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How Does Demography affect Long-Term Care Expenditures Projections? Evidence of four European Union Member states

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Abstract.

This study examines the sensitivity of future long-term-care demand and expenditure estimates to “official” demographic projections in four selected European countries: Germany, Spain, Italy and the United Kingdom. It uses standardised methodology in the form of a macro-simulation exercise and finds evidence for significant differences in assumptions about demographic change and its effect on the demand for long-term care, and on relative and absolute long-term care expenditure. It concludes that mortality-rate assumptions can have a considerable influence on welfare policy planning. Relative dispersion between country-specific and Eurostat official estimates was found to be higher for the United Kingdom and Germany than for Italy and Spain, suggesting that demographic projections had a greater influence in those countries.

Keywords: population projections, long-term care, expectancy and mortality.

Projecting Long-Term Care Expenditure in Four European Union Member States: the Influence of Demographic Scenarios

Abstract.

This study examines the sensitivity of future long-term-care demand and expenditure estimates to “official” demographic projections in four selected European countries: Germany, Spain, Italy and the United Kingdom. It uses standardised methodology in the form of a macro-simulation exercise and finds evidence for significant differences in assumptions about demographic change and its effect on the demand for long-term care, and on relative and absolute long-term care expenditure. It concludes that mortality-rate assumptions can have a considerable influence on welfare policy planning. Relative dispersion between country-specific and Eurostat official estimates was found to be higher for the United Kingdom and Germany than for Italy and Spain, suggesting that demographic projections had a greater influence in those countries.

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1. Introduction

Population projections are increasingly important for planning a range of social policies, including pensions, health care and long-term care. Long-term care means help with domestic tasks, such as shopping and preparing meals, assistance with personal-care tasks, such as dressing and bathing, and nursing care. Long-term care constitutes a significant part of health and social care expenditure and is a key policy question in most developed societies. Studies with a European focus have examined the sensitivity of long-term care (LTC) demand and expenditure to changes in informal care patterns (Pickard *et al*, 2006), dependency rates (Rothgang *et al*, 2003) and economic and financial reforms in four European Union countries (Comas *et al*, 2006). However, very little research has been devoted to the influence of different demographic scenarios on expenditure projections.

Life Expendtancy expansion as a result of reductions in mortality rates arguably lead to an increase in age-related welfare expenditure, which could threaten the sustainability of welfare states in the long run (OECD, 1998)[1]. Long-term care is of particular importance here, given its association with the ageing process. A recent study by the European Policy Committee (2006) suggests that from 2004 to 2050 the European countries examined will experience an increase in relative expenditure on long-term care, up to an average of 1.7 percentage points of their gross domestic product (GDP), and predicts an increase in the number of elderly citizens with disabilities who are in need of care. Surprisingly, little attention is given to how changes in mortality and life expectancy affect LTC demand and expenditure[2]. Despite the fact that ageing is forecast to boost future demand for, and expenditure on, health and long-term care (Spillmann and Lubitz, 2000; Schulz *et al*, 2004), projections of the number of years an individual

[1] Other demographic changes, such as changes in future fertility rates, may have an impact on the availability of LTC support for informal care within families. Similarly migration rates may influence the availability of givers of formal care. However, these rates only exert an indirect influence on LTC supply and demand.

[2] Some studies claim that dramatic changes in mortality will lead to an acceleration of the ageing process and an increase in welfare expenditure which will threaten the sustainability of the welfare state (OECD, 1998).

can be expected to live are found to be subject to significant *uncertainty* and some studies report a potential deviation of about 20% in a 30-year forecast of the total population (Alho, 2002).

Deviations from projected figures for elderly dependent people resulting from demographic uncertainty[3] are systematically examined here. Nonetheless, they are not the only source of expenditure variability[4]. A less well-known effect is the one arising from changes in mortality rates, as life-expectancy estimates are key assumptions in the projections of future demand for long-term care[5]. Differences in official projections bring to the fore the importance of dealing with demographic uncertainty – primarily resulting from mortality estimates – and ultimately lead to evaluations of the accuracy of population-based forecasts (Alho, 1990; Lee and Tuljapurkar, 1998)[6]. It seems likely that long-term trends in age-specific mortality will exhibit a downward pattern (Kinsella and Philips, 2005)[7]. However, some studies find that the relative error one can expect in age-specific mortality forecasts is *higher* than the error for other determinants, such as changes in fertility rates (Alho, 2003). It is important to examine demographic factors, given that earlier official population projections have underestimated the size of the elderly population (Benjamin, 1988; Brody, 1995; Murphy 1995; Olshansky, 1993)[8]. However, there is very little evidence in the literature demonstrating the influence of population projections on LTC demand and expenditure.

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[3] Recent research by the National Research Council 2000 suggests that uncertainty in demographic forecasts is more important than was originally thought.

[4] Part of the existing uncertainty may be due to changes in social patterns of life and care (Pickard *et al*, 2006), (and also to changes in morbidity and available health technologies, although these have already received significant attention).

[5] Although the effect of demographic uncertainty on health and LTC expenditure has been the subject of country-specific studies (Lassila and Valkonen, 2004), very little research has examined the effect of i*diosyncratic demographic patterns* in several European countries.

[6] Other causes of demographic uncertainty are potential demographic under-estimations due to imperfections in census design, and difficulties in obtaining representative data for certain population groups, such as those living in institutions (e.g., nursing homes).

[7] This is due to continued improvement in living conditions, and to the increased control of disease and prolongation of life achieved by advances in medical technology.

[8] Levels and fluctuations of national economic activity have marked effects on internal population movements. However, some studies question the validity of examining the effects of migration on mortality rates given that the age structures and urban locations of different migrant groups vary widely (Uitenbroek and Verhoeff, 2002).

This paper examines the sensitivity of estimates of future LTC demand and expenditure in four European Union countries (Spain, Italy, Germany and the United Kingdom) to different "official population projections", which vary mainly in life expectancy and mortality assumptions[9]. Three of the countries examined are of particular interest as they rank among the five countries in the world with the "oldest" populations [10], and one country is taken for comparative purposes. Given that Eurostat demographic scenarios are extensive and standardised, the study takes them as reference points for comparison with the country-specific scenarios. It contributes to the literature by comparing LTC projections and expenditure under different patterns of life expectancy across the countries under examination, and by using a specific macro-simulation model employed elsewhere. Its findings provide evidence of the importance of demographic assumptions in projecting the burden of LTC expenditure and demand. It also finds that variability in expenditure projections is higher for the United Kingdom (UK) and Germany than for Italy and Spain.

The structure of the paper is as follows: Section 2 focusses on the effects of demographic uncertainty on both population and expenditure projections; Section 3 examines the projections and describes the model; Section 4 deals with the cross-country comparison; and Section 5 contains the discussion.

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9 Furthermore, it specifically looks at mortality, which is considered to have a direct demographic effect, whereas fertility and migration are only considered to affect future long-term care indirectly (as argued further on in the text).

10 In 2004, Italy was the world leader, with 19.1% of the population aged 65 and over, Germany was 4th with 18.3% and Spain was 5th with 17.6%. The UK was the exception, holding 15th position among the "oldest" countries with 15.7% (Kinsella and Philips, 2005).

2. Uncertainty in mortality and life expectancy estimates

2.1 Mortality and demographic uncertainty

Significant improvements in health care and nutrition, among other factors, have given rise to unprecedented increases in life expectancy, although there is much debate on whether similar changes will continue to happen in the near future[11]. Mortality rates for countries belonging to the Organisation for Economic Cooperation and Development (OECD) have decreased for all ages in life, with the exception of the age group between 25 and 45 years. The most remarkable change for OECD countries s probably the growth of survival probabilities responsible for a 'rectangularisation' of survival curves, which seem to expand, to some extent weakening the assumption that there is a limit to human life (Hayflick, 1981, Fries, 1980)[12]. Indeed, there is still some progress in population longevity in Europe, and some experts (the proponents of 'the mortality-reduction paradigm') argue that the decline in mortality rates will continue and may even accelerate (Vaupel *et al*, 1986; Manton, 1991; Vaupel *et al*, 1994)[13]. However, new evidence from ongoing empirical research (Nusselder and Mackenbach, 2001) suggests that in the Netherlands life expectancy at age 85 has declined.

The increase in life expectancy results from an interaction with potential morbidity. Thus, if the increase in life expectancy exceeds the reduction in morbidity, one would expect to observe an increase in the burden of dependent elderly people, and consequently in LTC expenditure. Empirical evidence suggests that both compression and expansion of morbidity can be observed simultaneously (Nusselder et al, 1996). Finally, some recent research questions the influence of ageing on health expenditure by suggesting that 'the number of quarters remaining until death', rather than individual age, is a

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[11] According to United Nations estimates, in the 1950s world life expectancy was 46.4 years (66.0 years in developed regions and 40.7 years in less developed regions). By 1998, world life expectancy had increased to 63.0 years (75.0 years in developed regions and 62.0 years in less developed regions.

[12] However, to date, it seems that the maximum life expectancy permitted by the genetic makeup of the human species (if such a thing exists) is somewhere between 116 to 120 years, in the light of the fact that Jeanne Calment celebrated her 120th birthday in 1995.

significant determinant of health expenditure (Zwiefel *et al*, 1999; Zwiefel *et al*, 2004). However, several authors have raised methodological issues and have found that age does have a significant impact (Seshamani and Gray 2004). Thus, future rates of improvement in mortality and life expectancy, and their effects on LTC expenditure, are still an open question.

2.2 Demographic change and long-term care: which patterns matter?

Demographic change is a well-known key driver of need for long-term care. The larger the cohort of elderly people, the larger the size of the group in need of LTC. Because of the inevitable uncertainty about the future rate of increase in the number of older people, sensitivity analysis is important in the context of projections of LTC demand and associated expenditure for the next half-century. This has been made clear by the fact that past population projections have sometimes under-estimated future numbers of older people, because they under-estimated improvements in mortality rates (Shaw, 1994). It is, therefore, important to consider the impact on LCT projections of a range of population projections, especially if they cover a long period of time.

In projecting populations, different demographic scenarios are often examined, generally in the form of discrete categorisation into high, low and medium variants. It is common practice to consider the medium-variant projections to be the most likely forecasts, since national and international agencies have found they play a useful role and generally achieve some accuracy. The current practice of providing *high* and *low* variants to communicate uncertainty around the medium projection, although having some drawbacks (Lutz and Goldstein, 2004), gives an indication of potential patterns of demographic change. Although variants are arguably non-specific about the probability range (e.g., do not usually allow for temporal fluctuations such as 'baby booms'), the dominant approach in forecasting has been to rely on formal models extrapolating historical trends.

a) Fertility rates

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[13] This argument is supported by an observed pattern of decreasing mortality rates at advanced ages and low mortality rates in highly populated areas, where people have healthy lifestyles.

Since those who will be aged 65 and over in the future (e.g., in 2050) are alive today, recent patterns of fertility at country level must be taken into account when projecting future population figures. This particularly applies to the time when ‘baby booms’, occurred in different countries. Alho (2003) estimates a median error in the baseline fertility forecast for 22 European countries of about 10% for long forecasts and of 26% for shorter forecasts, indicating that overall fertility has been quite volatile in Europe in the last half century[14]. The UK ‘baby boom’ took place in the late 1940s and again in the early 1960s[15]. ‘Baby booms’ took place in Germany in the early 1960s and in Italy in the late 1960s. Interestingly, in Spain there was a ‘baby boom’ in the late 1950s (after the Spanish Civil War and the post-war period) and again in the mid-1970s. These ‘baby boom’ cohorts will reach age 65 around 2030 onwards and age 85 around 2050.

Between 1980 and 1998, fertility decline was significantly lower in Northern and Western Europe than in Southern and Eastern Europe; some studies suggest that decline is higher in countries where the male-breadwinner model is strongest (Hugo, 2000). Italy has the lowest fertility rate in the European Union (EU-15), but almost all of its fellow member states, including UK, Spain, and Germany, are projected to depopulate over this century. Nevertheless, in disentangling the influence of fertility on LTC demand and expenditure, it is important to distinguish between “future fertility” and “past fertility”. Indeed, whilst past fertility is irrelevant, future fertility will affect the availability of informal caregivers within households. Yet, as indicated in the introduction, *future fertility as a form of demographic change will exert indirect effects.*

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[14] Some evidence indicates that from 1980-98 EU-15 experienced an overall decline in fertility of more than 20 per cent (Hugo, 2000). However, the period during which fertility exerted a significant effect on population expansion differs from country to country.

[15] In the UK, baby boomers are the generation born between 1945 and 1965. During this time some 18.5 million children were born in the UK, with two peaks in the birth rate in 1947 and 1964.

b) Migration

Projected migration rates may affect the number of older people in the future. However, evidence of the effect of migration on population growth in Europe is heterogeneous across the four countries examined. In the UK and Germany, second-generation migrant births already account for between 10 and 13 per cent of total births. In Germany and Italy, migration contributes twice as much to population growth as natural increase (Hugo, 2000). This feature is particularly striking given that, although migrants are mainly younger people, many of those migrating in the first quarter of this century will be elderly people by 2050.

Future levels of immigration are inevitably uncertain, as they depend partly on events that happen in other countries. However, they are not the most important source of uncertainty in projecting numbers of elderly people[16]. Furthermore, countries may not be seen as independent units with respect to international migration. On the other hand, the importance of welfare issues should not be lightly dismissed; the benefits of public access to long-term care in the future might be linked to migration policy decisions. Finally, as some authors point out, immigration-flow estimates can differ considerably depending on whether one looks at the statistics of the sending country or the receiving country (Poulain, 1993).

Even so, migration into Western societies means that there are more potential caregivers available, provided that migrants are low-skilled and willing to take any sort of job to remain in the destination country. Accordingly, the *impact of migration on long-term care rather than being direct, is made indirectly through its effects on the availability of care giving*.

c) Mortality

Projected mortality rates are key figures in forecasting numbers of older people. A hypothetical decline in mortality rates, together with the impact of past ‘baby booms’, could explain the differences in projections of numbers of older people over the coming decades[17]. The decline in mortality rates is explained by the “survival of the fittest ” hypothesis, and by a deceleration in aging at very old ages (Kinsella and Philips, 2005). However, out of the three main causes of demographic change, *reduction of mortality rates is the only factor that directly affects potential demand for LTC.* Indeed, a reduction in mortality rates means an increase in the share of population in need of LTC, primarily those aged 80 or older.

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[16] For Germany the irrelevance of migration to estimates of the number of dependent persons has been demonstrated in Rothgang 2002a, 2002b and 2002c.

[17] As mentioned above, the effect of ageing on mortality is still under debate (Nusselder and Mackenbach, 2001), although a large part of demographic uncertainty is produced by potential changes in the causes of mortality rates at later stages of life.

3. Demographic projections and life expectancy in four European Union countries

3.1 General Assumptions

This study uses the Eurostat 1999-based population projections for the central or baseline, high and low scenarios on fertility, mortality and migration up to 2050. The high scenario assumes high fertility, mortality and migration, and the low scenario assumes the opposite. The use of Eurostat population projections, rather than the official national figures, should facilitate comparisons between countries. Furthermore, the Eurostat projections were also used by the Economic Policy Committee in dealing with the effects of ageing (EPC, 2001). Arguably, their use improves comparability with other areas of social policy as well as cross-country comparability.

Interestingly, these projections indicate that the size of the EU population will continue to grow from 376 million in 2000, to 386 million in 2020 (EPC, 2001). The number of older people aged 65 and over is expected to rise by about 70% between 2000 and 2050, increasing from 61 million in 2000 to 103 million in 2050. Projections at the EU level, however, are influenced by the imminent incorporation of Eastern European countries into the EU.

Eurostat population projections incorporate assumptions on future fertility rates, life expectancy and migration. Although fertility rates currently differ substantially between the different EU countries, they are expected to converge by 2050, reaching 1.5 in Germany, Spain and Italy, and 1.8 in the UK. A recent study examining low-lowest fertility in Europe identified a cluster of European countries with low-lowest fertility, in particular Italy and Spain, that also exhibited the latest late home-leaving behaviour, and had only a limited proportion of women participating in the labour market (Billari and Kolher, 2004). However, as indicated above, fertility is not necessarily relevant in projecting LTC expenditure.

Migration is country-specific and connected with EU economic development. Net immigration over most of the period to 2050 is forecast to be 200,000 per year in Germany, 60,000 per year in Spain, 80,000 per year in Italy and 70,000 per year in the UK.

The key issue for LTC projections, however, is the prediction of mortality rates and life expectancy. From 2000 to 2050, life expectancy in the EU as a whole is assumed to rise slightly more for men (five years) than for women (four years). Male life expectancy is projected to rise from 75 in 2000 to 80 in 2050, and female life expectancy from 81 in 2000 to 85 in 2050. The figures for each of the four countries participating in this study are shown in Table 1. The high and low variants of the Eurostat projections are based on different assumptions about future fertility, net migration and life expectancy. These variants represent the two “plausible extremes” of demographic change: the “high” scenario assumes high migration rates, high fertility rates and high life expectancy, while the “low” scenario is characterised by low migration, fertility and life expectancy. However, base-case projections are based on the "best hypotheses" and are comparable on an international level.

Official national population projections are included as a further variant in the sensitivity analysis, though these are not designed to be comparable between countries. National projections tend to be based on a variety of assumptions, but some country-specific studies are based on these data. The use of the national projections, therefore, provides additional input for the sensitivity analysis.

For consistency purposes, the study used projected, instead of released, data for 2000. Figure 2 summarises the main sources of demographic change.

[Insert Table 1 and Figure 1 and 2 about here]

Table 1 shows the life expectancy projections for each country under the three different Eurostat variant scenarios and the official national forecasts. As expected, they indicate that life expectancy will be systematically higher for women than for men, although in most variants the gender gap narrows slightly in the fifty years under consideration, because life expectancy for men is rising faster than for women. Base-case data for the year 2000 show that life-expectancy for women was highest in Spain (82.1), followed by Italy, Germany and the UK. Life-expectancy for men was highest in Italy (75.5) followed by the UK, Spain and Germany. Over the period 2000 to 2050 there is a convergence process: life expectancy for men converges across countries to 80 years (79 for Spain, 81 for Italy) and life expectancy for women converges to 85 years (86 for Italy).

However, as life expectancy depends on mortality, different assumptions on mortality could play a role in life-expectancy changes. As Figure 1 suggests, with the exception of Spain, increases in life expectancy will vary from 10-11% in the high scenario to 2-4% in the low scenario. Furthermore changes appear to be more marked for women than for men.

3.2 Model description

Our macro-simulation model has a common structure for all four countries. It is divided broadly into three parts: the projected number of dependent elderly people; the estimated volume of services they will require; and the estimated expenditure that those services would involve.

The first part of the model classifies the number of older people projected for each country into groups by age, gender, dependency, and (in some of the models) other characteristics.

The second part of the model classifies the services that would be received by dependent older people into three groups: informal care; formal services provided to people in their own home; and institutional care.

The third part of the model calculates the expenditure that would be required to pay for those services, by applying unit costs to each of them. All four countries cover a range of LTC services for people aged 65 or over.

Figure 2 summarises the main demographic effects of the three key variables examined. The central assumptions behind the study's base case are described in Figure 3.

[Insert Figure 3 about here]

The model covers, as far as is possible, both public and private sector provision and funding of services. It includes: informal care by family and friends (although it does not include the costs of providing informal care); services provided to people who live in their own homes; and services provided to those living in institutions.

Cash allowances have only been included when there is a specific choice between cash and services, as in the German system. The rationale behind this is that in Germany, since the value of services on offer is higher than the cash allowance, people are unlikely to use their cash allowances to purchase formal care. Disability benefits in the UK and Italy, however, are often used as payments for private care or to meet public sector charges, and are therefore not alternatives to care. Their inclusion in total expenditure would produce double counting.

4. Cross-country comparison of each country's official population projections

Under the base Eurostat projections, over the period 2000 to 2050, the number of elderly people (aged 65 and over) will rise by 55.7% in Italy, 63.7% in Germany, 66.5% in the UK and 75.6% in Spain. Over the same period the number of very elderly people (aged 85 and over) is projected to rise by 152.0% in the UK, 167.8% in Italy, 167.9% in Germany and 193.5% in Spain. Under these projections, demographic pressures are expected to be greater in Spain than in the other three countries. The difference between the base Eurostat projections and the national official projections is considered separately for each country in Figures 4 and 5.

[Insert Figure 4 and 5 about here]

4.1 Spain

The Spanish population projections were calculated by Fernández Cordon (2000) (see Appendix: Table A4).[18] There is a downward trend in birth and death rates in Spain. As in most Southern European countries, this trend started some decades later than in the more developed European countries, but at the end of the 1980s there was a sharp drop in birth rates, which was greater than in any other EU country. (Until 1900, birth and death rates in Spain were still very high, in both cases exceeding 30%, as is typical of a pre-industrial underdeveloped society. There were also significant differences between Spanish regions[19]).

Interestingly, the mortality assumptions underlying the Spanish country-based population projections assumed higher mortality rates than Eurostat, while life-expectancy estimates were consistently below the Eurostat base case, and sometimes even below the low-case Eurostat scenario.

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[18] The projections were based on constant migration assumptions and a linear growth in life expectancy. Fertility showed a smoothly increasing pattern, rising from 1.14 in 2000 to 1.72 in 2030 and from then onwards remained constant.

[19] Whilst Catalonia and the Balearic Islands embarked on industrial development before 1900, areas such as Andalusia, the Canary Islands and Extremadura did not follow suit until the 1920s.

4.2 Italy

The population projections for Italy were prepared by ISTAT (*Previsioni della popolazione residente,* 2000) (see Appendix: Table A2). Their estimates assumed constant migration, and an increase in life expectancy both for males and females up to 2030. In 2030, male life expectancy was projected to be 81.4 years and female life expectancy 88.1 years. Since the 'baby boom' started around 1965 in Italy, it is expected to affect the number of people aged 65 and over during the period 2030-2040. According to the official projections, projected expansion in life expectancy was among the lowest for the EU countries considered here. However, it was one of the highest when Eurostat projections were used.

4.3 Germany

According to Eurostat, life expectancy in Germany was projected to rise by 5.3 years for men and 4.2 years for women between 2000 and 2050 (See Appendix: Table A3). For the same period (1998-based) national projections from the Federal Office of Statistics predicted an expansion in life expectancy of only 3.7 years for men and 4.0 years for women[20]. Thus, the reduction in the gap between male and female life expectancy in the Eurostat projections was not mirrored in the national projections, where the gender gap actually increased. As a consequence, the projected number of older people differed considerably between the two sets of forecasts. While Eurostat started with a lower number of elderly people (65 years and older) for 2000 (13.3 million as compared to 13.7 million in the national projection), it projected 21.8 million, which was 2.3 million higher than the number projected by the Federal Office of Statistics. According to Eurostat the number of older people will grow slightly between 2030 and 2050 (+ 419,000),

[20] The projection also contained an "alternative" scenario with an additional gain in life expectancy of 2 years (men) and 1.9 years (women) until 2050. The above discussion, however, is based on the standard case. With respect to migration, a high scenario (+ 200,000 foreign (net) migrants per year) and a low scenario (+ 100,000 foreign (net) migrants per year) were distinguished, as well as a control scenario with no net migration of foreigners. The reference above is to the high-migration scenario. The fertility rate was kept constant at 1.4 for all scenarios.

whereas according to national projections this number will decline (- 844,000). In both sets of projections, however, there was the same shift in age structure within the older population: while the estimated number of 65-80 year-old people decreased sharply between 2030 and 2050, the estimated number of the very old (80 years and older) rose correspondingly. This produced an overall increase in the projected number of dependent people even for these decades, assuming constant age-specific dependency rates.

4.4 United Kingdom

The Government Actuary's Department produces regular population projections for the United Kingdom (see Table A1). The latest set, which were 2000-based projections, assumed that the total fertility rate would fall to 1.74 children per woman by 2015, and that net immigration would fall to 135,000 per year by 2002 (Shaw, 2002). Life expectancy for men was predicted to rise from 75.8 in 2000 to 78.9 in 2025. Life expectancy for women was predicted to rise from 80.6 in 2000 to 83.2 in 2025. The number of older people aged 65 and over was projected to rise by 71% between 2000 and 2050, as against 67% under the Eurostat base projection. The number of very elderly people aged 85 and over was projected to rise by 175% between 2000 and 2050, as against 152% under the Eurostat base projection.

5. The effect of variant population predictions on projected numbers of dependent older people and on projected LTC expenditure

5.1 Effect on the dependent elderly population

The use of variant population projections has a significant impact on the projected numbers of dependent older people in 2030 and 2050 (Figure 4). The numbers of dependent older people in each country under the four different population projection scenarios are plotted in Figure 4, assuming constant dependency rates by age and gender. Figure 5 shows the changes in numbers of dependent elderly people. Under the base case, the number of dependent elderly people was projected to rise between 2000 and 2050 by 87% in the UK, 102% in Spain, 107 % in Italy and 121% in Germany. The differences between countries are due partly to differences in the Eurostat population projections (as discussed above) and partly to differences in the definition of dependency. Official projections indicated only a slight population change in the UK and Spain as compared with the base case. However, this did not apply in Italy and Germany. Interestingly, with the exception of the UK, the "high" scenario prediction indicated a rise of over 140%.

There was a significant difference between the high and low Eurostat population projections for dependent older people in 2050, as Figure 4 shows. The number of dependent older people in Germany was projected to rise from around 1.4 million in 2000 to 2.5 million (low scenario), 3.1 million (base scenario), and 3.7 million (high scenario). The number of dependent elderly people in Spain was projected to rise from around 2.3 million in 2000 to 3.9 million (low), 4.7 million (base) and 5.6 million (high). The number of dependent elderly people in Italy was projected to rise from around 1.5 million in 2000 to 2.7 million (low), 3.2 million (base) and 3.8 million (high). Finally, the number of dependent elderly people in the UK was projected to rise from around 3.0 million in 2000 to 4.8 million (low), 5.6 million (base) and 6.8 million (high).

The projected numbers of dependent elderly people for Spain and the UK did not vary greatly between the official national population projections and the Eurostat base-scenario population projections. For Germany, the official national population projections predicted somewhat fewer dependent older people in 2050 than the Eurostat base population projections. For Italy, the official national population projections suggested substantially more dependent older people in 2050 than the Eurostat base population projections and were closer to the Eurostat high projections.

5.2 Expenditure projections

The second main aspect to examine is the total effect of the variant population projections on projected LTC expenditure relative to GDP (Table 2). For Germany and the UK, the difference between the projected proportion of GDP spent on long-term care under the low and high Eurostat population projections constituted over one percentage point of GDP in 2050. In these countries the projected proportion of GDP spent on long-term care rose more than twice as much between 2000 and 2050 under the high population projection as under the low population projection. In Spain and Italy, the difference in projected LTC expenditure relative to GDP under the high and low population projections was not as great. Nevertheless, even in these two countries the difference in the projected proportion of GDP spent on long-term care between the low and high Eurostat population projections constituted over half of a percentage point of GDP in 2050. In Italy and the UK projected expenditure was below that of official national projections, whilst in Spain and Germany this was not the case. Interestingly, Italy was the country exhibiting the largest rise in projected expenditure; in the low scenario a 100% increase was projected, whilst in other countries the rise was about 70%. Differences in relative expenditure between the highest and lowest population assumptions varied from 35-50%, with Italy exhibiting the smallest difference and the UK the largest.

[Insert Table 2 about here]

Figure 6 provides a measure of relative dispersion (coefficient of variation) of relative expenditure to GDP and expenditure growth. It reveals that in UK and Germany the variability of population projections was higher, and that in the UK case it more than doubled that of Italy and Spain. However, the relative variability of expenditure growth was far more stable, though it exhibited similar patterns to that of relative expenditure to GDP. These results are interesting, given that levels of expenditure in Southern European countries were significantly lower, yet results might be more sensitive to factors such as social change (Pickard *et al*, 2006). On the other hand, it is important to note that the variability in expenditure relative to GDP was larger than that of expenditure change, indicating that potential changes in the economic size of countries were an additional source of uncertainty in projecting LTC expenditure.

[Insert Figure 6 about here]

6. Discussion

This paper examines the effect of changes in predictions of mortality (life expectancy) on LTC demand and expenditure. In particular, it examines the sensitivity of projected numbers of dependent older people and of LTC expenditure to the use of variant population projections based on different assumptions about future mortality rates (and migration patterns). Other studies have examined the effects of social change (Pickard et al, 2006), policy options and financing scenarios (Comas *et al*, 2006), and changes in health and disability assumptions (Rothgang et al, 2003). However, demographic assumptions have been largely dismissed in previous studies.

To ensure comparability, the study employs the Eurostat standardised scenarios (high, base and low). Interestingly, it finds evidence of significant demographic uncertainty, associated with the use of different mortality assumptions, in projections of LTC demand and expenditure.

To examine the sensitivity of government future planning to differences in demographic assumptions, it then examines the difference between Eurostat-based figures, and those obtained when national official population projections are employed. Predictably, it finds that country-specific official projections also produce different LTC expenditure figures.

This reinforces the hypothesis that population-projection assumptions are responsible for the variability of projected expenditure, in both absolute and relative terms. (Variability seems to increase with country size.)

The findings from demographic-based projections indicate that (with the exception of Spain where the LTC system was markedly under-funded until the 2006 reform [Costa-Font and Font-Vilalta, 2006]) there is evidence of cross-country convergence in the relative share of LTC expenditure over time. Cross-country differences result mainly from assumptions on potential patterns of social change (Pickard et al, 2006), though there are clearly some demographic factors behind differences in the relative share of LTC expenditure and demand. The study's findings provide convincing evidence of a marked – though not unique- effect of population change on LTC expenditure. Expenditure growth varies from 70%-90% in the most optimistic scenario, to 150%-180% in highest scenario. The effect of demographic assumptions on relative LTC expenditure ranges between 35%-50%.

Some caveats should be mentioned, mainly the need to examine demographic effects jointly with changes in economic activity in future work, given that economic activity could be endogenously influenced by changes in population scenarios[21]. Clearly, the increase in old-age dependency is likely to lead to higher demand for, and expenditure on LTC services. However, the extent to which this will imply a significant change in GDP will strongly depend on whether long-term care is covered by a shift from other activities or by an increase in migration.

[21] However, though it is true that GDP is partly a function of a country's population (countries with more people than projected will tend to have larger GDPs) given that population expansion occurs mainly within the old-age cohorts it is debatable whether GDP can be expected to change much overall.

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Tables and Figures

Table 1. Life expectancy projections in Germany, Spain, Italy and the United Kingdom

	2000*		2030		2050	
	Male	Female	Male	Female	Male	Female
Germany						
Low	74.4	80.6	76.6	82.7	77.3	83.4
Base	74.7	80.8	79.2	84.3	80.0	85.0
High	75.1	81	82.6	86.3	83.8	87.1
Official	74.4	78.5	76.6*	83.1*	78.1	84.5
Spain						
Low	74.5	81.9	75.3	83.2	76.1	83.4
Base	74.89	82.1	78.04	84.74	79.01	85
High	75.3	82.3	81.8	86.7	83	87
Official	73.32	82.36	77.77	84.48	78.49	84.95
Italy						
Low	75.2	81.8	77.5	83.7	78.3	84.4
Base	75.5	81.95	80.05	85.29	81	86
High	75.8	82.1	83.5	87.4	84.8	88.1
Official	77.9	84.4	81.4	88.1	81.4	88.1
UK						
Low	74.9	79.8	76.8	82.3	77.4	83.2
Base	75.21	80.03	79.29	84.09	80	85
High	75.5	80.2	82.7	86.4	83.7	87.4
Official	75.8	80.6	79.3	83.5	80.0	84.1

Notes: *Data refer to 2010 for Italy. Official figures refer to 2025 and 2035 respectively. The figures in the table are the arithmetic mean of those for 2025 and 2035.

Sources: EUROSTAT, 2000; Statistisches Bundesamt: 9. koordinierte Bevölkerungsvorausberechnung; Variante 2. Istat, Previsione della popolazione residente (Base 1 gennaio 2000); Fernández Cordón (2000); Government Actuary's Department (2000). The official projections for Italy are for 2010 instead of 2000.

Figure 1. Projected life expenditure/expectancy???? change 2000-2050

Figure 1a. Men

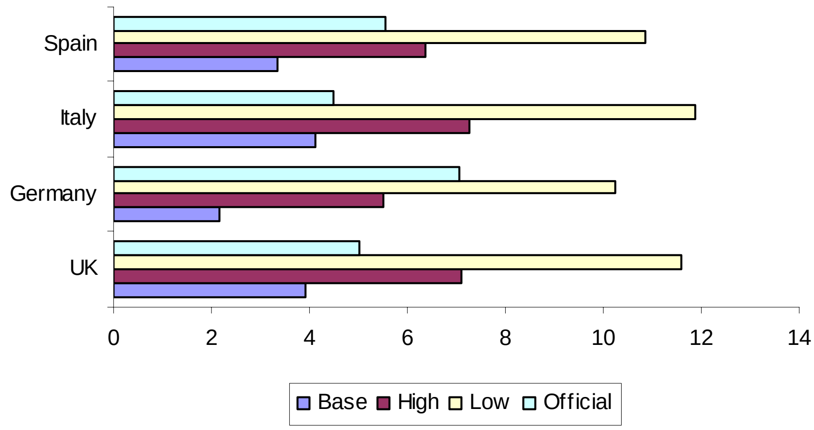

Figure 1b. Women

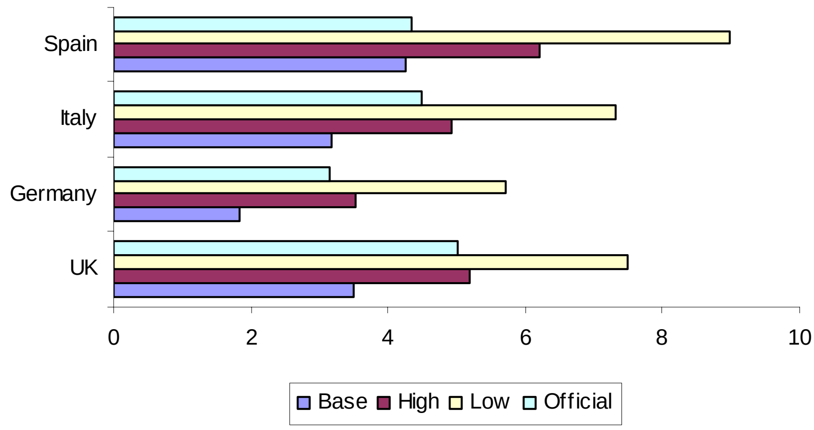

Figure 2. Main causes of demographic change affecting LTC expenditure

a) Mortality: reduction of mortality (assuming no effects on morbidity) is expected to *directly* increase the average percentage of individuals in need of long-term care and expenditure in current generations.
b) Fertility: reduction of fertility rates is expected to reduce the likelihood of intra-household care-giving by offspring and partners, *indirectly* increasing LTC expenditure in future generations, due to higher demand for formal care.
c) Migration: an increase in migration is expected to increase the availability or supply of formal caregivers, accordingly reducing its price, and hence *indirectly* increasing access to formal long-term care and LTC expenditure.

Figure 3. The central case: base assumptions

Numbers of older people and their characteristics

- Older population changes by age and gender in line with Eurostat 1999-based population projections. These are country-specific, but based on a common methodology.
- Prevalence rates of dependency by age and gender remain unchanged.
- The proportion of older people by age and gender living in each household type remains constant [22].

Demand for services

- The proportion of older people receiving informal care, formal community-care services and residential and nursing-home care remains constant for each sub-group by age, gender and dependency.

Supply of services

- The supply of formal care will adjust to match demand[23].
- Demand will be no more constrained by supply in the future than in the base year.

Expenditure and economic context

- The unit costs of care will rise in line with the Economic Policy Committee (EPC) assumption[24] for productivity growth in each country, and GDP will also rise in line with EPC assumptions. These assumptions are country-specific, but based on a common methodology.

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[22] This assumption only operates explicitly in the UK model, but it is implicit in the other three models.

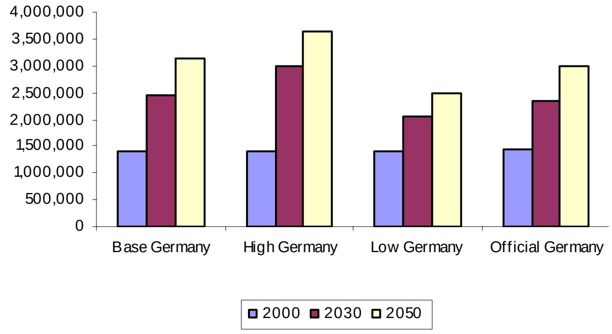
[23] The models assume that the real rise in wages and other payments for care will ensure that supply is sufficient. Changes in assumptions about unit costs are made as part of the sensitivity analysis.

[24] Details of the assumptions are available in the EPC report (2001)

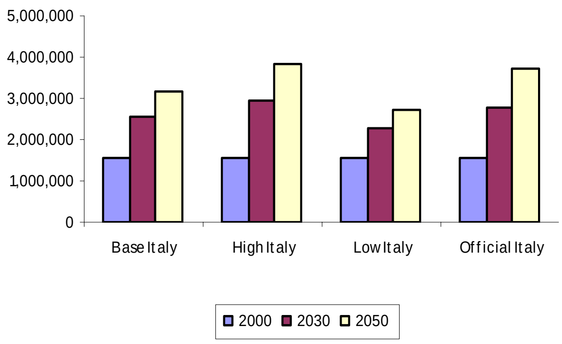
Stop **Figure 4. Number of dependent elderly people in the four countries**

4.1 Projections for the UK

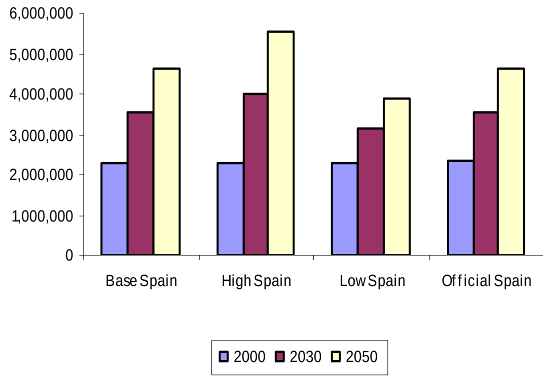
4.2 Projections for Germany



4.3 Projections for Italy

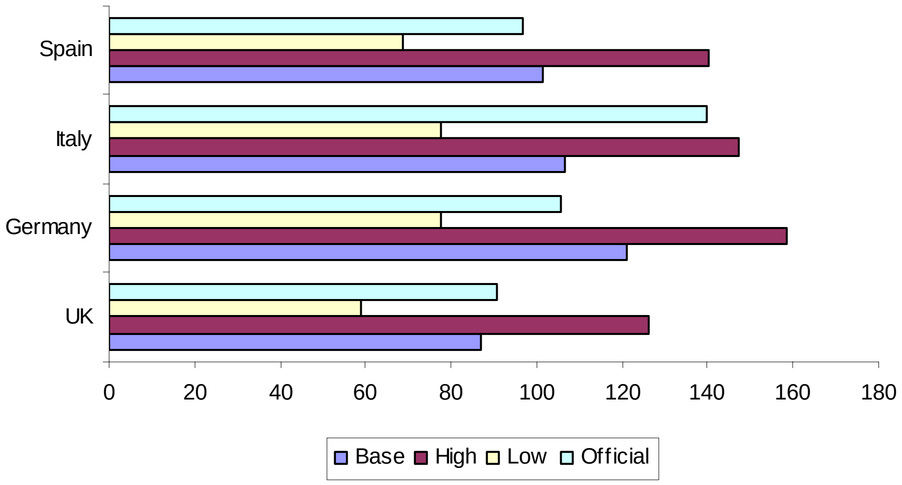


4.4 Projections for Spain



Sources: EUROSTAT, 2000; Statistisches Bundesamt: 9. koordinierte Bevölkerungsvorausberechnung; Variante 2. Istat: Previsione della popolazione residente (Base 1 gennaio 2000); Fernández Cordón (2000); Government Actuary's Department (2000). Official projections for Italy are for 2010 instead of 2000.

Figure 5. Growth in the number of dependent elderly people (2000-2050)



Sources: EUROSTAT, 2000, Statistisches Bundesamt: 9. koordinierte Bevölkerungsvorausberechnung; Variante 2. Istat, Previsione della popolazione residente (Base 1 gennaio 2000); Fernández Cordón (2000); Government Actuary's Department (2000). Official projections for Italy refer to 2010 instead of 2000.

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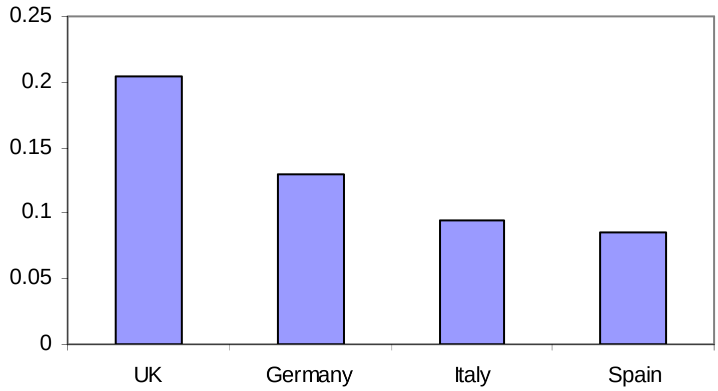
Table 2. Expenditure on long-term care as a percentage of GDP under different population projection assumptions

Expenditure % GDP		2000	2030	2050	Growth %
UK					
	Base	1.36	2.06	2.75	101.7
	High	1.36	2.45	3.46	153.6
	Low	1.36	1.77	2.27	66.5
	Official	1.38	2.21	2.86	106.3
Germany					
	Base	1.24	2.11	2.72	120.2
	High	1.24	2.60	3.23	160.8
	Low	1.23	1.76	2.18	76.4
	Official	1.27	2.03	2.66	108.8
Italy					
	Base	0.99	1.61	1.94	95.8
	High	0.99	2.05	2.77	179.1
	Low	0.99	1.63	2.06	108.6
	Official	0.99	1.95	2.72	173.8
Spain					
	Base	0.65	1.03	1.39	115.3
	High	0.65	1.19	1.69	160.7
	Low	0.65	0.90	1.13	73.9
	Official	0.65	1.02	1.37	110.2

Note: The base-case projections assume 0% inflation and 0% GDP growth

Figure 6. Coefficient of variation of expenditure under different population projection assumptions



Appendix

Table A1. Projections for the United Kingdom

	Base		Official		High		Low	
2000	men	women	men	women	men	women	men	women
65-69	1,230,932	1,354,094	1,232,481	1,350,088	1,231,562	1,354,442	1,230,302	1,353,747
70-74	1,050,197	1,280,265	1,054,519	1,280,061	1,051,080	1,280,754	1,049,313	1,279,771
75-79	829,297	1,191,792	823,151	1,169,589	830,446	1,192,533	828,148	1,191,050
80-84	427,892	771,531	450,002	794,327	428,853	772,362	426,928	770,699
85+	303,051	829,119	315,065	847,342	304,427	831,368	301,675	826,867
2030								
65-69	2,087,630	2,155,920	2,149,685	2,195,995	2,165,711	2,197,898	2,012,218	2,114,634
70-74	1,584,005	1,760,491	1,682,461	1,825,402	1,684,496	1,812,521	1,489,211	1,709,820
75-79	1,197,708	1,462,943	1,236,235	1,445,863	1,331,025	1,533,232	1,077,154	1,395,674
80-84	923,000	1,287,445	994,616	1,274,108	1,104,520	1,393,222	770,141	1,189,335
85+	590,603	1,135,030	795,404	1,238,539	909,819	1,457,933	394,254	898,895
2050								
65-69	1,766,174	1,775,687	1,860,783	1,897,406	1,889,388	1,849,105	1,649,469	1,703,941
70-74	1,512,359	1,595,007	1,593,807	1,667,621	1,653,101	1,668,923	1,382,604	1,523,598
75-79	1,456,387	1,666,772	1,418,047	1,554,950	1,656,538	1,762,976	1,279,445	1,575,338
80-84	1,217,345	1,591,241	1,251,938	1,494296	1,498,092	1,732,444	987,692	1,461,066
85+	1,017,661	1,835,744	1,297,230	1,901,892	1,722,763	2,430,701	635,763	1,426,676

Source: Eurostat and Government Actuary's Department

Table A2. Projections for Italy

	Base		Low		Official		High	
2000	men	women	men	women	men	women	men	women
65-69	1,432,908	1,687,249	1,432,284	1,686,997	1,436,000	1,679,223	1,433,531	1,687,501
70-74	1,185,475	1,555,510	1,184,662	1,555,119	1,184,324	1,555,640	1,186,289	1,555,900
75-79	877,013	1,364,596	876,02	1,363,965	877,068	1,365,080	878,004	1,365,228
80-84	368,895	680,222	368,163	679,583	369,083	681,719	369,629	680,863
85+	351,415	839,838	349,959	837,732	357,7	856,681	352,872	841,946
2030								
65-69	1,983,245	2,130,962	1,915,312	2,099,647	2,043,866	2,166,311	2,053,449	2,162,650
70-74	1,581,564	1,811,563	1,496,175	1,773,000	1,624,548	1,848,919	1,671,546	1,850,856
75-79	1,255,670	1,572,271	1,146,452	1,518,454	1,288,502	1,625,302	1,374,736	1,627,846
80-84	979,455	1,379,863	840,936	1,296,873	1,010,869	1,473,995	1,139,583	1,467,877
85+	772,434	1,458,227	534,89	1,184,351	953,374	1,633,277	1,148,638	1,828,352
2050								
65-69	1,490,282	1,524,571	1,386,525	1,461,151	1,611,550	1,650,650	1,599,750	1,589,156
70-74	1,598,943	1,727,875	1,474,737	1,663,517	1,705,319	1,854,746	1,732,538	1,793,953
75-79	1,616,581	1,890,386	1,448,917	1,808,690	1,694,314	2,011,639	1,802,709	1,975,336
80-84	1,334,851	1,727,101	1,120,041	1,610,891	1,389,270	1,875,325	1,589,208	1,851,246
85+	1,200,509	1,989,190	793,92	1,597,837	1,468,251	2,711,998	1,922,698	2,548,607

Source: Eurostat and Istat

Table A3. Projections for Germany

	Base Case		Low		High		Official (thousands)	
2000	men	women	men	women	men	women	men	women
65-69	1,887,030	2,129,300	2,128,892	1,886,132	1,887,921	2,129,712	1,957	2,193
70-74	1,486,080	2,066,010	2,065,363	1,484,941	1,487,220	2,066,655	1,548	2,047
75-79	932,610	1,915,010	1,913,949	931,397	933,817	1,916,068	950	1,885

80-84	375,360	920,170	919,196	374,530	376,890	921,138	432	1,042
85+	382,750	1,219,170	1,215,778	380,984	384,520	1,222,562	1,382	2,927
2030								
65-69	3,149,867	3,279,080	3,024,685	3,211,235	3,279,886	3,347,967	2,989	3,230
70-74	2,440,243	2,716,086	2,293,604	2,640,745	2,595,670	2,793,212	2,297	2,686
75-79	1,831,505	2,280,312	1,654,397	2,183,442	2,026,467	2,381,052	1,626	2,173
80-84	1,118,417	1,557,725	942,997	1,445,918	1,324,638	1,677,626	1,013	1,565
85+	1,054,717	1,943,352	706,587	1,556,990	1,611,730	2,465,410	2,639	3,738
2050								
65-69	2,378,812	2,421,516	2,138,856	2,254,416	2,635,095	2,592,456	2,026	2,256
70-74	2,059,817	2,202,454	1,832,836	2,059,721	2,308,957	2,350,211	1,747	2,078
75-79	1,922,391	2,228,640	1,670,751	2,083,280	2,208,830	2,381,756	1,512	1,990
80-84	1,873,250	2,411,695	1,524,896	2,209,125	2,297,547	2,631,390	1,476	2,203
85+	1,616,699	2,674,387	1,027,014	2,113,821	1,681,784	3,473,760	2,988	4,193

Source: Eurostat and Official projections

Table. A4 Projections for Spain

		Base		Low		High		Official
2000	men	women	men	women	men	women	men	women
65-69	943,993	1,099,243	943,590	1,099,097	944,396	1,099,390	963,669	111,303
70-74	774,135	981,792	773,615	981,566	774,656	982,019	785,882	989,380
75-79	548,937	795,110	548,324	794,761	549,550	795,458	570,526	814,197
80-84	289,400	525,799	288,842	525,330	289,957	526,268	292,775	527,450
85+	195,890	441,879	195,100	440,753	196,680	443,004	204,612	456,027
2030								
65-69	1,284,577	1,439,936	1,232,549	1,418,808	1,338,674	1,461,312	1,312,891	1,464,914
70-74	1,040,027	1,257,926	975,313	1,231,788	1,108,782	1,284,543	1,069,560	1,281,367
75-79	775,167	1,035,724	698,366	1,000,656	859,945	1,071,918	789,745	1,041,636
80-84	544,453	846,883	456,725	794,886	648,102	902,089	559,670	864,531
85+	403,526	819,425	270,290	663,834	621,788	1,032,698	402,232	826,606
2050								
65-69	1,189,393	1,263,427	1,099,869	1,214,764	1,284,764	1,312,995	1,154,576	1,248,623
70-74	1,288,644	1,461,330	1,176,656	1,410,182	1,410,475	1,513,830	1,281,662	1,477,783
75-79	1,126,970	1,398,167	991,784	1,336,913	1,279,747	1,461,912	1,112,822	1,410,773
80-84	819,599	1,161,864	667,694	1,079,967	1,004,646	1,249,637	788,662	1,166,399
85+	669,792	1,201,978	422,257	778,784	1,121,778	1,543,871	619,213	1,231,542

Source: Eurostat, (2002) and Fernández Cordón (2000)