.008(0.006)	-0.001(0.004)
TOBCON				0.00006(0.00002)***	0.00004(0.00001)***
CEILHO					-
PUHES					0.009(0.001)***
GATE					-
PUBINT					-
PUBCONTR					-
SALARYGP					-0.110(0.037)***
CAPGP					-0.102(0.031)***
GLOBALHO					0.006(0.013)
CASEHO					-0.098(0.026)***
COPAYGP					0.061(0.035)*
COPAYHO					-0.021(0.019)
FREEGP					0.013(0.036)
FREEHO					0.045(0.044)
PHYSH					-0.00099(0.00039)**
DIALY					0.001(0.0005)***
TOMSCA					0.003(0.001)**
BEDS					0.077(0.007)***
AUSTRIA		-0.013(0.027)	0.083(0.021)***	0.008(0.019)	-0.177(0.034)***
BELGIUM		0.016(0.027)	0.105(0.021)***	0.034(0.029)*	-0.030(0.029)
DENMARK		0.155(0.027)***	0.272(0.021)***	0.175(0.031)***	0.163(0.033)***
FINLAND		0.091(0.027)***	-0.045(0.022)**	-0.078(0.036)**	-0.072(0.034)**
FRANCE		0.186(0.029)***	0.265(0.021)***	0.221(0.040)***	-0.027(0.035)
GERMANY		0.194(0.028)***	0.331(0.022)***	0.292(0.023)***	0.022(0.037)
GREECE		-0.287(0.028)***	-0.344(0.021)***	-0.113(0.053)**	0.171(0.042)***
IRELAND		0.195(0.036)***	-0.201(0.035)***	-0.151(0.045)***	0.107(0.042)**

ITALY		0.012(0.029)	0.080(0.022)***	0.100(0.027)***	0.125(0.034)***
LUXEMBOURG		0.268(0.027)***	0.163(0.021)***	-0.122(0.047)***	-0.546(0.042)***
NETHERLANDS		0.293(0.029)***	0.114(0.024)***	0.036(0.033)	0.159(0.035)***
PORTUGAL		-0.387(0.029)***	-0.560(0.023)***	-0.228(0.048)***	0.024(0.053)
SPAIN		-0.348(0.028)***	-0.431(0.021)***	-0.207(0.041)***	0.046(0.058)
SWEDEN		-0.112(0.036)***	0.290(0.035)***	0.189(0.052)***	0.111(0.057)*
UK		-0.263(0.029)***	-0.123(0.023)***	-0.157(0.023)***	-0.077(0.038)**
TIME TREND			0.025(0.001)***	0.015(0.002)***	0.015(0.002)***
R^2 / R^2_{ADJ}	0.41 / 0.41	0.83 / 0.82	0.91 / 0.90	0.94 / 0.94	0.98 / 0.98
R^2 / R^2_{ADJ} (model with country dummies only)			0.62 / 0.61		
R^2 / R^2_{ADJ} (model with country dummies and time trend only)			0.89 / 0.89		

Note: Significance marked by ***(1%), **(5%), *(10%).

Dependent variable is log (THEPC).

CEILHO only varied for Austria and Belgium (from 1 to 0), and for Finland and Italy (from 0 to 1). For Denmark, Germany and the Netherlands it was a constant 0. For the remaining countries it was missing.

GATE assumed constant value 0 for Belgium, France, Germany, Greece and Luxembourg, and 1 for the remainder.

PUBINT assumed constant value 0 for Austria, Belgium, France, Germany, Greece, Luxembourg, Netherlands and Portugal, and 1 for the remainder.

PUBCONTR assumed constant value 1 for Austria, Belgium, Germany, Luxembourg and Netherlands, and 0 for the remainder.

Table 5. Correlation matrix for key variables and institutional factors, EU15

	THEPC	GDP	AGE0-5	AGE65-74	AGE75+
PUHES	0.38	0.52	0.05	0.05	0.22
SALARYGP	-0.28	-0.35	-0.08	0.27	0.02
CAPGP	-0.09	-0.06	-0.02	-0.08	-0.01
GLOBALHO	-0.32	-0.23	0.33	-0.25	-0.43
CASEHO	0.12	0.14	-0.23	0.27	0.22
COPAYGP	-0.01	0.09	0.33	-0.13	-0.09
COPAYHO	0.34	0.28	0.22	-0.07	0.11
FREEGP	0.41	0.36	-0.19	0.17	0.22
FREEHO	0.44	0.31	-0.02	-0.02	0.01
PHYSH	-0.10	-0.19	-0.22	0.22	0.16
DIALY	0.40	0.35	-0.49	0.39	0.37
TOMSCA	0.43	0.53	-0.34	0.31	0.34
BEDS	0.31	0.29	-0.20	0.02	-0.02

Note: Data are identical to those used for Table 4.

6.3 Results from EU11 countries

6.3.1 Demographic variables

For the EU11, the results seem to follow similar patterns as for the EU15, but the results regarding the effects of age differ. The results are collated in Table 6.

Turning first to age 0-5, the simple relationship to health expenditure is provided by model (1) and turns out to be negative. However, when controlling for unconditional differences across countries, the effect shifts to significantly positive. This observation seems to indicate a potentially spurious cross-country relation between age 0-5 and health expenditure, as countries with high proportions of 0-5 year-olds have low health expenditures for reasons unrelated to age. The positive effect seems to be robust toward inclusion of the time trend (model 3). While it loses significance when controlling for GDP and population characteristics only (model 4), it seem to regain significance when further controlling for institutional and technology variables (model 5). This indicates that the impact of the institutional variables fuel the direct effect of age 0-5.

A similar spurious cross-country relationship seems to exist for health expenditure and those aged 65-74, where a negative relationship found for the simple model (1) turns to positive when controlling for cross country heterogeneity (model 2). This positive effect is relatively stable and remains significant when controlling for the time trend (model 3), GDP and population characteristics (model 4) and including institutional and technology characteristics (model 5.

For the age group 75+, a positive effect on health expenditure is found throughout. This holds true for the simple model (1) as well as when controlling for country heterogeneity (model 2), the time trend (model 3) and GDP and population characteristics (model 4). However, the effect is reduced and turns out to be insignificant when account is taken of institutional and technology variables (model 5).

Thus, to summarise, when properly controlling for unconditional country heterogeneity and increasing health expenditure over time, there is evidence of positive relationships between health expenditure and the age groups 0-5, 65-74 and 75+. These effects are robust toward control for GDP and population characteristics. With the exception of age 75+, which turns out to be insignificant, these are robust toward inclusion for institutional and technology characteristics.

6.3.2 Other demand side variables

The relationship between GDP and health expenditure seems to be surprisingly weak for the EU11 with negative income elasticities. However it is not statistically significant.

The unemployment rate has a statistically significant negative association with expenditure while alcohol consumption shows a positive association. The rest of the demand side variables show no significant association with expenditure.

6.3.3 Supply side variables

Among supply side variables only the gate keeper variable is positively associated with expenditure. Significantly negative association is found for public expenditure as a share of total, salary and capitation payment of GPs. The rest are insignificant.

As opposed to what was found for the EU15 countries, the effects of the age variables on THEPC seem to be robust to the inclusion of institutional variables (model 5). Similar to what was found for the EU15, the simple correlations between the age variables and the institutional variables are relatively large for those of the latter which significantly influence THEPC.

However, from a comparison of model 5 for the EU15 and the EU11, it can be seen relatively few institutional variables significantly impact on the THEPC for the EU11. Therefore, the direct effects of the age variables on THEPC make up a relatively larger part of their total effect, while their indirect effects via the institutional variables are relatively modest. In particular, indicators of capacity and technology are not significantly associated with expenditure.

*Table 6. Regressions for EU11 countries (N=11, T=14, N*T=154). Dependent variable: log THCEPC*

	(1)	(2)	(3)	(4)	(5)
INTERCEPT	10.40(0.85)***	1.96(0.78)**	1.96(0.78)**	-2.70(1.79)	-0.224(1.77)
AGE 0-5	-0.366(0.061)***	0.078(0.040)*	0.105(0.045)**	0.112(0.047)**	0.179(0.046)***
AGE 65-74	-0.305(0.060)***	0.291(0.044)***	0.257(0.052)***	0.347(0.061)***	0.219(0.072)***
AGE 75-	0.156(0.070)**	0.281(0.054)***	0.231(0.066)***	0.226(0.072)***	0.071(0.099)
LOG GDP				-0.081(0.136)	-0.037(0.135)
LE 65 F				0.155(0.132)	0.052(0.116)
LE 65 M				0.124(0.116)	0.141(0.115)
FLFPR				0.020(0.031)	0.020(0.027)
UNEMP				-0.019(0.006)***	-0.018(0.006)***
ALCCON				0.061(0.013)***	0.028(0.015)*
TOBCON				-0.00005(0.00007)	0.00008(0.00007)
CEILHO					-
PUHES					-0.0098(0.003)**
GATE					0.139(0.083)*
PUBINT					0.057(0.088)
PUBCONTR					0.031(0.082)
SALARYGP					-0.462(0.076)***
CAPGP					-0.591(0.096)***
GLOBALHO					0.081(0.049)
CASEHO					0.005(0.062)
COPAYGP					0.058(0.058)
COPAYHO					-0.147(0.092)
FREEGP					-
FREEHO					0.053(0.132)
PHYSH					-0.006(0.009)
DIALY					0.0027(0.006)
TOMSCA					0.020(0.020)
BEDS					0.022(0.048)
CYPRUS		-	-	-	-
CZECH REP		0.513(0.060)***	0.575(0.077)***	0.087(0.134)	0.178(0.229)
ESTONIA		-0.400(0.066)***	-0.320(0.090)***	-0.253(0.100)**	-0.221(0.169)
HUNGARY		0.100(0.085)	0.202(0.116)*	0.016(0.143)	0.555(0.227)**
LATVIA		-0.961(0.074)***	-0.888(0.093)***	-0.839(0.098)***	-0.580(0.111)***
LITHUANIA		-0.484(0.066)***	-0.483(0.066)***	-0.747(0.089)***	-0.637(0.173)***
MALTA		-	-	-	-
POLAND		0.434(0.062)***	0.381(0.074)***	0.447(0.177)**	0.345(0.227)

SLOVAKIA		0.779(0.066)***	0.709(0.085)***	0.661(0.146)***	0.651(0.160)***
SLOVENIA		0.759(0.061)***	0.798(0.068)***	0.420(0.143)***	0.520(0.161)***
BULGARIA		-1.239(0.097)***	-1.099(0.145)***	-0.941(0.241)***	-0.263(0.324)
ROMANIA		-0.892(0.059)***	-0.902(0.059)***	-0.729(0.175)***	-0.887(0.253)***
TURKEY		1.390(0.197)***	1.026(0.345)***	1.877(0.523)***	0.339(0.710)
TIME TREND			0.017(0.013)	-0.014(0.015)	0.015(0.024)
R^2 / R^2_{ADJ}	0.26 / 0.25	0.89 / 0.88	0.90 / 0.89	0.93 / 0.92	0.96 / 0.95
R^2 / R^2_{ADJ} (model with country dummies only)			0.77 / 0.75		
R^2 / R^2_{ADJ} (model with country dummies and time trend only)			0.88 / 0.87		

Note: Significance marked by ***(1%), **(5%), *(10%).

Dependent variable is log (THEPC).

Cyprus and Malta were omitted, as THEPC was only available for one and three years respectively.

Only observations from 1990 and onwards included.

CEILHO only varied for Lithuania (from 0 to 1). For the Czech Republic, Estonia, Hungary, Malta and Slovenia it was a constant 0. For Slovakia, Romania and Turkey it was a constant 1. For the remaining countries it was missing.

FREEGP was equal to FREEHO throughout.

Table 7. Correlation matrix for key variables and institutional factors, EU11

	THEPC	GDP	AGE0-5	AGE65-74	AGE75+
PUHES	-0.23	-0.07	-0.18	0.34	0.32
GATE	0.23	0.29	-0.47	0.38	0.32
PUBINT	-0.49	-0.38	0.23	-0.01	0.04
PUBCONTR	0.64	0.66	-0.44	0.30	0.35
SALARYGP	-0.36	-0.31	0.30	-0.11	-0.07
CAPGP	0.12	0.10	-0.26	0.33	0.34
GLOBALHO	-0.33	-0.44	0.51	-0.46	-0.42
CASEHO	0.27	0.36	-0.19	0.18	0.24
COPAYGP	0.09	0.11	-0.51	0.37	0.19
COPAYHO	0.10	0.20	-0.44	0.35	0.26
FREEHO	0.45	0.33	-0.01	-0.16	0.05
PHYSH	0.33	0.16	-0.14	-0.06	-0.08
DIALY	0.38	0.50	-0.66	0.41	0.39
TOMSCA	0.28	0.36	-0.46	0.23	0.18
BEDS	-0.03	0.10	-0.07	0.32	0.49

Note: Data are identical to those used for Table 6.

6.4 Summary of incremental effects

The isolated effect on expenditure per capita of the variation of each one of the explanatory variables is illustrated in Table 8. The two upper rows show average income and health care expenditure per capita in EU15 and EU11 countries. Variation is indicated as either 1% change, 1% unit change, or a 0-1 change for dummy variables used to characterise health care systems.

Calculations are based on the average effects across countries as shown in Table 4 and 6. Not unexpectedly, the largest effect stems from change in income in EU15 countries.

Table 8. Effect of incremental variation in explanatory variables on total health care expenditure per capita in EU15 and EU11 countries, measured in US PPP dollars, 2000 prices. Based on model 5, GDP and total health care expenditure year per capita 1990

		EU15	EU11
GDP	*GDP per capita*	*22379*	*8316*
THEPC	*Total health care expenditure per capita*	*1667*	*421*
Variables:	**Increase by:**		
AGE 0-5	1% unit	- 0.12	0,75***
AGE65-74	1 % unit	0.12	0,92***
Age 75+	1 % unit	-0.18	0.30
GDP/capita	1%	9.32***	-0,16
LE 65 F	1 year	1.12***	0.22
LE 65 M	1 year	-0.48*	0,59
FLFPR	1% unit	0.08	0.08
UNEMPL	1% unit	-0.07	- 0.08***
ALCCON	1 litre per capita	-0.02	0.12*
TOBCON	100 cigarettes per capita	0.0009***	0.0003
PUHES	1% unit	0.15***	- 0.04**
GATE	1 = Physicians as gatekeepers	-	0.59*
PUBINTEG	1 = Public integrated health care system	-	0.24
PUBCONTR	1 = Public contract health care system	-	0.13
SALARYGP	1 = Salaried GPs	-1.83***	-1.94***
CAPGP	1 = Capitation payment for GPs	-1.70***	2.49***
GLOBALHO	1 = Global hospital budgets	0.10	0.34
CASEHO	1 = Case-based hospital budgets	-1.63***	0.02
COPAYGP	1 = Co-payment for GP visits	1.02*	0.24
COPAYHO	1 = Co-payment for hospital treatment	-0.35	- 1.61
FREEGP	1 = Free choice of hospital	0.22	-
FREEHO	1 = Free choice of hospital	0.75	0.22
PHYSH	1 physician / 1,000 people	-0.02**	- 0.03
DIALY	1 patient / 100,000 people	0.02***	0.001
TOMSCA	1 unit /1,000,000 people	0.07**	0.08
BEDS	1 bed / 1,000 people.	1.28***	0.09

7. Discussion

7.1 Effect of ageing

Different results were found in the two groups of countries. In the EU15, the age effects seem to be mediated by institutional and technology characteristics, as they turn insignificant when controlling for these, while for the case of EU11 the age groups 0-5 and 65-74 remain significant. Whether such a mediating effect has actually occurred or whether there are other reasons for institutional variables accounting for much of the variation that ageing accounts for in a simpler model cannot be tested in this paper. While for the EU15 there is a strong partial (negative) correlation between financing hospitals with global budgets and the relative size of the 75+ years age group (Table 5), it is not obvious that this is in any way related to ageing. The strong partial association between technology indicators may result from GDP being a confounder as richer countries have a higher share of the population that are older and can afford to invest in technology. Thus, the results should be interpreted cautiously.

Going into more detail, for the EU15 and the EU11, an increase in the 65-74 year-old age group as a share of the population is positively associated with health care expenditure per capita. This effect is relatively weaker in the EU15 than in the EU11 and becomes insignificant for the EU15 when institutional and technology characteristics are included. For the 0-5 year-old age group, the association to health expenditure is positive as for the EU11 countries, while it is negative for the EU15 countries, although the association is insignificant and small for the latter when institutional and technology characteristics are included. For the 75+ age group, the association with health expenditure turned out to be positive for the EU11 group and negative for the EU15 group, but insignificant for both groups when institutional and technology variables were included. Thus, it seems in both country groups to be that it is the presence of specific institutional structures and health care technology benefiting old people, rather than the proportion of such people, that governs health care expenditure.

A specific feature of this paper is the distinction between different age groups, especially the inclusion of 65-74 years old and 75+ years old as specific groups. There seems to be some indication of differences with regard to the association between the 75+ year-old age group and total health care expenditure per capita for the two subgroups of countries (model 4). For EU15 countries, an increasing share of the population in the 75+ year-old age group is associated with decreasing health care expenditure per capita, according to our estimates, while it is associated with increasing health care expenditure per capita for EU11 countries. However, the associations are insignificant in model (5). The association between the age groups and expenditure in the EU11 countries is stronger for the age group 64-75 years compared to the older age group. There may be a number of conceivable mechanisms by which this association may differ beyond the supply and demand factors which are already included in the estimations. One possible explanation may be differences in practice variation or treatment patterns. Thus, Moïse et al (2003) concluded from their review of earlier studies that less is spent on health care for the very old than for younger age groups because, on average, they receive less aggressive and less expensive treatments. However, their conclusion was less clear-cut when long-term care was included. A practice style discriminating the older age groups may be more pronounced in EU11 than in the richer EU15 countries. It is unclear, though, whether a more aggressive treatment would have a better outcome. A limitation of this paper is that it does not address the question of whether there has been a change in practice style over time, involving a more intensive treatment of older people due to the progress in technology.

Another explanation relates to the data. In principle, health care expenditures should include long-term care according to the OECD definition of health care. As pointed out in Schulz (2005), the inclusion of long-term care may be incomplete for EU11 countries in particular, and this may lead to lower health care expenditures for older people in particular. This data problem may be one explanation why we found a lower coefficient for the 75+ year-old age group compared to the 65-74 year-old age group.

A reason for the relatively low association between health care expenditure per capita and the size of the older 75+ year-old age group for the EU11 countries may be associated with a transition in several countries from a tax-financed system to an insurance-based system in which older people outside the labour market have only limited opportunities to be insured, containing their demand for health care services. The need for health care services may be constrained within certain institutional set-ups and this may explain why the direct effect of AGE75+ becomes insignificant when the institutional variables are included. Within some institutional set-ups, demand pressure from ageing is mediated by the institutional mechanisms. Various types of budget ceiling mechanisms exist within different institutional set-ups, which will contain the impact of demand.

In further studies it might be worthwhile following up on the study of age-related diseases by OECD (2003) and look into diagnoses to see whether there is an age dependency in the incidence of specific health problems and costs of treating them. The hypothesis is that the incidence of health problems with high treatment costs varies by age. Or there may be an age dependency in presenting health problems to professional health care givers as well as in the aggressiveness of treating presented problems. Obviously, this demand side consideration has to be connected to supply side restrictions and prioritisations.

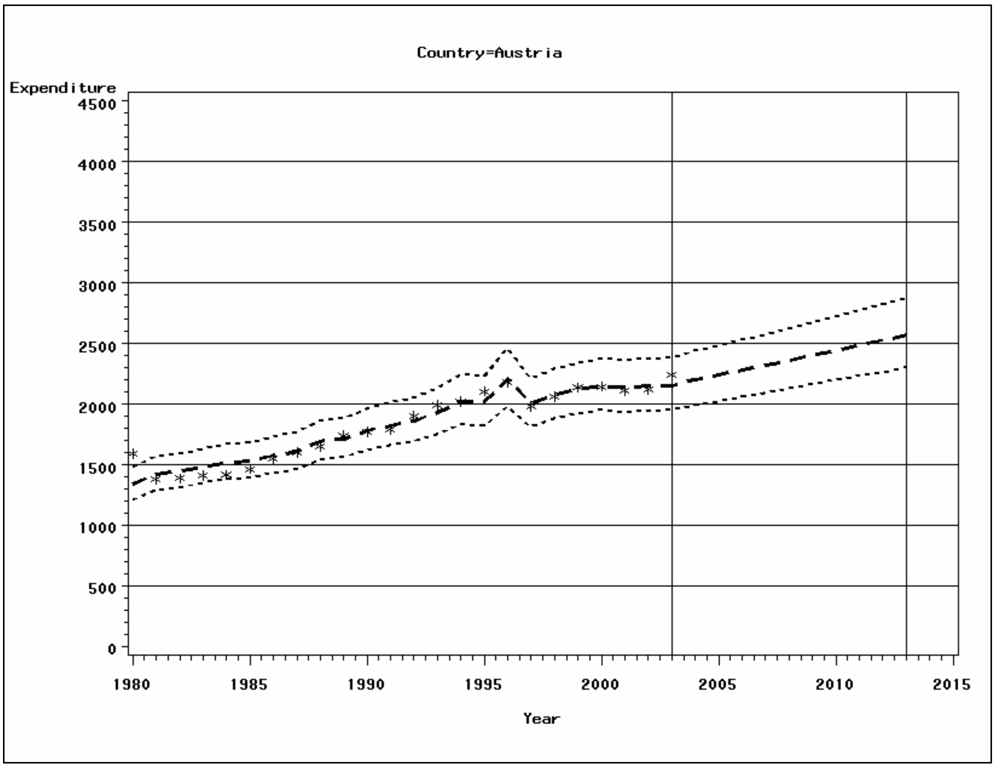
It is worth pointing out that the findings are based on historical data and are a result of former demand pressure and deliberate supply side responses and/or built-in mechanisms in health care systems in Europe.

Some studies reviewed in Gerdham et al. 2000 (Philips, 1986; Engle & Granger, 1987) have pointed out issues related to potential non-stationarity of times series. For this paper, this problem might especially be relevant for the variables GDP and THEPC. In particular, unit roots in these variables may lead to a common trend between them, so that a significant relationship may be spurious rather than substantial. However, as a linear time trend is included, eventual non-stationarities are accounted for – at least up to trend stationarity – so that the results of the regressions are considered to be reliable.

7.2 Using regression results for forecasts

Ten-year forecasts were carried out. The model used is model (5), estimated separately for the EU15 and the EU11 country groups (i.e. model (5) of Tables 4 and 5). For the explanatory variables, extrapolations were inserted for this period. Specifically, ARMA (1,1) extrapolations of each continuous variable (i.e. the variables Age 0-5, Age 65-74, Age 75+, GDP, LE65F, LE65M, FLFPR, UNEMP, ALCCON, TOBCON, PUHES, PHYSH, DIALY, TOMSCA and BEDS) were calculated independently within each country and applied. For a few cases (FLFPR for Slovakia and PUHES for Bulgaria and Romania) the variations of the 1990-2003 series were too small to be able to carry out this exercise. In these cases, the 2003 value was simply applied. For the dummy variables (i.e. the variables GATE, PUBINT, PUBCONTR, SALARYGP, CAPGP, GLOBALHO, CASEHO, COPAYHO, FREEGP, FREEHO, PHYSH, DIALY, TOMSCA, BEDS) the value of 2003 within each country was simply extrapolated.

Figure 2. Health expenditure by country (EU15 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



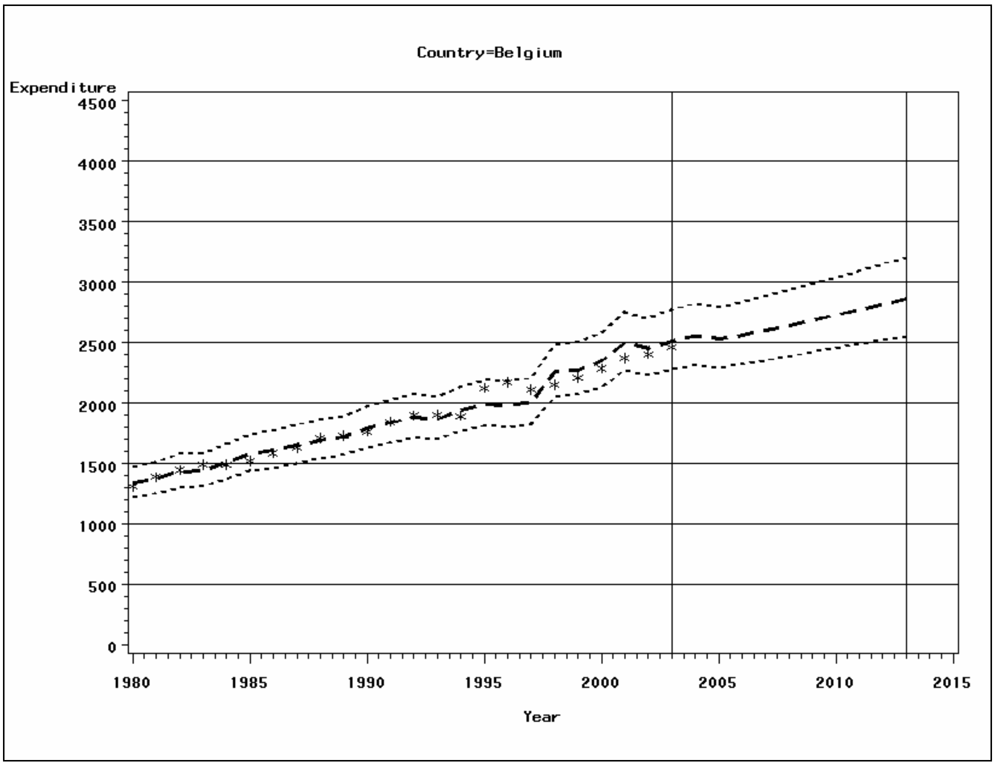
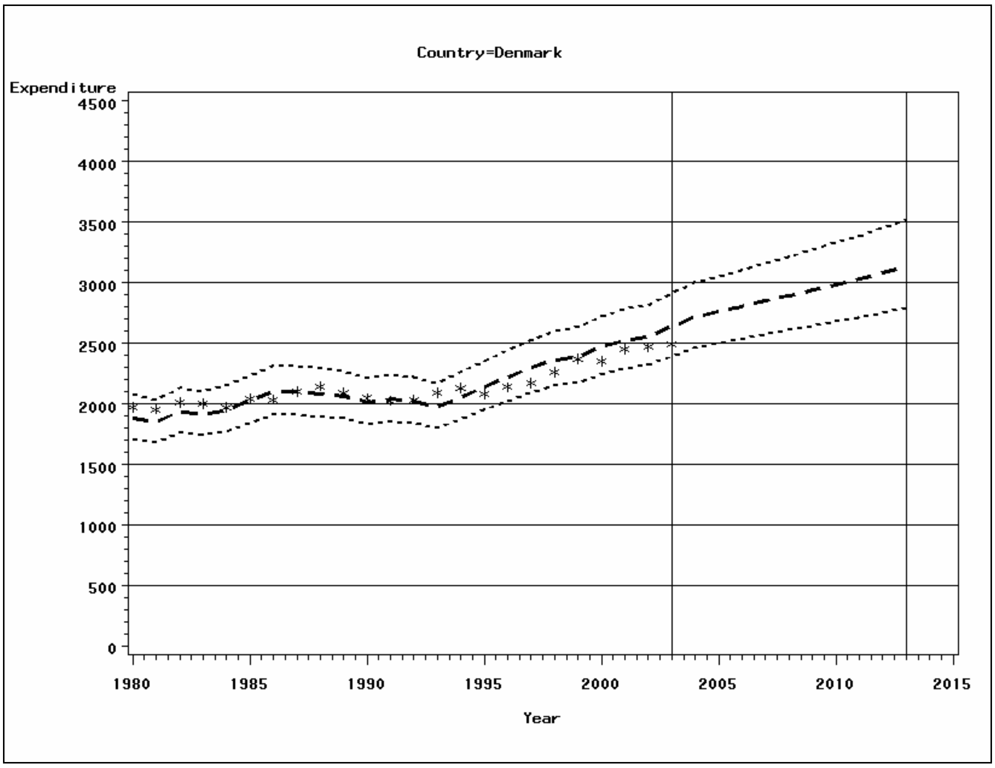


Figure 2 (continued). Health expenditure by country (EU15 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



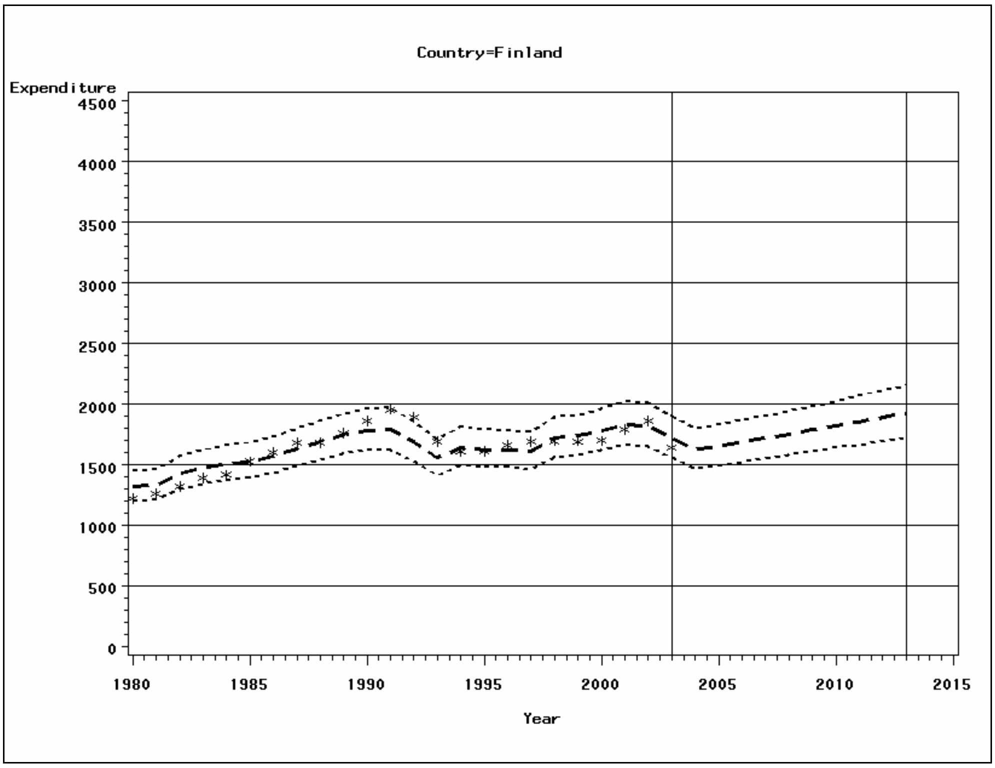
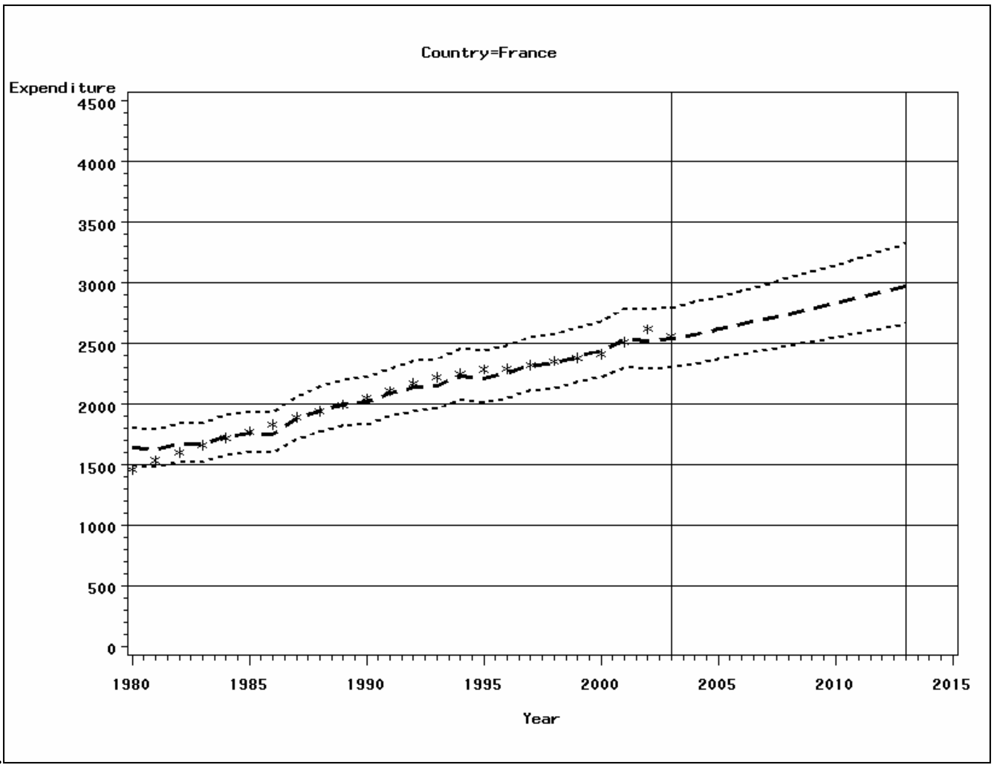


Figure 2 (continued). Health expenditure by country (EU15 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



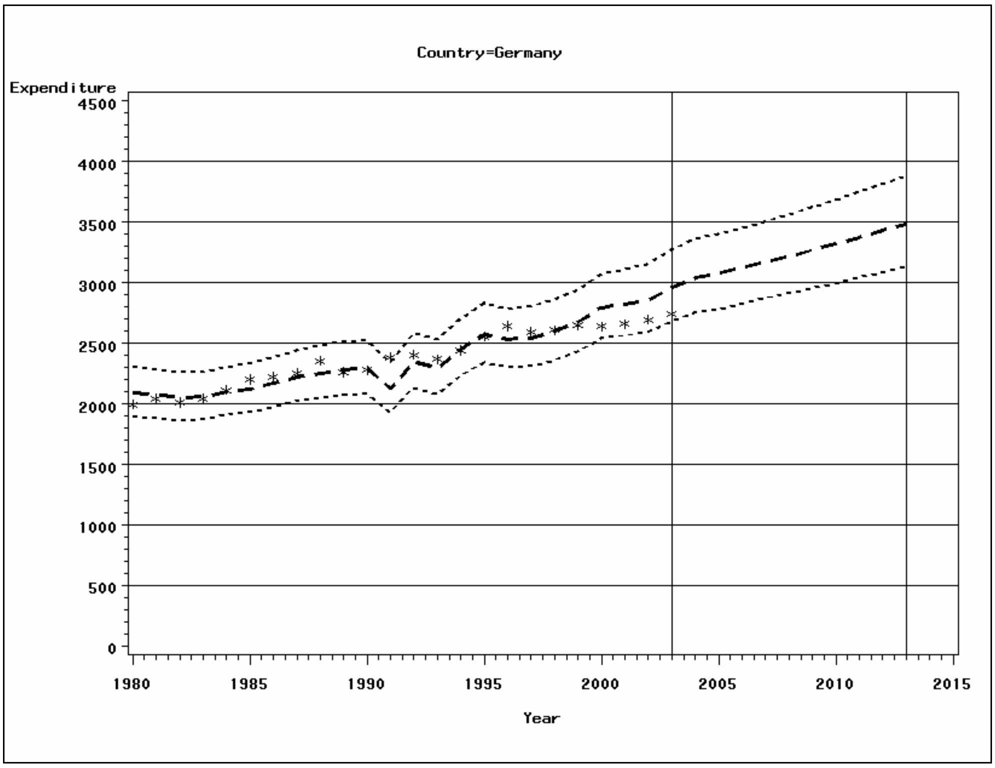
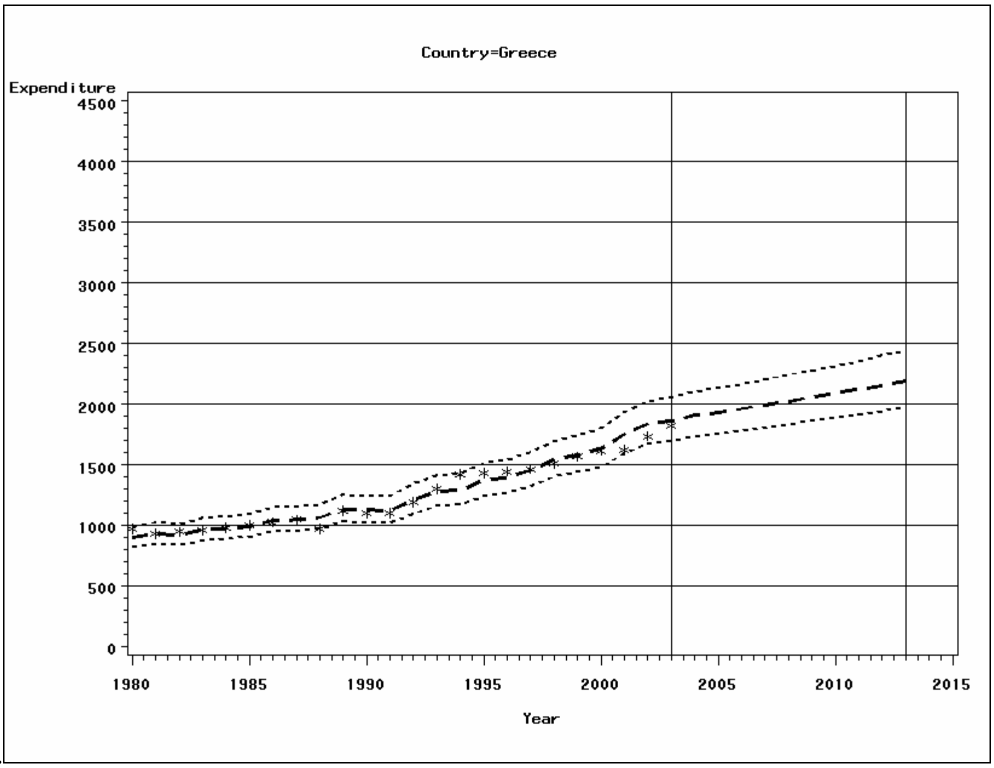
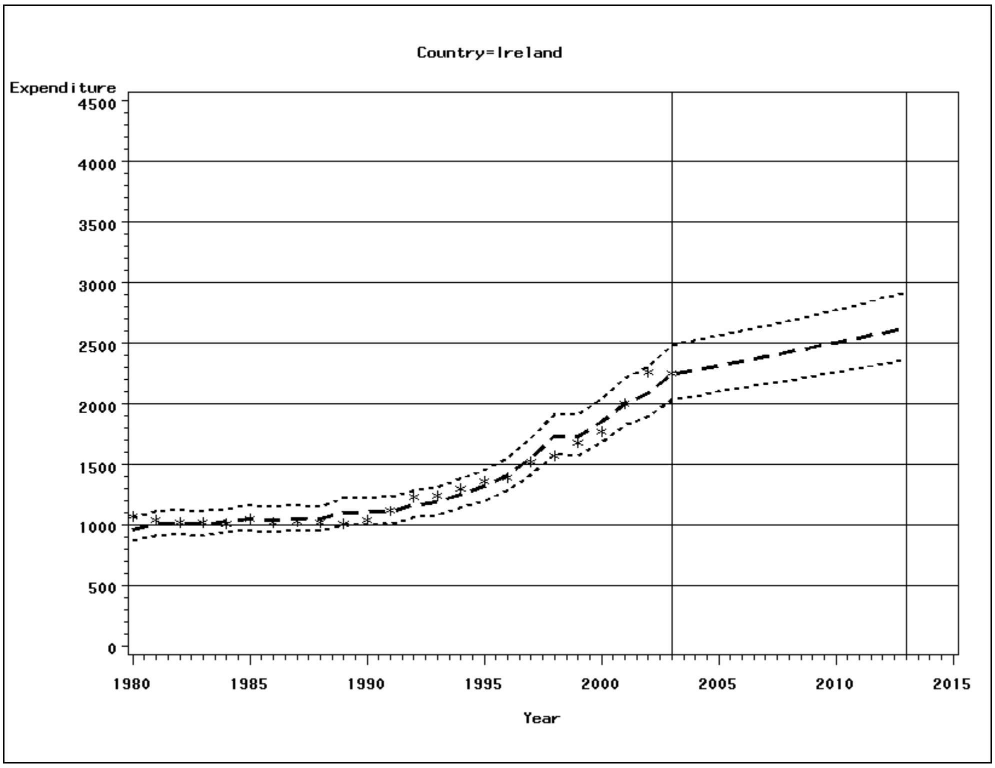


Figure 2 (continued). Health expenditure by country (EU15 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts





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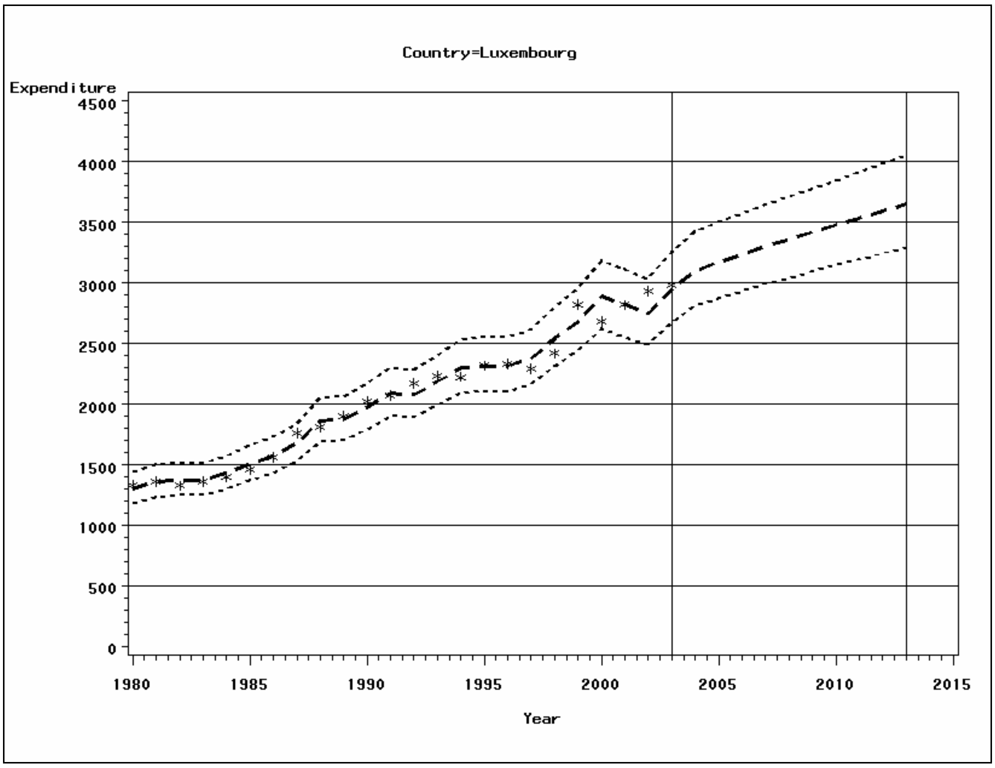
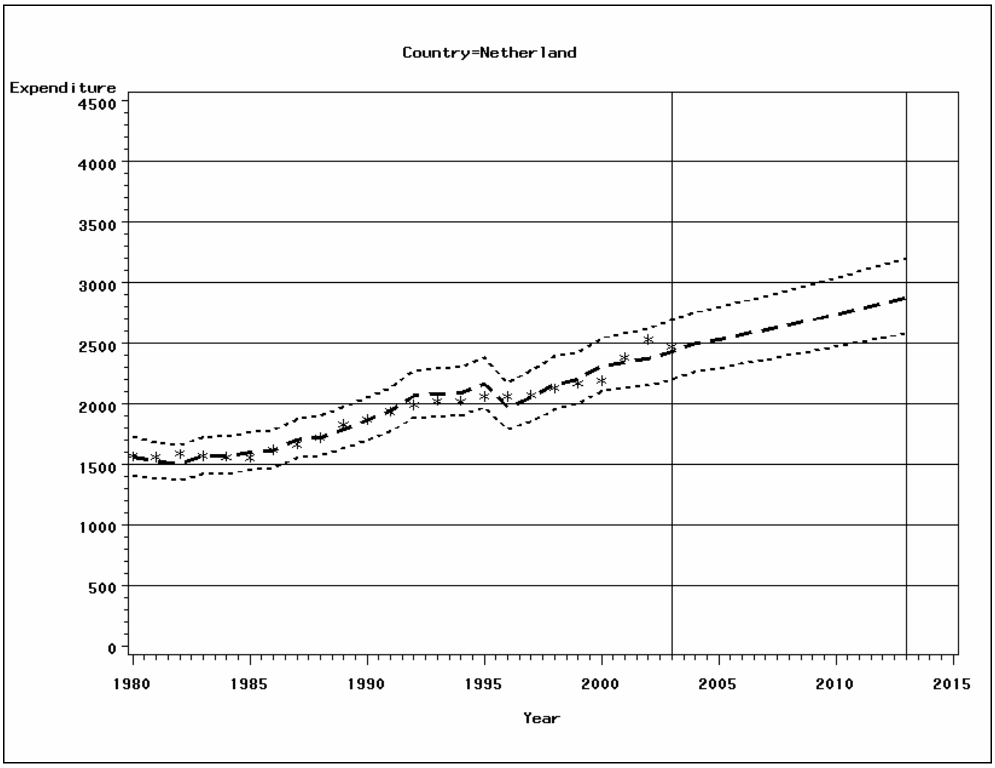


Figure 2 (continued). Health expenditure by country (EU15 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



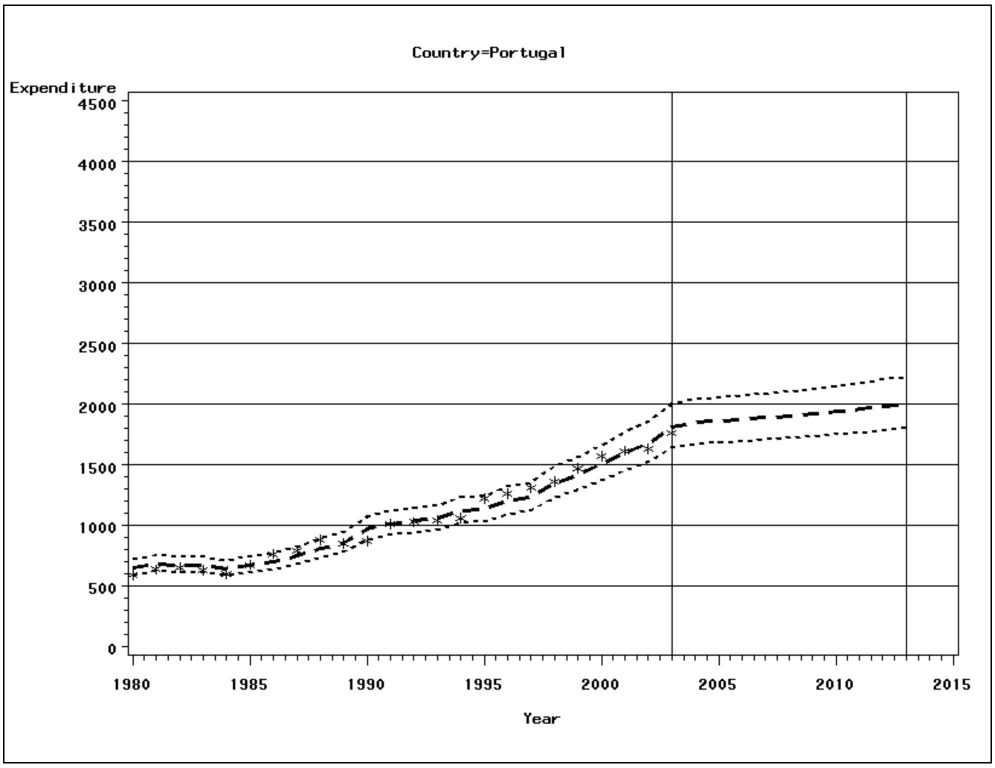
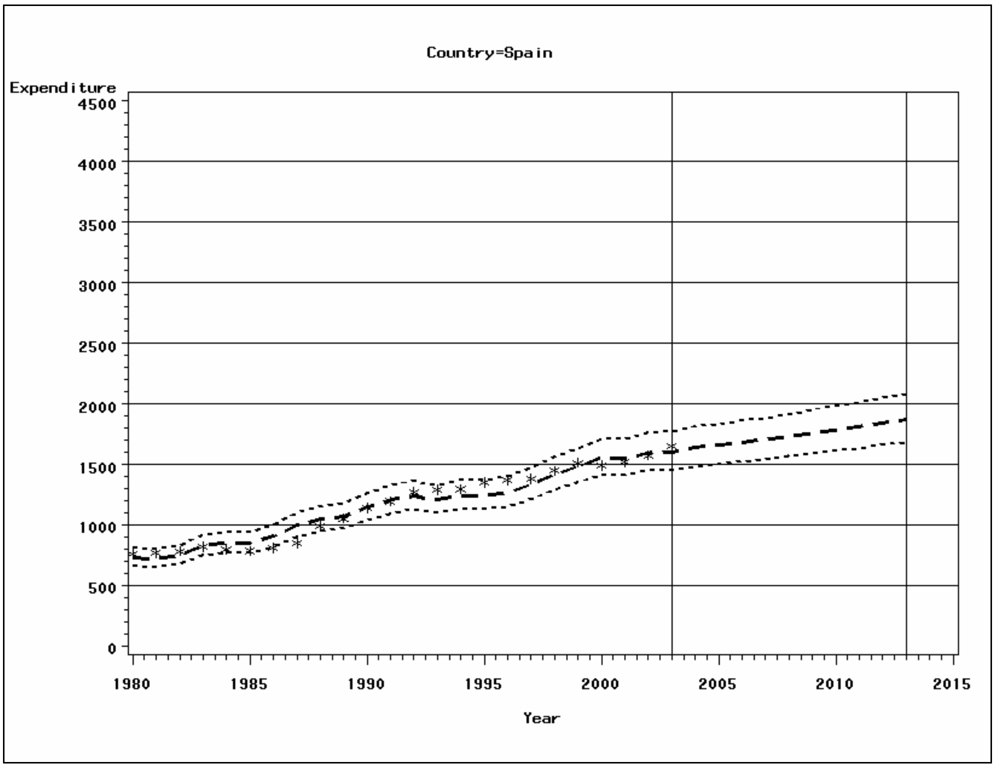


Figure 2 (continued). Health expenditure by country (EU15 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



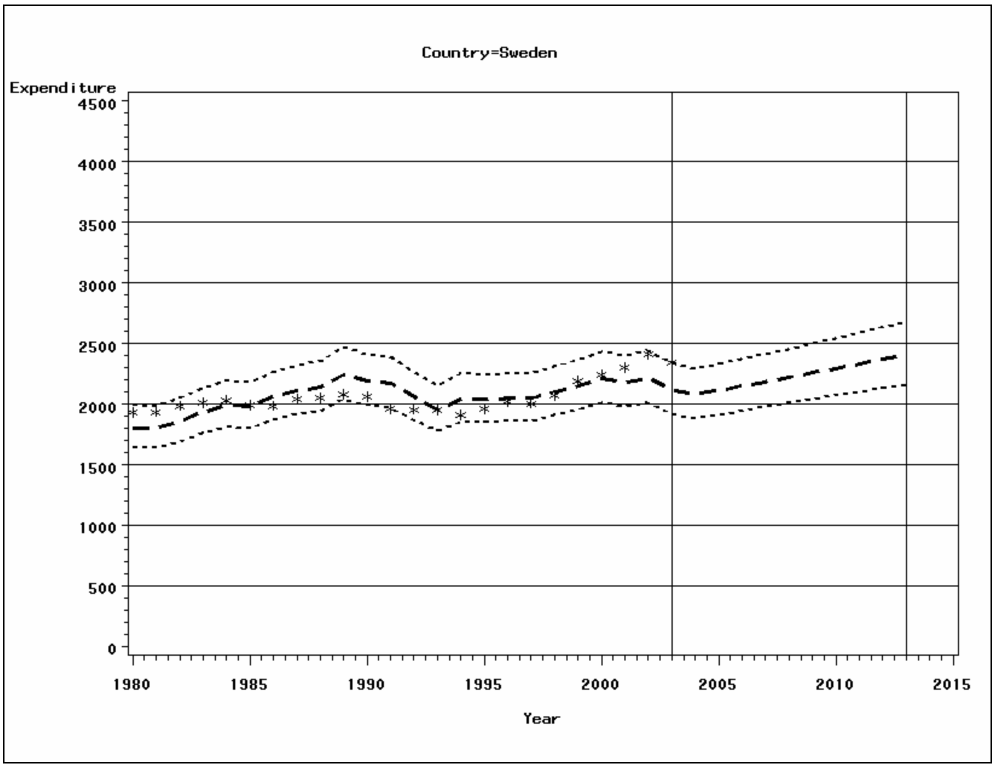


Figure 2 (continued). Health expenditure by country (EU15 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts

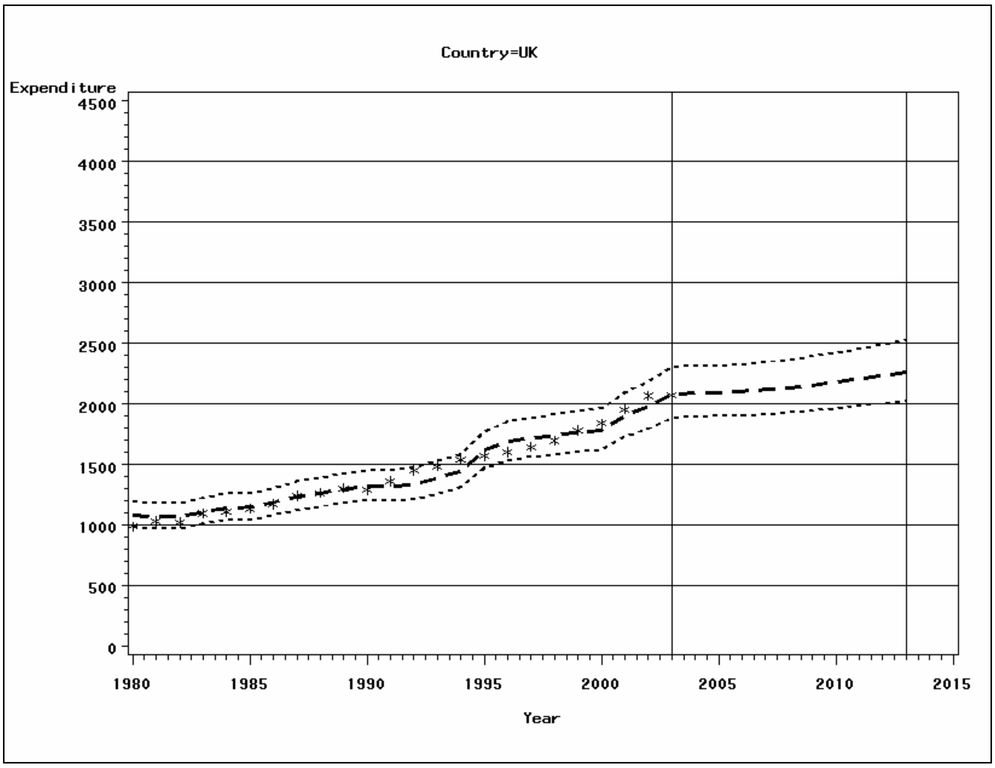
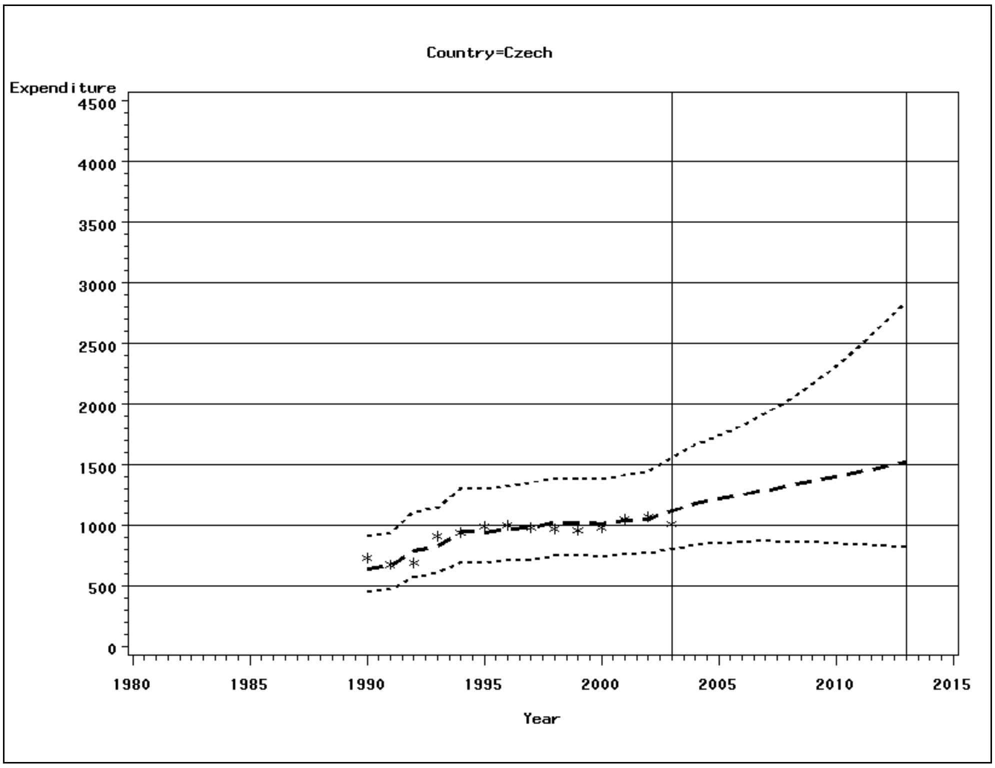


Figure 2 shows the forecasts for the EU15 countries. For the 1980-2003 estimation period, the forecasts seem to fit the observed values (marked by stars) adequately, as these, with few exceptions for the very early years, are well within the 95 percent confidence intervals of the forecasts. Expenditure is expected to increase with varying speeds during the 2004-14 forecast period.

Figure 3. Health expenditure by country (EU11 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



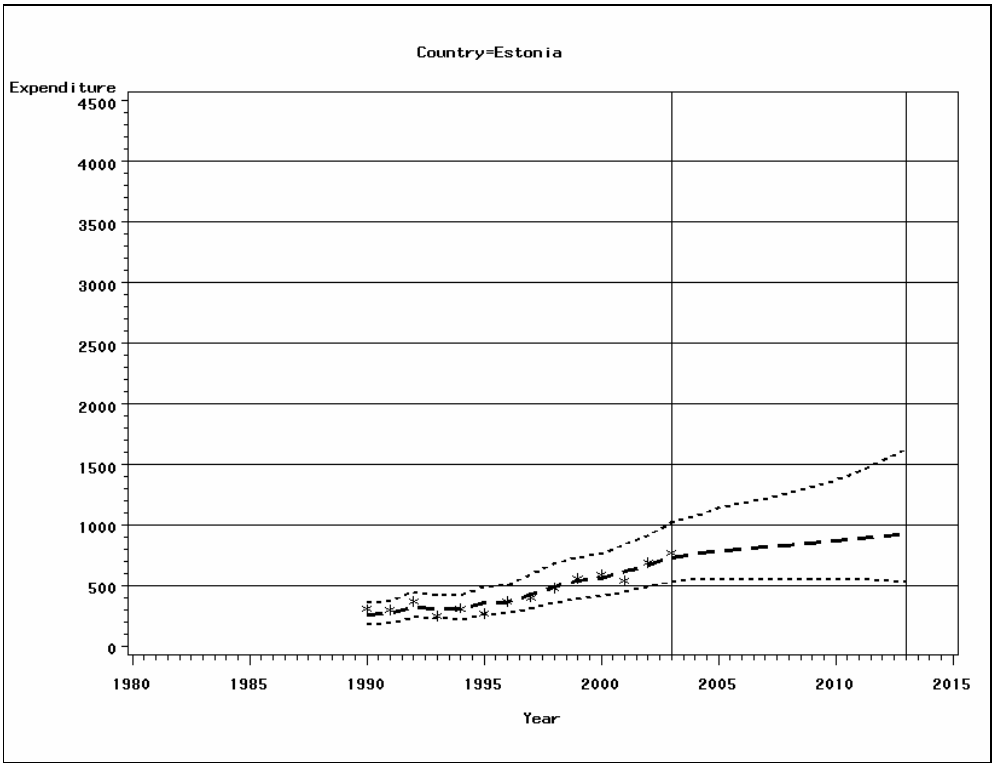
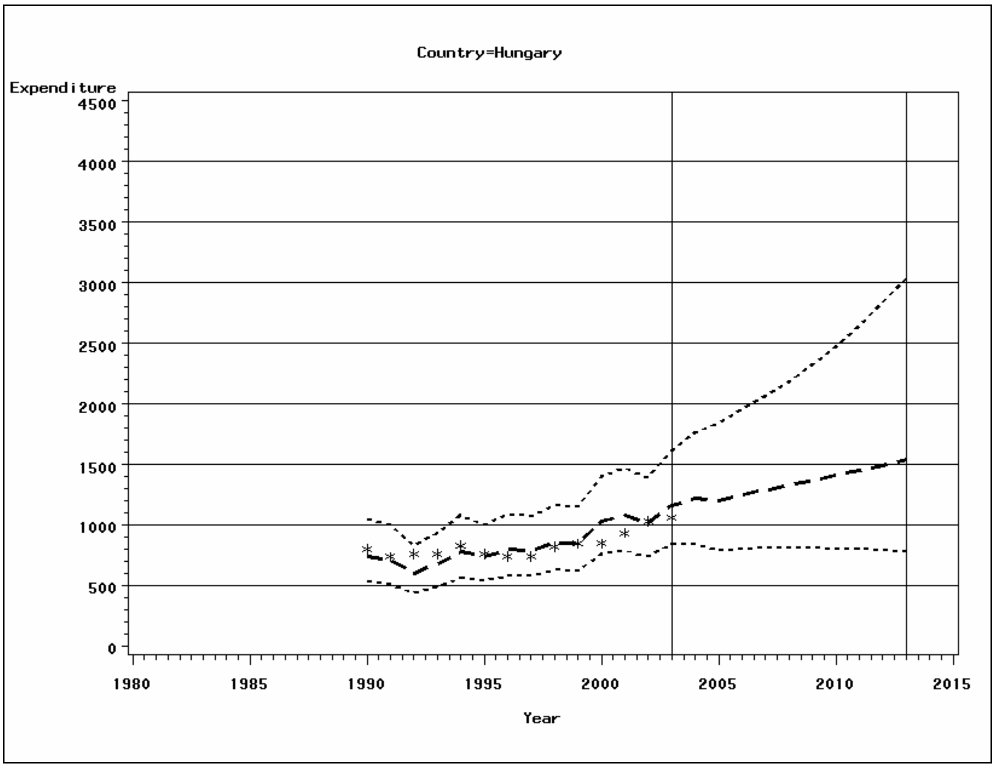


Figure 3 (continued). Health expenditure by country (EU11 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



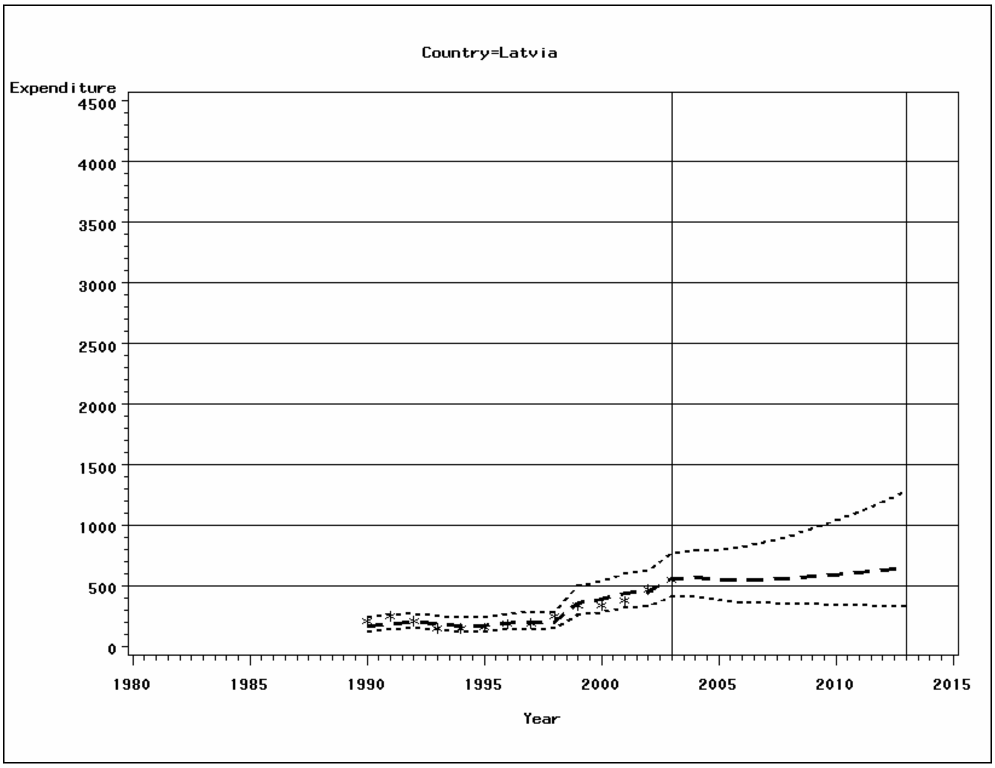
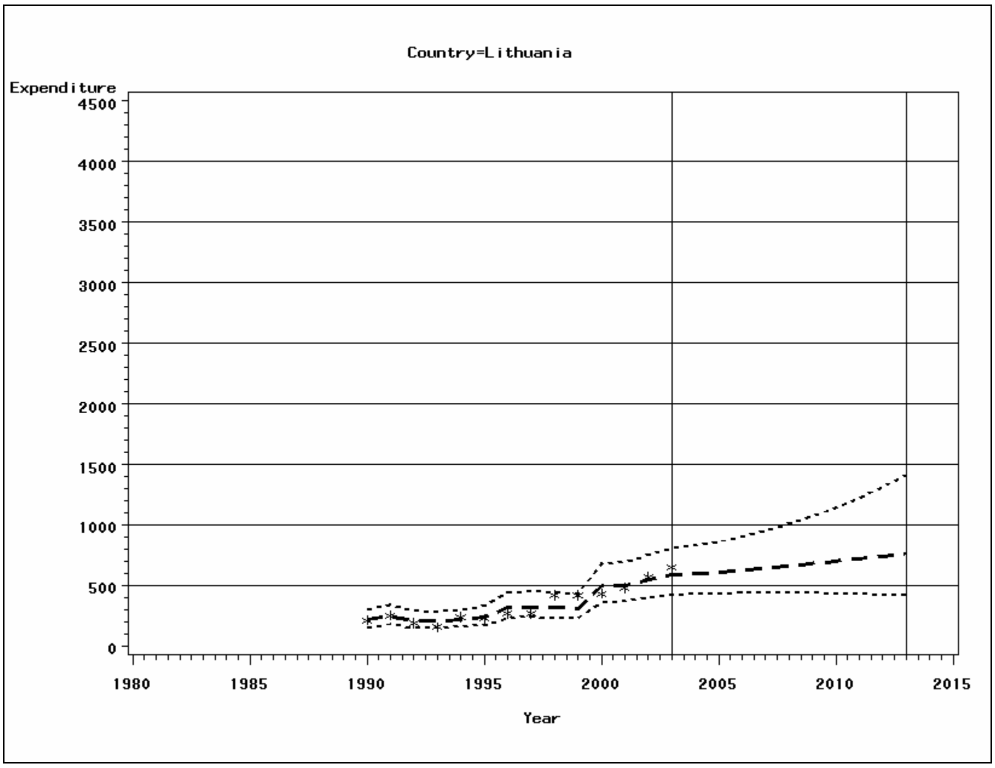


Figure 3 (continued). Health expenditure by country (EU11 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



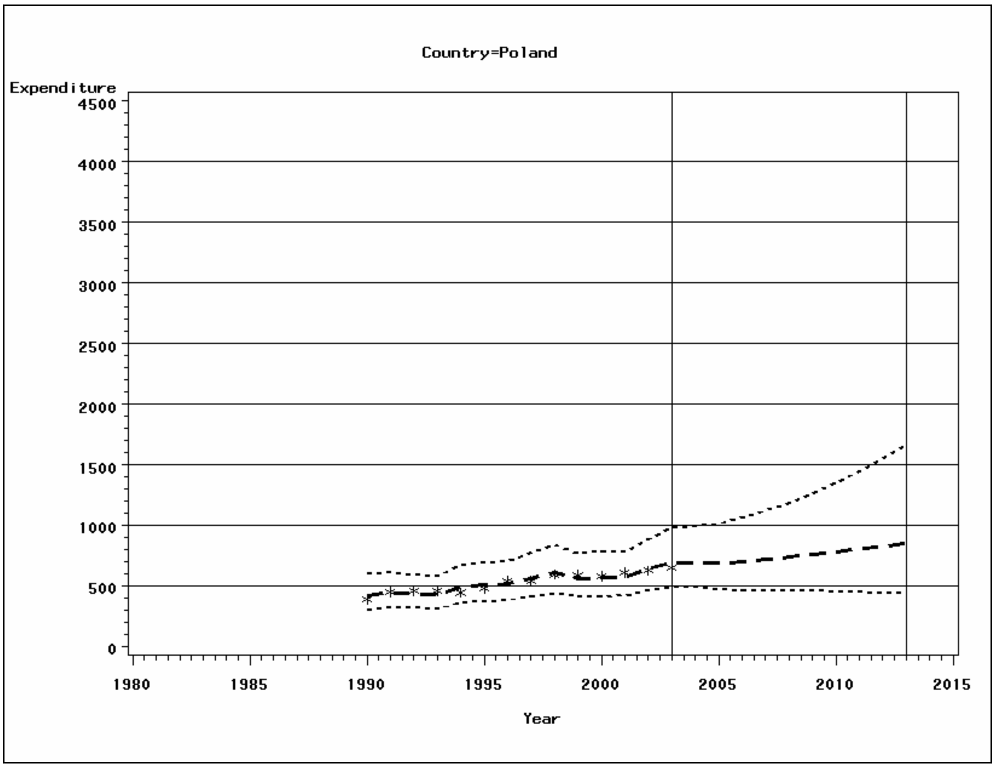
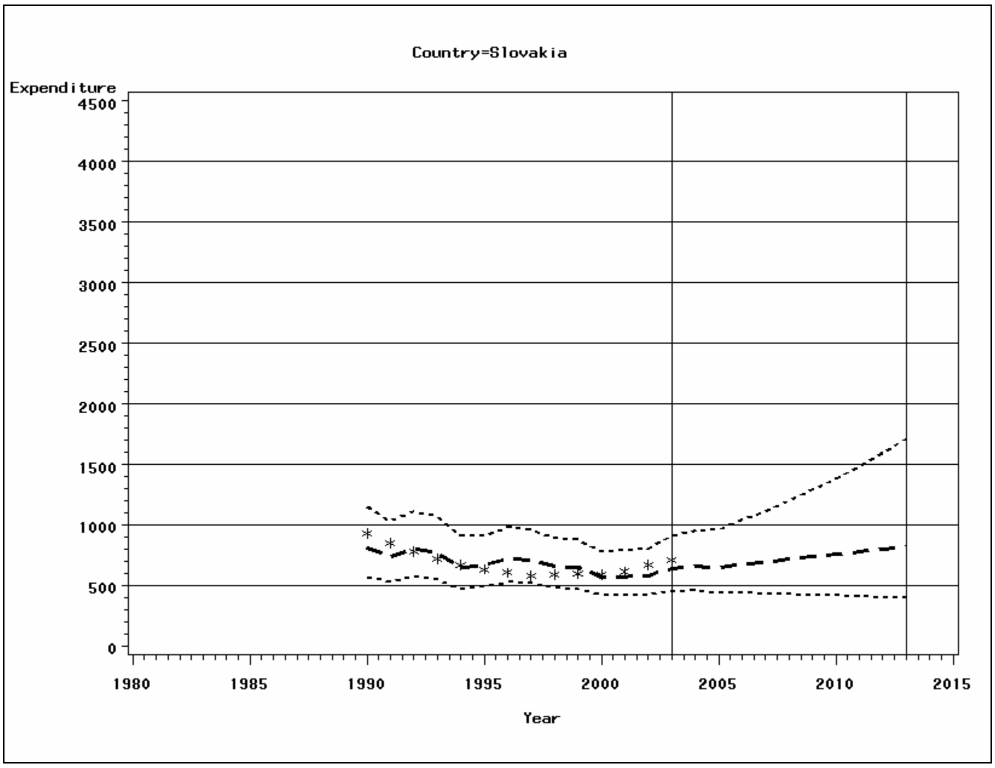


Figure 3 (continued). Health expenditure by country (EU11 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



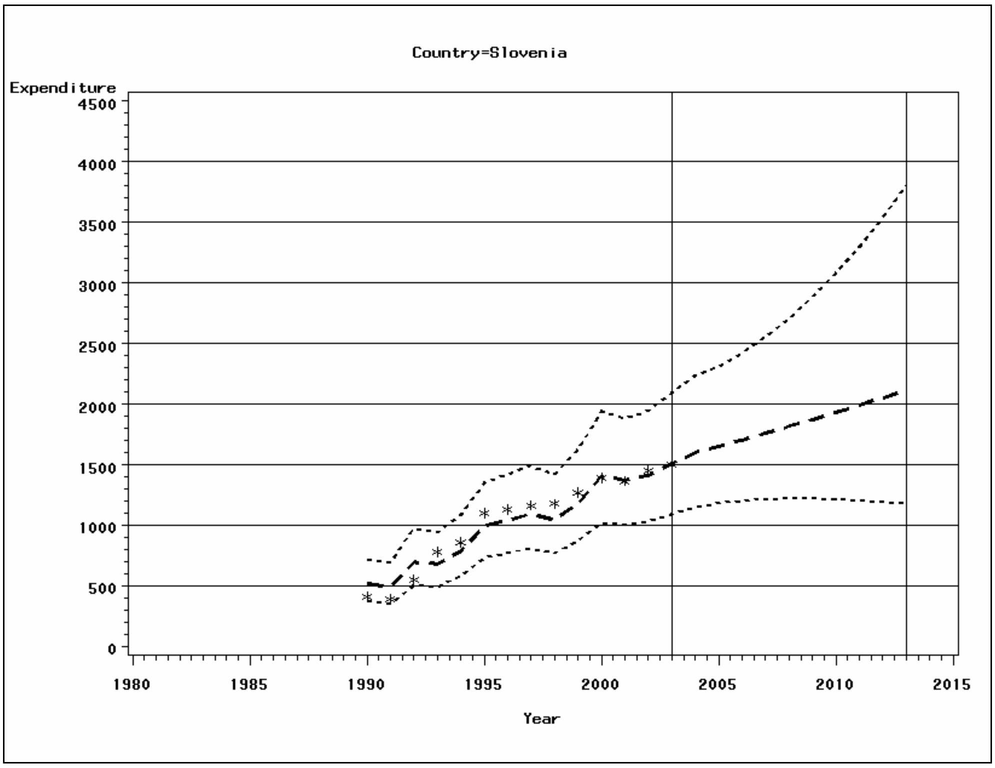
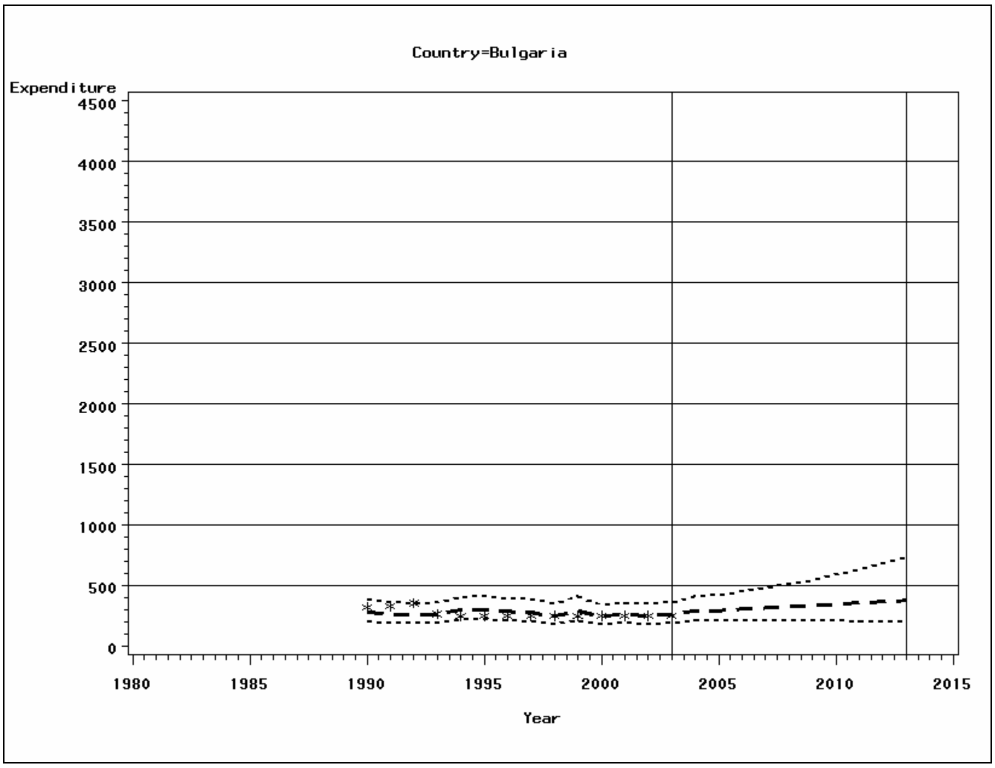


Figure 3 (continued). Health expenditure by country (EU11 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts



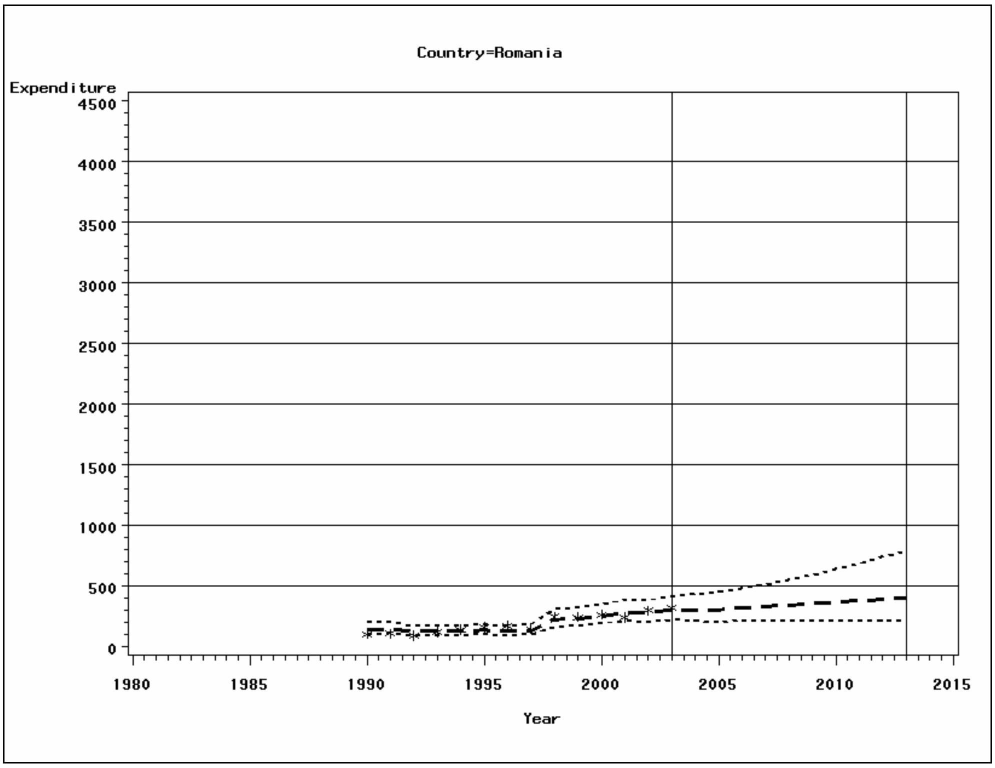


Figure 3 (continued). Health expenditure by country (EU11 countries) – Observed and forecasted values and 95 percent confidence intervals of forecasts

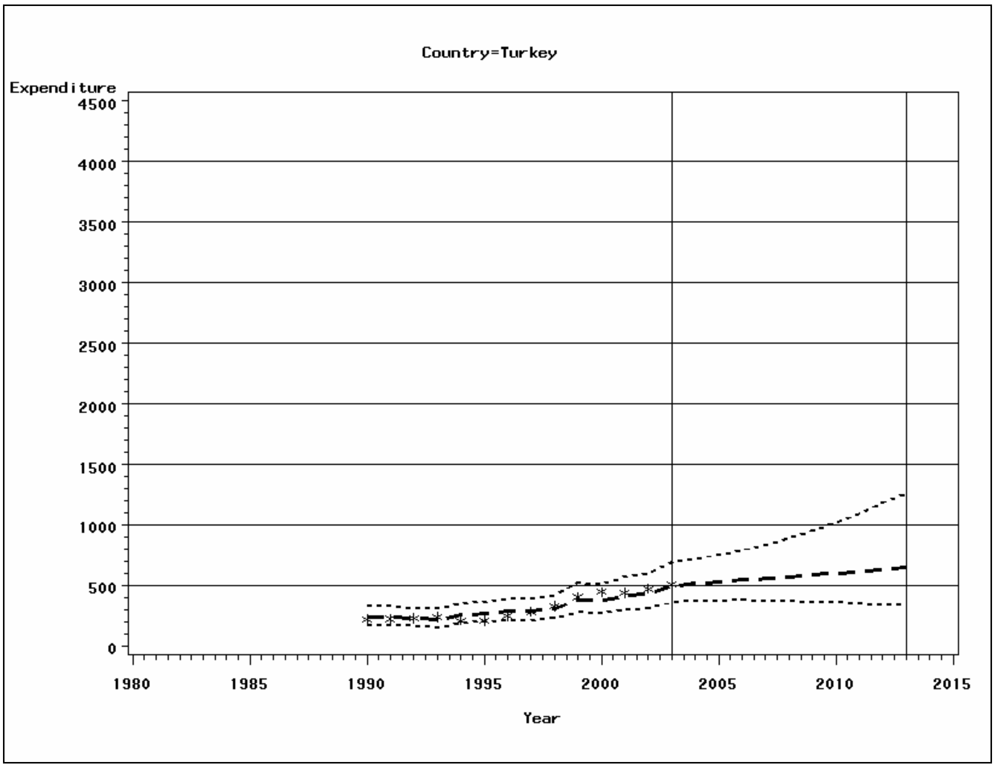


Figure 3 shows the forecasts for the EU11 countries. It is especially noteworthy that the forecast confidence intervals are much broader than for the EU15, which is related to the poorer quality of the EU11 data. Turning to the 2004-13 forecast period, expenditure is expected to increase in all EU11 countries, but to a varying extent. However, it should be noted that there is greatest uncertainty, as reflected by broader confidence intervals, in those countries with the largest expected increase in expenditure.

Finally, it should be noted that these forecasts were mostly intended to serve as illustrations. They are based on very mechanistic extrapolations of the explanatory variables. Future research may well consider more realistic and/or more authoritative scenarios for the future development of the explanatory variables. However, such an exercise is beyond the limits of this paper.

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Appendix

Classification of countries by institutional variables

Public contract (PUBCONTR): Austria, Belgium, Germany, Luxembourg, Holland, Czech Republic (1993-2003), Hungary (1990-2003), Lithuania (1996-2003), Poland (2003), Slovakia (1995-2003), Slovenia (1992-2003); **Public integrated (PUBINTEG):** Denmark, Finland, Ireland, Italy, Spain, Sweden, United Kingdom, Czech Republic (1980-1990), Estonia (1980-1991), Hungary (1980-1990), Latvia, Lithuania (1980-1995), Malta (1980-2003), Poland (1980-1998), Slovakia (1980-1992), Slovenia (1980-1991), Bulgaria (1980-1998), Rumania (1980-1997); **Mixed health care system or being transition**: France, Greece, Portugal, Cyprus, Czech Republic (1991-1992), Estonia (1980-1991), Poland (1999-2002), Slovakia (1993-1994), Bulgaria (1999-2003), Rumania (1998-2003), Turkey (1980-2003).

Use gatekeeper (GATE): Austria, Denmark, Finland, Ireland, Italy, Holland, Portugal, Spain, Sweden, United Kingdom, Estonia (1998-2003), Hungary (1992-2003), Latvia (1997-2003), Lithuania (1996-2003), Malta, Poland (1999-2003), Slovakia (1994-2003), Slovenia (1992-2003), Bulgaria (1999-2003), Rumania (1994-2003). **No gatekeeper:** Belgium, France, Germany, Greece, Luxembourg, Cyprus, Czech Republic, Estonia (1980-1997), Latvia (1992-1996), Lithuania (1990-1995), Poland (1980-1998), Bulgaria (1980-1998), Turkey.

Significant co-payment (COPAY): Austria (1996-2003), Belgium, Finland, France, Germany, Ireland, Luxembourg, Holland (1997-1998), Portugal, Sweden, Cyprus, Estonia (1995-2003), Hungary, Latvia (1995-2003), Poland (1994-2003), Slovakia (2003), Slovenia (1992-2003), Bulgaria (1997-2003), Rumania (1998-2003), Turkey (2002-2003). **No or insignificant co-payment**: Austria (1980-1995), Denmark, Greece, Italy, Holland (1980-1996, 1999-2003), Spain, United Kingdom, Czech Republic, Estonia (1980-1994), Hungary, Latvia (1980-1994), Lithuania (1980-1995), Malta, Poland (1980-1993), Slovakia (1980-2002), Slovenia (1980-1991), Bulgaria (1980-1996), Rumania (1980-1997), Turkey (1980-2001).

The following classification is used: **Remunerate hospital with global budget (GLOBALHO)**: Denmark (1980-1999), Finland (1980-1992), Ireland, Luxembourg (1995-2003), Holland (1980-1987), Portugal (1980-1996), Spain, Sweden (1980-1991), Cyprus, Czech Republic, Estonia (1980-1991), Hungary (1980-1989), Latvia (1980-1993), Lithuania (1980-1991), Malta, Poland (1980-1998), Slovakia (1980-1993), Slovenia (1980-1992), Bulgaria (1980-2000), Rumania (1980-1999), Turkey. **Case-based reimbursement (CASEHO)**: Austria (1997-2003), Italy (1995-2003), Hungary (1993-2003), Lithuania (1992-2003), Poland (1999-2003), Slovakia (2001-2003), Slovenia (2000-2003).

Remunerate GP with salary (SALARYGP): Portugal, Spain (1996-2003), Sweden (1980-1992), Estonia (1980-1991), Hungary (1980-1991), Latvia (1980-1996), Lithuania (1980-1999), Poland, Slovenia (1980-1991), Bulgaria (1980-1999), Rumania (1980-1997). **Remunerate GP with capitation (CAPGP)**: Ireland, Italy, Spain (1980-1995), Sweden (1993-2003), Hungary (1992-2003), Latvia (1997-1998), Bulgaria (2000-2003). **Remunerate GP with a mix of capitation and FFS (MIXEDGP)**: Austria, Denmark, Finland, Greece, Holland, United Kingdom, Cyprus, Czech Republic (1997-2003), Estonia (1998-2003), Latvia (1999-2003), Lithuania (2000-2003), Malta, Slovakia (1994-2003), Slovenia (1992-2003), Rumania (1998-2003), Turkey.

The following classification is used: **Have overall ceiling of hospital budget (CEILHO)**: Austria (1997-2003), Belgium (1986-2003), Denmark, Finland (1980-1992), Germany, Italy (1980-1991), Holland, Sweden, Czech Republic, Estonia (1992-2003), Hungary (1990-2003), Lithuania (1994-2003), Malta, Slovenia (1992-2003). **No overall ceiling of hospital budget (CEILHO)**: Austria (1980-1996), Belgium (1980-1985), Finland (1994-2003), Italy (1992-2003), Lithuania (1991-1993), Slovakia (1993-2003), Rumania, Turkey.

The following classification is used: **Have free or some possibility to make a choice of hospital (FREEHO)**: Austria, Belgium, Denmark, France, Luxembourg, Netherlands, Sweden and Turkey (1980-2003), Slovakia (1993-2003), Latvia (1992-1998).

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PRAXIS	Center for Policy Studies, Tallinn, Estonia
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