Available online at www.sciencedirect.com
SCIENCE DIRECT®
Health Policy 75 (2006) 187–213
HEALTH policy
www.elsevier.com/locate/healthpol

Future costs for long-term care
Cost projections for long-term care for older people in the United Kingdom

Martin Karlsson*, Les Mayhew, Robert Plumb, Ben Rickayzen

City University, London, UK

Abstract

The purpose of this paper is to analyse the future sustainability of the UK system for provision of long-term care (LTC) due to changes in demography and health status among the older people. It considers how demand for LTC will evolve and to what extent there will be sufficient supply to meet demand. For formal care, this requires an estimate of how much the public purses, and hence taxpayers, will be burdened with LTC costs. For informal care, it involves estimating whether there will be enough carers if current patterns of provision were to continue. The results show that demand for long-term care will start to take off 10 years from now, and reach a peak somewhere after 2040. The research finds that the most significant increase will be in demand for informal care, where the number of recipients are projected to increase from 2.2 million today to 3.0 million in 2050. Relative increases will be similar in all care settings, amounting to between 30 and 50% compared with the levels today; however, the most noticeable increase will be in demand for formal home care, which is projected to be 60% above current levels by 2040. Total expenditure on formal long-term care will increase from £ 11 billion per year today to approximately £ 15 billion per year by 2040 (in 2001 prices). Expressed in taxation terms the effective contribution rate will increase from around 1.0% of total wages today to 1.3% in 2050. Availability of informal carers is potentially a big problem, but the extent of the problem is very sensitive to the assumptions made concerning health improvements and care-giving patterns.

Keywords: Long-term care; Projected expenditure; Health status; Demography; UK

1. Introduction

The subject of long-term care (LTC) is receiving increasing attention both in the research community and by various countries' governments due to the belief that an ageing population will greatly swell the demand for long-term care services and create huge public expense. One of the issues which needs to be determined is by how much demand will increase; another is to address the ambiguity over whether long-term care is a response to a medical condition, a social need or both. The corollary is to decide how the burden is to be shared between the individual, the family and the state.

* Corresponding author. Present address: Faculty of Actuarial Science and Statistics Cass Business School, City University, 106 Bunhill row, London EC1Y 8TZ, UK. Tel.: +39 03484787514.
E-mail address: martin.karlsson@iue.it (M. Karlsson).

0168-8510/$ – see front matter © 2005 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.healthpol.2005.03.006

LTC is administered to people who have reached a stage in life in which they are dependent on others for social, personal and medical needs. It is usually associated with the very old but, in fact, could begin at any age depending on the reasons for the disability—perhaps a road accident, a mental or a congenital condition. For some, long-term care may be needed over an extended period whereas, for others, it is required in the period immediately prior to death. In this paper the focus is on older people since they tend to have the greatest need for long-term care.

The purpose of this paper is to analyse the sustainability of the UK system for provision of long-term care in the light of the changes in demography and health status among older people that are expected in the future. In particular, we wish to find out how demand for LTC will evolve and to what extent there will be sufficient supply to meet demand. In terms of formal care, this requires an estimate of how much the public purse, and hence the taxpayers, will be burdened with LTC costs in the future. As far as informal care is concerned, it involves estimating whether there will be enough carers under the assumption that current patterns of provision do not change in the future.

1.1. Long-term care in the UK

Whilst slightly different LTC systems operate within Scotland and the rest of the UK, the basic premise is that, in the UK, LTC relies less on public financing than most other European systems. Eligibility to free or subsidised care is based on means testing, and under some circumstances, the value of a person's home into account as well as income and other assets. In the UK, the LTC sector is characterised by dual arrangements, in which different principles apply to health care services—provided by the National Health Service (NHS) and social services—financed by local authorities.

Local authorities have two main sources of funding—government grants and locally raised revenue in the form of council tax. The funds are not earmarked, but there are recommendations and management targets on how to spend the money and the service levels expected. By contrast, the NHS is responsible for funding some nursing home places and also finances nursing care in all care settings based on health related criteria. The NHS is financed by the constituent countries of the UK and is largely financed out of income taxation [1]. There is only a small market for private long-term care insurance, and up to the end of the year 2000, fewer than 40,000 policies had been sold [2].

1.2. Trends in demography and health

As far as this research is concerned, the basic demographic trends are taken as 'given', but it is important to understand how these trends have emerged in general terms and what the implications are in terms of the demand for long-term care. An ageing population is a trend common to all developed countries that manifests itself in terms of an increasing proportion of older people in the population. This has arisen not only because people are living longer but also because women are having fewer children than in the past. In several countries, the population has stagnated or is set to decline (the US being a notable exception).

Over the past 25 years, there has been an intense academic debate on the implications for healthy life expectancy (HLE) of falling mortality rates. Three competing hypotheses have been proposed. The most optimistic one, suggesting a compression of morbidity, is due to Fries [3]. According to this perspective, adult life expectancy is approaching its biological limit so that if disability spells can be postponed to higher ages the result will be an overall reduction in the time spent disabled. By contrast, Gruenberg [4] suggested an expansion of morbidity based on the argument that the observed decline in mortality was mainly due to falling accident rates. The third hypothesis was proposed by Manton [5], according to whom the development in mortality and morbidity is a combination of the two, which could lead to an expansion of the time spent in good health as well as the time spent in disability.[1]

There is, however, not yet enough empirical evidence available to draw a definite conclusion on how the gap between healthy life expectancy and total life expectancy is behaving in all countries. According to national statistics for Great Britain, HLE at age 65 in-

[1] However, Mayhew [14] argued that the key point was whether the gap between healthy life expectancy and life expectancy was increasing since this ultimately determined the number of people under care. Delaying the onset of disability would simply defer expenditure but not necessarily avoid it.

creased by around 1.5 years between 1981 and 2001, whereas overall life expectancy increased by 2.1 years for women and 3 years for men, suggesting that the gap has expanded in the last 20 years. These figures are consistent with Manton's argument above [6].

The key implication is that trends in health could make a significant difference to costs and therefore public policy. We therefore need to ensure that our analysis takes into account a range of possible health scenarios. For this part of the analysis we rely on previous work by Rickayzen and Walsh [7] who developed a methodology for projecting disability prevalence rates, allowing for health trends (see Section 2.1).

1.3. Previous research

One of the first rigorous reports on the future costs of long-term care was provided by Nutall et al. [8]. The projection was based on a multi-state model of disability, where the three states are assumed to be healthy, disabled and dead. Separate series of models were built to incorporate severity of disability in which no recovery was allowed once the particular disabled state has been reached. The OPCS study of disability provided the basis for prevalence rates (with the implicit assumption that prevalence rates by age had remained constant between 1986 and 1991, the base year). The study projected a rapid increase in the demand for long-term care from 2011 onwards. In order to estimate the future costs of LTC, it was assumed that LTC costs remain constant in terms of GNP (alternative scenarios with changing relative prices were also considered). According to the central projection, LTC costs as a share of GNP would increase by 47% (from 7.3 to 10.8%).

A more recent projection has been provided by the PSSRU [9] (see [10] for the most recent update) with the Personal Social Services Research Unit (PSSRU) model. The PSSRU model, originally developed for the Royal Commission on Long-term Care [11], assumes that dependency rates by age and sex remain constant over the projection period (ending at 2031) and uses a cell-based model to project the future demand for LTC services and the implied costs. The dependency measure used in the PSSRU model is the number of activities of daily living (ADLs) and instrumental activities of daily living (IADLs) failed by the individual, which are based on typical daily activities such as cooking. The outcome of the baseline scenario of the model is that formal LTC service will have to expand by 61% between 1995 and 2031. Further attempts to model future LTC costs have been made by London Economics and the Institute for Public Policy Research [12], and the Department of Health [13].

The present study differs from the PSSRU model in several ways. Firstly, the models differ in the definition of dependency. The PSSRU model uses ADLs and IADLs for the non-institutionalised population and treats institutionalisation as a distinct kind of dependency. Our model, on the other hand, uses the wider OPCS scale and takes accounts of the heterogeneity—in terms of dependency—of the institutionalised population. Secondly, the PSSRU model makes projections for England, whereas we are concerned with the entire UK. Thirdly, the definition of LTC is different; we use a narrower definition of LTC, covering only institutional care and certain home care services, whereas the PSSRU model also covers care settings such as long-stay hospital care, day care and community nursing. Finally, the basis of funding is different in the two models; we use the labour remuneration of the working population as a basis, whereas the PSSRU model assumes a constant growth in GDP. A comparison of the results achieved by us and by Wittenberg et al. [10] is provided in Appendix A.

There are two main advantages to our approach. Firstly, by relying on transition probabilities as the basis for projecting future needs, and not simply a demographic extrapolation of current needs, we are likely to get a more accurate estimate of the levels of future needs, as well as in the range in uncertainty which we need to consider. Secondly, we avoid having to take the detour of first calculating costs of LTC and then comparing them to the GDP, which has been projected to grow at some constant rate (as in the PSSRU model). On the contrary, we acknowledge the fact that the capacity of the economy itself, especially where a labour-intensive service such as LTC is concerned, depends mainly on the size and structure of the labour force. It is unlikely that productivity increases in the economy will lessen the burden of LTC financing, and hence we use as our baseline scenario an assumption that prices of LTC services increase in line with general earnings.

This increased accuracy concerning the prevalence of dependency and the overall macro-economy, comes at the cost of less flexibility in other parts of the model.

Hence, we are not able at this stage to model the implications of changing family structures for the formal care sector, or the implications of shifts in the income distribution of older people for public finances. Thus, a crucial assumption underlying our work is that trends in dependency and demography are the main drivers of LTC expenditure.

1.4. Organisation of the paper

The paper is organised as follows. In Section 2, the different elements of our projection model are presented in more detail. In Section 3, we present results and undertake a sensitivity analysis. Section 4 concludes. Appendix A provides a comparison of our results with the PSSRU [10] model and in Appendix B we analyse the effects of altering the assumption with regard to the relative price of care services.

2. Projection model

Our projection model consists of several different components. An overview is given in Fig. 1 which will be explained in more detail in this section. From our projections, we derive two kinds of results; firstly, an estimate of the future costs of LTC to the public purse, expressed as a proportional income tax and, secondly, an estimate of the future surplus or shortfall of the number of informal carers relative to the demand for informal care. In Fig. 1, arrows going downwards represent factors determining demand, whereas arrows going up-

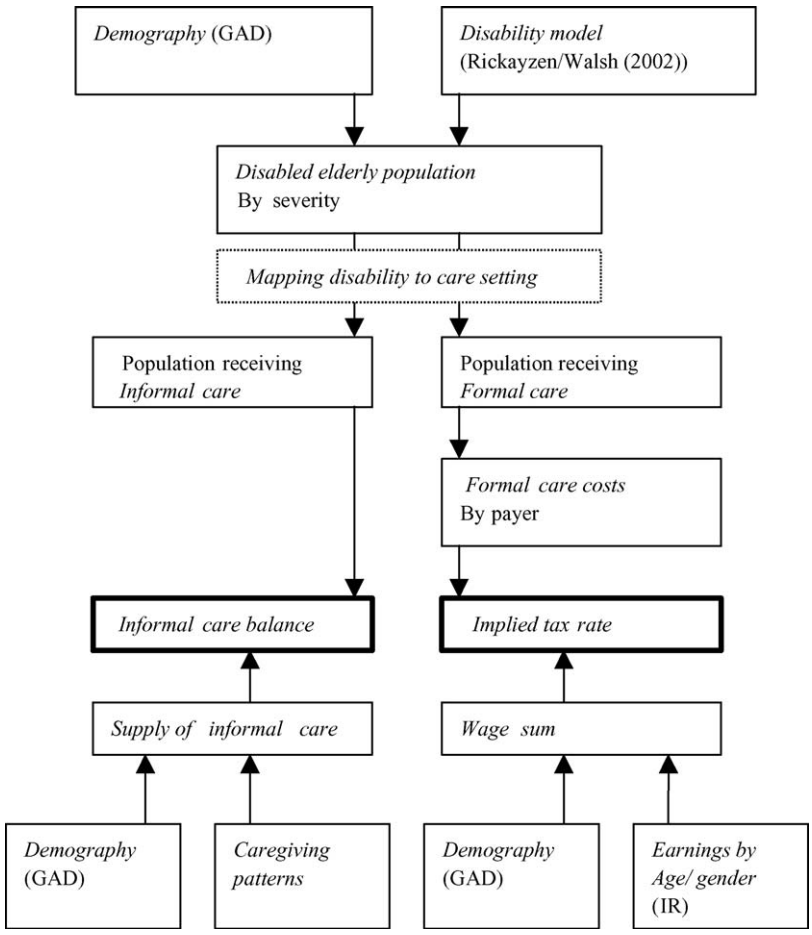

Fig. 1. The projection model. Key: GAD, Government Actuary's Department; IR, inland revenue.

wards represent factors determining supply. We now describe the steps in more detail.

2.1. The disability projection model

The long-term care projection model referred to in this paper is described in detail in [7]. For convenience, a brief outline of the model is given below.

The model requires three main pieces of data:

- Prevalence rate data are required as a starting point, which show the proportion of the UK population at each age with a particular level of disability.
- Transition rate data are required in order to project the current healthy and disabled population forward. Transitions include, for example, healthy people becoming disabled, disabled people becoming more severely disabled and people dying.
- Trend data are required to indicate how the transition rates might change over time. For example, general improvements in the health of the UK population might make it less likely that a healthy person of a certain age becomes disabled during the following year.

The data set used to provide the prevalence rate data comes from the OPCS survey of disability in Great Britain [15]. This entailed the screening of representative samples of private households and communal establishments in 1985 and 1986, respectively. Although the survey took place nearly 20 years ago, it still represents the richest source of data for UK long-term care models.

The published report on the survey allocated disabled people to one often categories of disability with Category 1 the lowest and Category 10 the highest levels of disability. Rickayzen and Walsh [7] use a 12-state multiple state model comprising the healthy state ("category 0"), 10 states of disability and the dead state. A pictorial representation of the model is given in Fig. 2. The arrows indicate the annual transitions allowed in the model. It can be seen that a person can deteriorate to any other level of disability during the course of a year, but can improve by at most one level of disability in a year.

The transition rate part of the model was developed from considering data available in respect of the different transition components: mortality rates, disability inception rates and recovery rates. The parameters

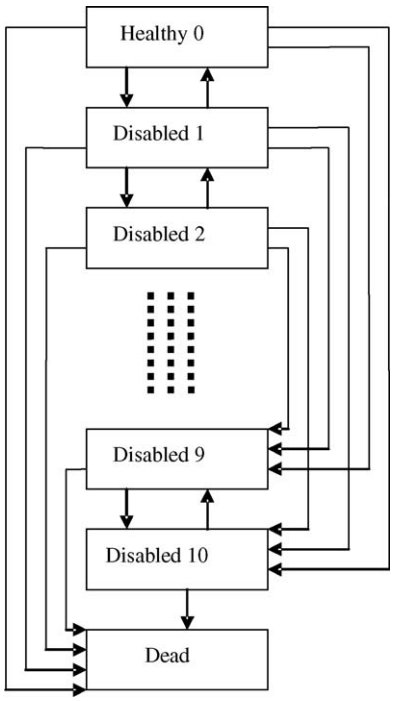

Fig. 2. The disability model.

were chosen such that the transition rate model generated the prevalence rates obtained from the OPCS survey.

Trends in healthy life expectancy data were then used to shape the assumptions made regarding changes in the transition rates over time. Due to the level of uncertainty in this part of the model, projections were made using 16 different sets of trend assumptions from the base year of 1996. Rickayzen and Walsh [7] quote the results from the central ("Basis C"), the most optimistic ("Basis N") and most pessimistic ("Basis A") sets of assumptions. The results for all 16 sets of assumptions can be found in [16].

In this paper we have used the assumptions which underlie Bases C, N and A in order to obtain central, optimistic and pessimistic results, except that an alteration has been made to the mortality rate assumption.

The overall mortality assumed throughout this paper is the IL92 mortality table (males and females, as appropriate) rather than the Government Actuary's Department central population projection for the period 1996–2036 [17], which was assumed in [7]. The reason for this is that using the IL92 tables will mean that the

mortality rates incorporated within the model increase smoothly with age. This change has an insignificant effect on the results.

We conclude our summary of the long-term care model by highlighting the differences between the three sets of assumptions used in this paper.

With Basis A (the most pessimistic assumptions), we assume no trends in the transition rates other than an improvement in overall mortality (which is implicit within both the IL92 tables and the GAD projections).

With Basis C (the central assumptions), in addition to the trend regarding overall mortality, we allow for the following improvement in disability rates: we assume that the probability that a healthy person aged x in year y becomes disabled in the following year is equal to the probability that a healthy person aged $x+1$ in year $y+10$ becomes disabled in the following year. This 1 year shift in age every 10 calendar years in relation to the probability of becoming disabled leads to this trend being described as "1 in 10". Since it is assumed that the probability of becoming disabled in a year increases with age, this represents an improvement in disability rates over time.

Basis N (the most optimistic assumptions) is similar to Basis C except that we assume a "1 in 5" rather than "1 in 10" trend regarding disability probabilities. We also assume a slight reduction in the probability that a disabled person becomes more severely disabled in the following year.

The reason for choosing Basis C as our central scenario is that, with these assumptions, there would be a gradual increase in healthy life expectancy over time, as well as in the expected time spent in disability. This is consistent with the information available from the national data sets [6]. The two other scenarios can be thought of as reflecting the compression of morbidity (Basis N) and the expansion of morbidity (Basis A) hypotheses mentioned in Section 1.2.

Rickayzen and Walsh's work [7] provides us with two pieces of information that are necessary for our analysis. Firstly, we obtain an estimate of the aggregate population split by age, gender and severity of disability for each year of the projection period. We denote by $n^{i}_{j,k,l}$ the number of individuals of gender i and cohort k belonging to severity group l in year j. Secondly, we have an estimate of the probability that an individual is in a certain state at some time in the future given that they were healthy at the outset. This variable will be denoted $\pi^{i}_{j,k,l}$ and represents the probability that a person of gender i and cohort k, who was healthy at the beginning of the projection period, belongs to the severity group l in year j.

2.2. Mapping from disability to care setting

The main principle behind the way in which the LTC sector in the UK operated during the post-war era was that local authorities provided care in residential homes, whereas the NHS took care of particularly frail people. However, in the 1980s this balance was disrupted by the increasing use of social security benefits as a means of funding long-term care. Social security benefits were provided without caps and means testing to fund people in residential homes in the private sector. As a consequence of this, expenditure grew from £ 350 million in 1985 to £ 2.5 billion in 1993/1994 [19].

In the 1980s, there was increased awareness that the incentives created by the system were out of kilter, and in 1988 a government report was presented which proposed some reforms to improve the system. Those suggestions were then incorporated in the 1990 *NHS and Community Care Act* which was implemented in 1993. To overcome perverse incentives for residential care, central government transferred money from social security to local authorities to be spent on care packages. The reform implied greater responsibilities for local authorities in the financing of LTC [11].

Following the reform, there were a number of significant changes in the structure of UK social services. Firstly, there was a sharp decline in the provision of home care services. From 514,000 being served in 1993 it had fallen to 373,000 in 2003. At the same time, however, the number of households receiving a substantial amount of care at home increased dramatically. Between 1996 and 2002, the average number of contact hours per household increased by 60%, leaving the total amount of hours provided in 2002 at a level 20% above the 1996 level [18]. As regards residential and nursing homes, there has been a relatively small decline in numbers from a peak in 1992 and the number of beds seems to have been more or less constant over the last few years [19].

Clearly, these trends are the effect of an interaction between policy changes and demographic changes. Between 1993 and 2002, the number of older people (people over age 65) increased by 3.5% in the United

Kingdom, whereas the number of people aged 80+ increased by 15%. This change in the composition of the older population is consistent with the observed fall in the number of recipients but increase in the number of contact hours per case. Given this ambiguity as to whether changes in overall provision patterns are driven by political decisions or the demography, we make the following simple assumption. We assume that the mapping between a certain level of disability and different care settings remains constant over the projection period and that the aggregate level of care provided depends mainly on the prevalence of disability in the population. In other words, we assume that the probability of ending up in a certain care setting given a particular level of disability does not change over time.

The Rickayzen and Walsh model [7] gives us, for each year of the projection period, an estimate of the entire UK population partitioned by severity of disability and gender. The Health Survey of England [20] provides an account of the number of residents in institutions and the prevalence of disability among them.[2] Together with additional information from the Department of Health, from the same data source, we are able to get a picture of the older population receiving formal home services, showing the aggregate numbers by gender and the prevalence of disability. Then, the population receiving no formal care can be treated as a residual, and we have a complete partition of the older population by care setting (nursing home, residential home, formal home care, no care) and disability (severe, moderate, no disability).[3]

The only other care setting which needs to be considered is in respect of people receiving informal care. To derive their numbers and distribution over different levels of disability, we use the following assumptions:

- Among the people receiving any domiciliary care (formal or informal), 80% receive informal care only, 10% receive informal and formal care, and 10% receive formal care only (cf. [21]).
- Nobody who is entirely healthy receives informal care.
- Everybody with severe disability receives some form of care. This means that people who are not covered by any other care setting are assumed to receive informal care.

Together, these three assumptions uniquely determine the size and distribution over different disability levels of the population receiving informal care. Thus, for all care settings under consideration, we have derived a conditional probability of ending up in a particular setting given gender and a certain level of disability. By doing so, we account for the heterogeneity—in terms of disability—of people within every care setting, a fact that has been ignored in most previous studies. On the other hand, availability of data forces us to define long-term care quite 'narrowly'. For instance, certain community care services—day care, community nursing—and long-stay hospital care have been excluded. This will have implications for the projections of aggregate costs and implied tax rates.

If we denote by $S^i_{l,m}$ the probability that a person of gender i and with disability level l is in care, setting m, we are able to calculate the aggregate population in a certain care setting in a certain year, j, for anyone aged 20 and over, as

$$N_{m,j} = \sum_{k=j-120}^{j-20} \sum_{l=0}^{2} \sum_{i=0}^{1} n^i_{j,k,l} S^i_{l,m}$$

where $j = 2000, 2001, \ldots, 2050$ and 120 is the assumed maximum age to which an individual can live.

The mappings from disability into care setting, corresponding to the variable $S^i_{l,m}$ in the equation above, are provided in Table 1.

2.3. Formal care

2.3.1. Care costs

Over the period 1993–2002, the unit price of social care services increased by 3.7% per annum whereas the price of health care services increased by 3.2% per annum [22]. These figures should be compared with the inflation rate of 1.7% per annum on average, and average wage inflation rate of 4.1% per annum. Hence,

[2] This survey covers England only, and thus it is an implicit assumption in our work that the distribution over care settings and disability levels are common to the entire UK.

[3] The Health Survey of England is less detailed than the OPCS scale used in the Rickayzen and Walsh model [7] in that it only distinguishes three different severity levels: healthy, moderate disability and severe disability. However, these categories correspond fairly well to OPCS scale 0, 1–5 and 6–10, respectively. A more complete account of how this mapping is derived can be found in [19].

Table 1
Probability of being in different care settings, given gender and disability

Category	Nursing home	Residential home	Informal care	Informal + formal	Formal only	No care	Total
Men							
No disability	0.001	0.006	0.000	0.000	0.035	0.958	1
Moderate disability	0.003	0.009	0.305	0.047	0.014	0.622	1
Severe disability	0.040	0.064	0.812	0.085	0.000	0.000	1
Women							
No disability	0.002	0.012	0.000	0.000	0.043	0.943	1
Moderate disability	0.003	0.018	0.425	0.052	0.015	0.487	1
Severe disability	0.105	0.192	0.622	0.080	0.000	0.000	1

although the prices of LTC services increase faster than general prices (a phenomenon known as Baumol's disease), they fall short of the general increase in earnings. The latter gap either reflects a productivity increase in the care sector, or the fact that relative wages in this sector are lagging behind wages in the rest of the economy.

To account for the divergent possibilities that future price increases in the care sector will continue to fall short of general wage inflation, or that the increased demand for these services actually triggers a disproportionate increase in their prices, we allow for three alternative scenarios. Our baseline assumption is that the *relative* prices of LTC services are constant in terms of labour (hence the *absolute* prices increase in line with wages). As alternatives, we consider the effect of having LTC prices grow 0.5% slower (faster) per year than wages.

Costs for formal care have been acquired from Laing and Buisson [23] for institutional care and [24] for domiciliary care. Annual figures are provided in Table 2. It should be noted that although the sums are expressed in pounds, we are not producing monetary projections but projections of the cost of care in terms of labour. Thus, the most relevant measure of the overall burden of LTC costs is the implied contribution rate, to be given below. It should also be noted that the formal home care item only covers personal care services in the strict sense—nursing care, meals and so on are not included.

Table 2
Average cost of care by setting. 2001 prices

Setting	£ per annum
Residential home	18356
Nursing home	23868
Formal home care	3016

Denoting by γ_m the total cost of care in setting m, we can calculate aggregate costs for each year by

$$C_{m,j} = N_{m,j}\gamma_m$$

2.3.2. The economy

The real interest in a projection of LTC costs is not how many pounds LTC expenditure will be required in the future, but how much the LTC sector will burden the economy. We adopt a simple method here that circumvents many of the dynamic problems characterising forecasts of this kind. As our baseline scenario, we assume that the relative prices of LTC services in terms of labour remain constant throughout the period and calculate the costs of LTC as a share of total labour remuneration in the economy.

To get a projection of the future wage sum, which is used as a basis to fund LTC, we took the average income by age group and sex in 2000—obtained from the Inland Revenue Statistics [25]—and multiplied it by the total population in each age group in all subsequent years (as given by the GAD forecasts). Formally, define y_i^a to be the average labour income per person of gender i in age group a and $n_{j,i}^a$ to be the number of individuals of gender i and age a at time j. Then, the projected wage sum, based on persons aged 15 or over, in year j is equal to

$$\mathrm{WS}_j = \sum_{i=0}^{1} \sum_{a=15}^{120} y_i^a n_{j,i}^a$$

Thus, the implicit assumptions we make are that, firstly, there is no productivity growth in the LTC market and that, secondly, the costs of LTC services (which

mainly consist of wages) increase at the same rate as labour remuneration in the economy in general. However, we analyse the implications of relaxing these assumptions (as indicated earlier in this section) in Appendix B.

2.4. Informal care

2.4.1. Care costs

We have assumed that informal care is provided for 30 h per week.[4] To assess the value of one hour of informal care, we use an opportunity cost approach for non-retired carers and apply the minimum wage (£ 4.20 h^{-1} in the base year, 2001) for retired carers. The average wage for full-time workers was £ 10.66 h^{-1} in 2001 [26]. Since carers below retirement age provide around 75% of all informal care [27], this would imply an average cost of informal care of £ 9.05 h− or £ 14,103 per year.

2.4.2. Supply of care

It is a common concern that there may be a shortage of informal carers if certain discernible trends carry on in the future. These trends are, inter-alia, the increase in single person households, the rising number of childless older people and the increase in the proportion of females in paid employment. It should be noted, however, that there are some trends that could be expected to countervail these threats to informal care provision. These trends are, for instance, a decreasing age at which people retire together with an improvement in health among younger retirees. Taken together, this implies that there will be a larger pool of able retirees available in the future to provide informal care. Furthermore, changing social values might lead to increased male participation in this traditionally female activity.

Given all these uncertainties, the best that can be done is to consider the past to get some guidance concerning the likely implications of the trends listed above. One good source of information is the General Household Survey, which offers comparisons over time by studying different cohorts. Previous research [28] shows that, as expected, the composition of the informal care provision has changed markedly over the last 15 years. There has been a marked drop in the provision of care coming from outside the household, whereas the proportion of people providing care within their own household has remained more or less constant. Overall, there has been a marked decrease in the number of people providing care to parents or parents-in-law, whereas the provision of care to spouses has increased significantly. This means that the total number of carers has declined at the same time as there has been an increase in the number of carers who provide the most intensive care; the overall effect, therefore, is uncertain.

As our baseline scenario, we make the conservative assumption that care-giving patterns remain as they are and then test how sensitive our results are to alterations in this assumption. We alter our assumptions in two dimensions; one is on the demand side, where we check the implications of our ‘pessimistic’ and ‘optimistic’ scenarios. Secondly, we look at the supply side and assess to what extent a convergence in male and female care patterns over the next two decades would change the results. Concerning this dimension, we consider, firstly, male care-giving patterns converging to female rates. One development producing such a result would be if trends in early retirement and improved health among young retirees proved to dominate the other trends mentioned above. An alternative hypothesis is that female care-giving rates converge to male ones, which would result in a considerable reduction in the total number of hours of care provided. This scenario is likely if the emancipation of women and changing family structures dominate the other trends.

We have projected the supply of care under the assumption that the relative supply by age and sex remains constant over the next couple of decades. Our data source in this section is the Family Resources Survey [27]. A summary of the data we use is given in Table 3. It should be noted that the percentages given in the columns labelled “carers in total population” refer to the total population within that subgroup of the population, and thus the percentages are not expected to sum to 100.

We assume that only relatively healthy people (OPCS levels 0–3) provide informal care. Thus, in Table 3 we have converted the frequencies from the survey into frequencies for the relatively healthy population. It is then straightforward to project the number of informal carers available in the future. We ignore

[4] The figure is consistent with the Family Resources Survey [27].

Table 3
Informal carers in population and amount of care provided

	Male			Female		
	Average care (hours per week)	Carers in total population (%)	Carers in healthy population (%)	Average care (hours per week)	Carers in total population (%)	Carers in healthy population (%)
11–15	9.38	1.5	3.5	9.95	2.1	
16–24	12.30	3.5	3.5	17.70	4.4	4.5
25–34	19.09	4.5	4.6	19.08	9.1	9.4
35–44	19.88	6.9	7.1	20.45	13.3	13.8
45–54	16.31	11.7	12.2	18.30	21.5	22.6
55–59	17.78	12.8	13.6	20.03	20.3	21.8
60–64	22.83	13.2	14.4	20.65	19.3	21.4
65–74	22.85	13.2	15.2	24.75	13.4	16.0
75–84	30.64	10.4	14.2	28.28	7.6	11.3
85+		6.8	16.0		3.6	9.6

Source: [27].

the small number of carers who are under 20 years old.

3. Results

The results are presented below, in the same order as the model and its assumptions were outlined in Section 2 (cf. Fig. 1).

3.1. The disabled population

Fig. 3 shows the projected number of disabled people, as well as the entire projected older population. According to our baseline projection (which corresponds to scenario C in [7]), the number of disabled older people will increase continuously up to the second half of the 21st century. However, it can be seen that the increase in the number of disabled people is lower than

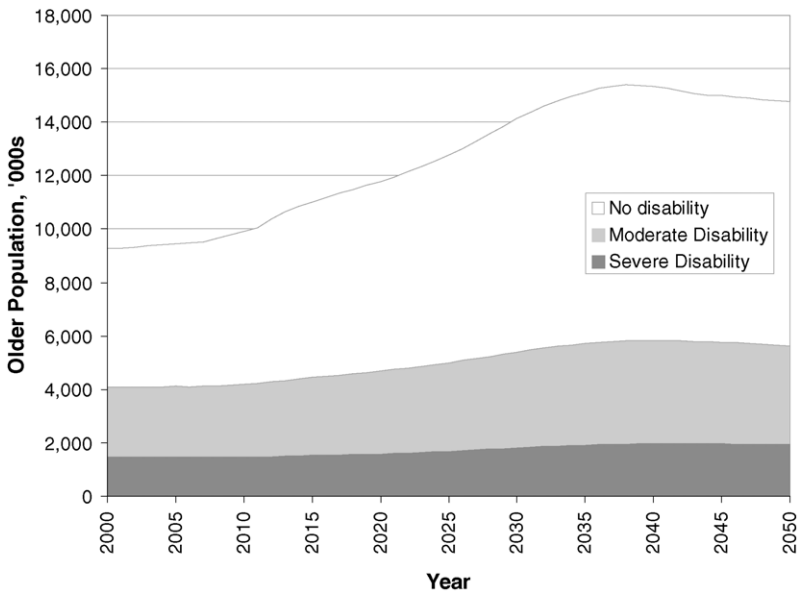

Fig. 3. Projected number of older people by severity of disability: baseline scenario, United Kingdom.

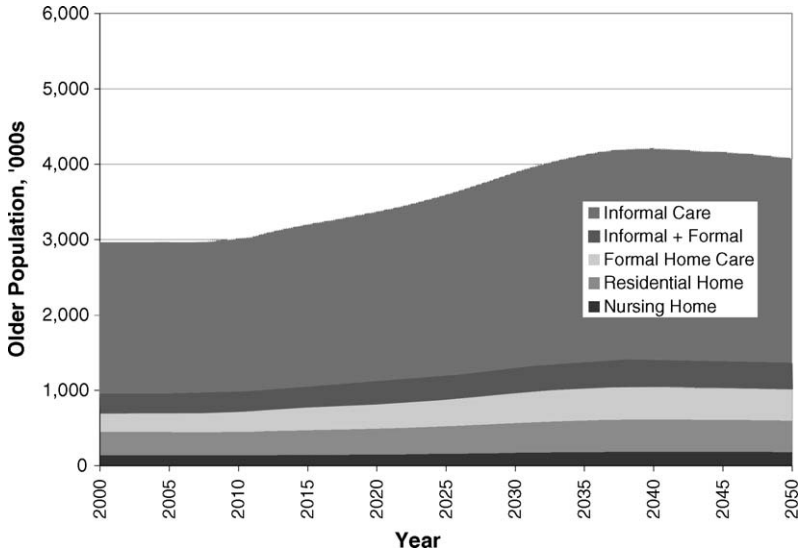

Fig. 4. LTC population by care setting: baseline scenario, United Kingdom.

the increase in the total older population, which reflects a general improvement in health status amongst the older population implicit in this scenario.

3.2. Care settings

Assigning to the severity levels the probabilities derived above (Table 1), we calculate the projected total population in each care setting for the same time period. Results are given in Fig. 4.

As expected, the largest increase—in absolute terms—will be in the number of older people receiving informal care. This population is projected to increase from around 2.2 million today to some 3.0 million in 2050. In relative terms, the changes are all of the same magnitude: the institutionalised population is projected

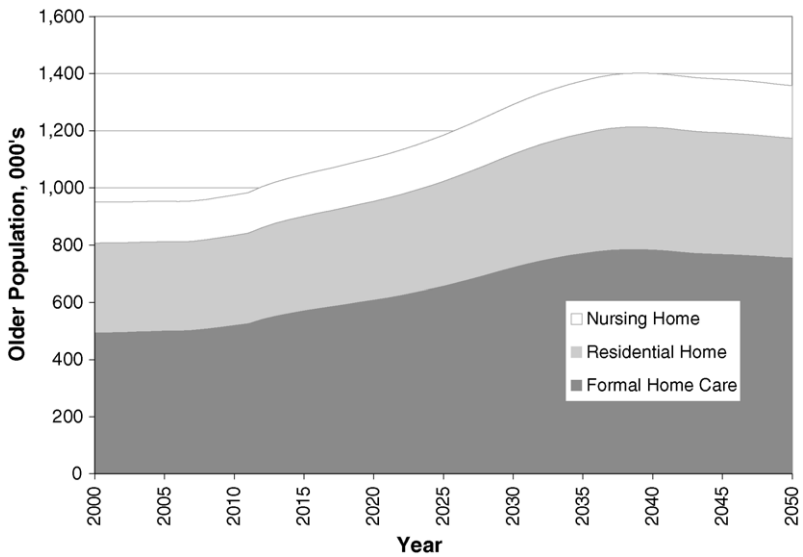

Fig. 5. LTC population receiving formal care: baseline scenario, United Kingdom.

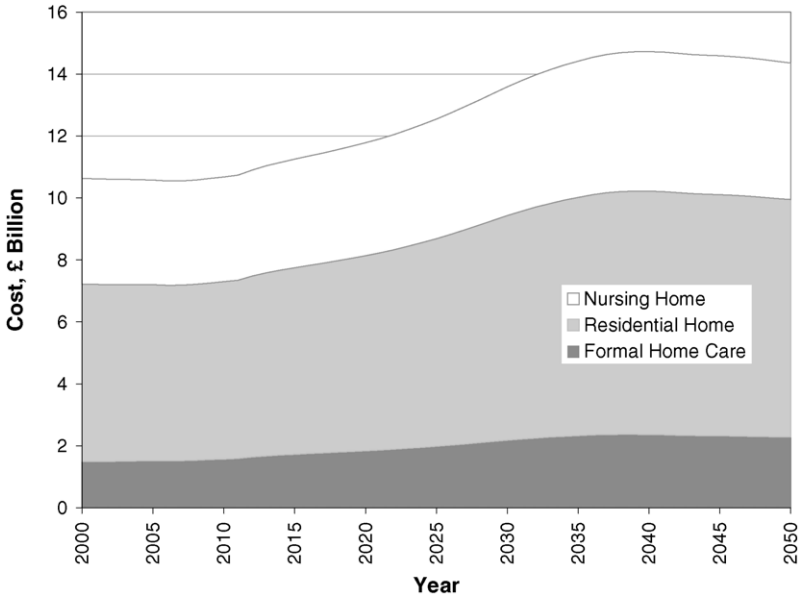

Fig. 6. Total costs of formal care services: baseline scenario, United Kingdom.

to increase by 32% over the next 50 years, compared to 36% for recipients of informal care. The number of recipients of formal home care services is projected to rise more rapidly in the first three decades but then growth slows down, so that the total relative increase over the next 50 years is 53%.

3.3. Formal care

We now consider the population receiving formal care in more detail. The projection is depicted in Fig. 5. According to the projection, the main increase in formal services is to be expected in domiciliary care. In fact, the demand for care in institutions is projected to be more or less constant during the first 15 years of the projection period. Generally, the nursing home population is projected to grow slightly more slowly than the residential home population. All three care settings reach their peaks around 2040, after which needs decrease slightly.

The next step is to estimate the total costs of formal care, using the figures in Table 2. Our projections are presented in Fig. 6. According to the projection, formal care costs are going to rise from around £ 11 billion in 1996 to around £ 15 billion in 2040 (in 2001 prices). Despite this increase, the proportions spent on the different settings remain fairly constant over the projection period, with residential care comprising more than 50% of total spending and domiciliary care less than 20%.

The costs outlined in Fig. 6 are covered by different sources of funding (mainly out-of-pocket payments and general taxation). To calculate the development of the burden for each separate source, we assumed that the mix between different sources of funding remains the same for each care setting in the future.[5] The cost levels so derived are presented in Fig. 7. By 2030, total public spending is projected to increase by 30% compared to 1996, and by 37% in 2050 compared with the same base year. Out-of-pocket payments are projected to increase slightly less 26% by 2030 and 33% by 2050.

However, the cost of care projections are more interesting when they are compared with the overall size of the economy, since this comparison will indicate the total burden of LTC. This is an important issue, espe-

[5] This assumption implies that the retired population experience an increase in earnings and wealth that follows the incomes of the working population, and that the government adjusts means testing parameters accordingly over time. It should be noted, however, that this assumption becomes increasingly problematic the greater the time horizon, due to, for example, the effects of unknown future policy changes.

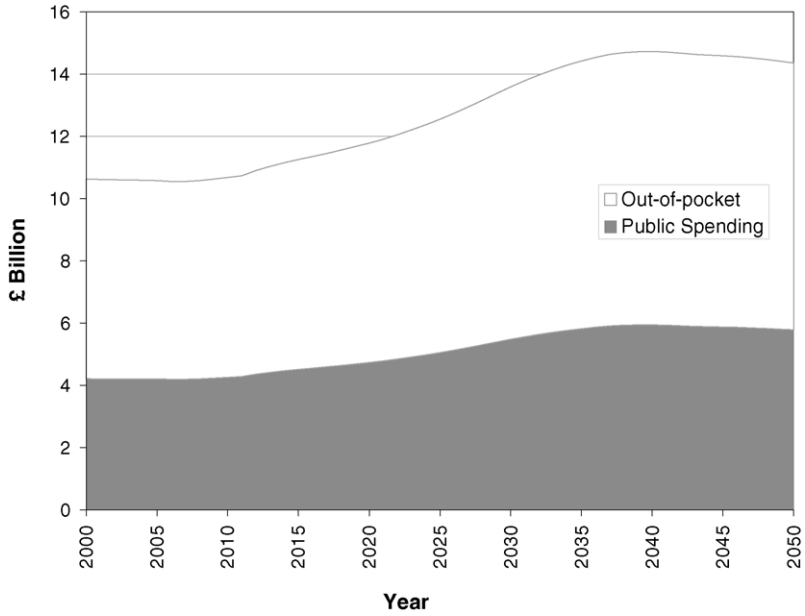

Fig. 7. LTC costs by payer: baseline scenario, United Kingdom.

cially with regard to public funding. To illustrate how public LTC costs are estimated to evolve over the next few decades, we express the costs as a percentage of future wage sum of the UK economy.

Our projection of the wage sum (in 2001 prices) is given in Fig. 8. It shows that the capacity of the economy is projected to increase sharply over the next 20 years—reaching a peak in 2021—reflecting a

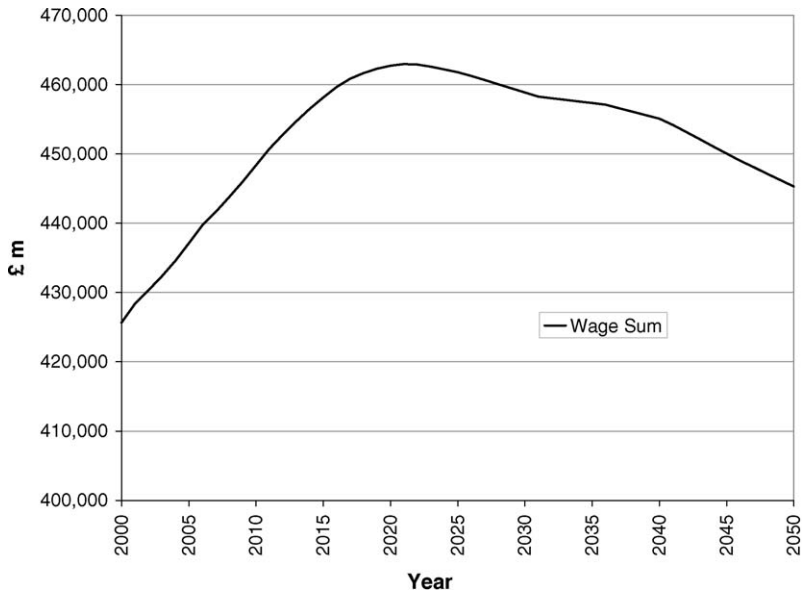

Fig. 8. Projection of the wage sum (in 2001 prices) as given by the working age population, United Kingdom.

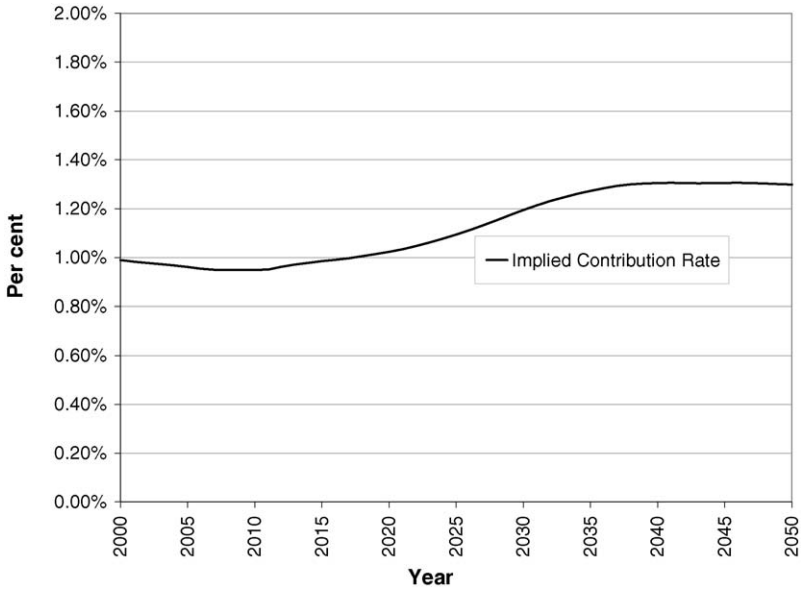

Fig. 9. Implied contribution rate for LTC: baseline scenario.

favourable age distribution of the labour force (more workers in more productive ages). After that, however, the wage sum is expected to decrease steadily over the next couple of decades, reflecting a shrinking labour force.

The next step is to divide the projected public LTC cost by the wage sum, to arrive at an implied contribution rate (assuming LTC to be financed out of general and approximately proportional income taxes). The projection is shown in Fig. 9. The results show that the contribution rate is expected to decrease slightly over the next decade from 1.0%, reaching a low of 0.95% in 2010. After that, it increases continuously until around 2040, when it reaches 1.3%, reflecting, first, the increase in LTC costs and later, also, the decrease in the wage sum.

3.4. Informal care

3.4.1. Demand for care

Informal care is 'financed' from a different source—namely 'in-kind' delivery. Fig. 10 shows the number of recipients of informal care by gender. The demand for informal care is projected to increase considerably, to reach a level 40% higher than today in 2040. Furthermore, the proportion of male recipients increases from 35 to 40% over the next decade and then stabilizes at around that level.

There are approximately twice as many recipients of informal care as there are recipients of formal care services. Therefore, informal care accounts for the bulk of the resources spent on care. When we use the assumption that the value of informal care is £ 14,103 per year per recipient (see Section 2.4), we estimate a total cost of approximately £ 32 billion at the beginning of the projection period (in 2001 prices), i.e. almost three times as much as the total formal care costs (see Fig. 6). Furthermore, informal care costs are projected to increase at a slightly greater rate than formal care costs over the projection period.

3.4.2. Supply of care

The approach so far in this paper has been a demand-driven one, i.e. we have assumed that the LTC sector will not be constrained by the supply of care and carers. However, as mentioned in Section 2.4, there is widespread concern that the availability of carers will be insufficient in the future. To investigate this, we have projected the supply of care under the assumption that the relative supply by age and sex remains constant over the next couple of decades. Results are provided in Fig. 11. The total number of informal carers is pro-

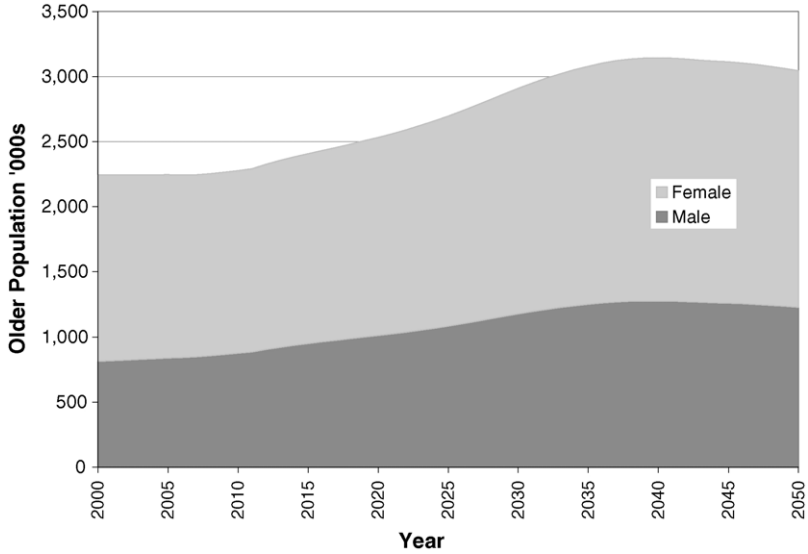

Fig. 10. Recipients of informal care by gender: baseline scenario, United Kingdom.

jected to increase by 18% over the next 40 years, and then to decline somewhat thereafter.

We also projected the future amount of care available measured in hours, given the averages provided in Table 3. Since no averages were provided for the age 85+ population, we assumed that their provision of care is similar to the supply of the age group 75–84 (the 85+ age group is very small in comparison, so this assumption is not crucial for the results). Results are presented in Fig. 12.

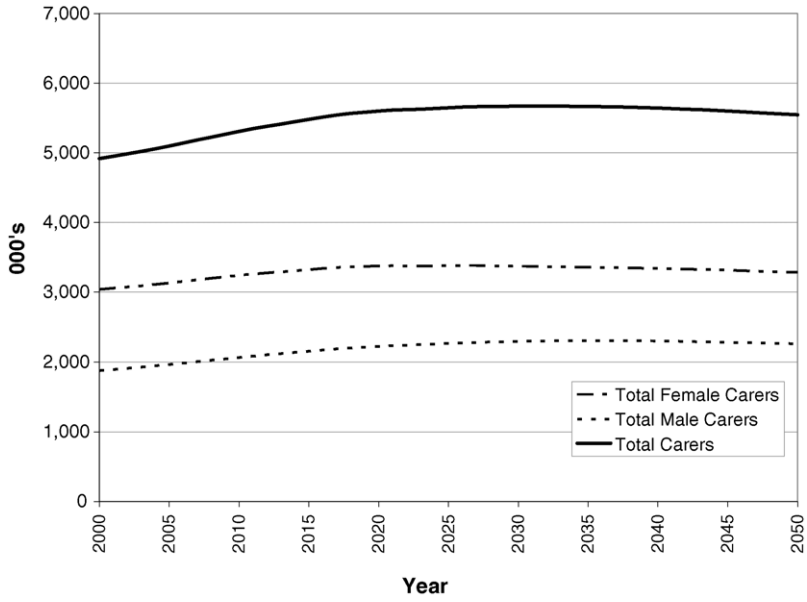

Fig. 11. Supply of informal carers, 2000–2066, United Kingdom.

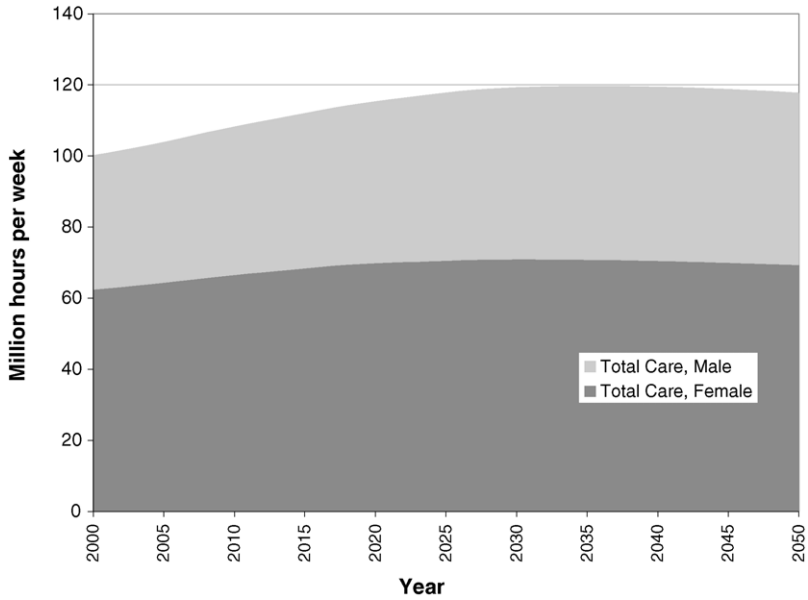

Fig. 12. Projected amount of informal care supplied.

The number of hours of informal care supplied is projected to follow roughly the same pattern as the number of carers, increasing by 17% in the next 40 years and then falling to a level some 10% above the current one. These figures may be compared with the projected demand for informal care, which is expected to increase by 41% over the next 40 years and then eventually to fall back to a level 20% above the present one. Thus, our projection for the older population indicates that there will be a shortage of informal care for some decades, unless the patterns of provision change.

To get a complete picture of the relationship between demand for, and provision of, informal care we need to take the needs of the non-retired population into account, since these comprise around one-third of the recipients. Since we do not have data on the relationship between disability and demand for care for this group, we simply assume that the individuals in the younger population with an OPCS level of five or more demand informal care. This threshold value is consistent with the data in the sense that is makes total demand meet total supply and, furthermore, makes demand by the non-retired population comprise roughly one-third of total demand at the beginning of the projection period. We plot the demand and supply of informal care in Fig. 13.

Fig. 13 indicates that the proportion of younger recipients requiring informal care tends to decrease from roughly one-third initially to 20–25% from 2030 onwards. This change also reflects a small decrease in absolute numbers, since the total number of disabled younger people is projected to decline over the next three decades. Looking at the total demand compared with total supply, we can conclude that, under our baseline assumptions, a shortage of informal care does not seem to be a big problem over the next couple of decades. Until 2030, there is an excess of supply of informal care, implying that there are more carers available than required. After 2030, demographic changes decrease the number of carers and at the same time increase the number of people requiring care, so that a shortage of carers arises. This period lasts for almost three decades. The peak is reached in 2042, when the shortage is 4.92 million hours per week or 4.1% of total care needs. This corresponds to around 250,000 carers, assuming that the average carer provides 20 h of care per week.

3.5. Sensitivity analysis

We consider three types of sensitivity analysis. Firstly, we analyse to what extent the results are sen-

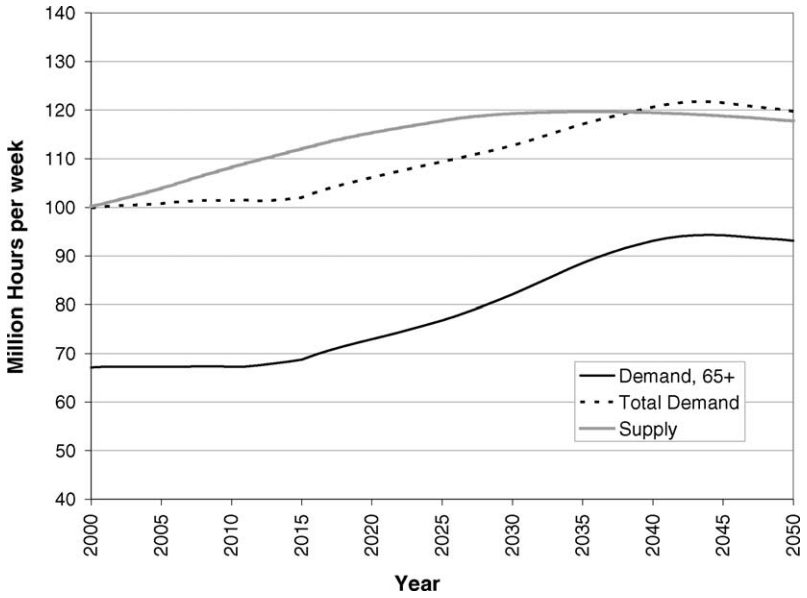

Fig. 13. Demand and supply of informal care, 2000–2066. Millions of hours per week, baseline scenario.

sitive to changes in the disability scenarios (taking the 'optimistic' (N) and the 'pessimistic' (A) scenarios of the Rickayzen and Walsh model [7] into account). Secondly, we analyse whether the projections regarding informal care are sensitive to changes in care-giving patterns. As a third test of the robustness of the results, we allow for different assumptions regarding the inflation rate; results on this part are presented in Appendix B.

3.5.1. The disabled population

3.5.1.1. The pessimistic scenario. The pessimistic scenario (Basis A in [7]) assumes that transition rates between disability levels remain constant throughout the projection period. The assumption that no further improvements in health occur has a strong impact on the results. Whereas in the baseline scenario the number of severely disabled people peaks at 2.0 million in around 2050 (see Fig. 3), the corresponding figure for the pessimistic scenario is 3.5 million (see Fig. 14). The number of care recipients increases accordingly as shown in Fig. 15. In this pessimistic scenario, the total number of recipients peaks slightly below 6 million, compared to 4.2 million in the baseline scenario (see Fig. 4).

3.5.1.2. The optimistic scenario. The optimistic scenario assumes some further health improvement in the population over and above the baseline scenario. With this scenario, the proportion of the older population that suffers from some degree of disability falls considerably throughout the projection period. The proportion of the older people with any disability starts at 43% in 1996, falls to 30% in 2040 and reduces to 23% in 2066. A graph of the older population, divided into the three disability categories, is given in Fig. 16.

The optimistic scenario also changes the results considerably. Whereas in the baseline scenario the number of severely disabled people peaks at 2.0 million around 2050, the corresponding figure for the optimistic scenario is 1.3 million (see Fig. 16). The number of care recipients decreases accordingly, as illustrated in Fig. 17. In the optimistic scenario, the total number of recipients peaks at around 3.4 million, compared to 4.2 million in the baseline scenario. Total LTC costs follow the same pattern, reaching a peak of £ 45 billion around 2040, compared to £ 57 billion in the baseline scenario.

3.5.1.3. Formal care. Total costs for the three different care settings under the two alternative scenarios are presented in Figs. 18 and 19. These can be com-

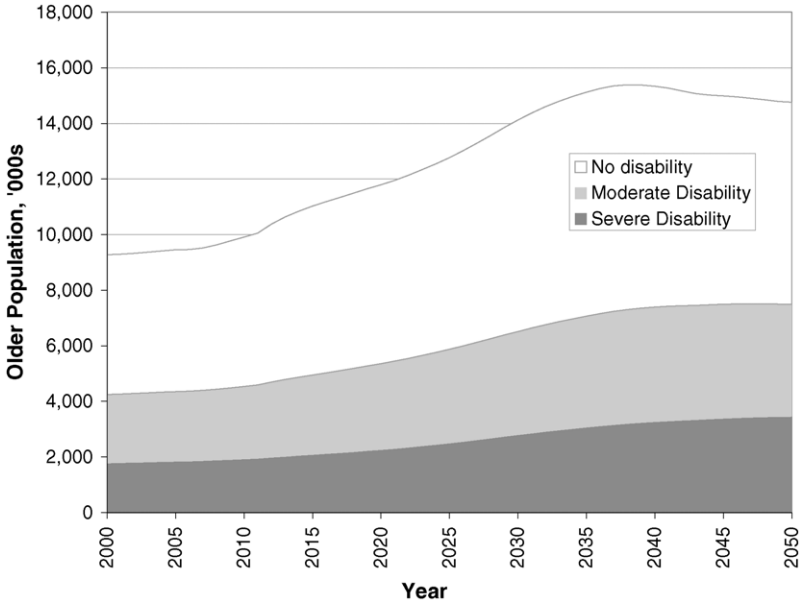

Fig. 14. Projected number of older people by severity of disability: pessimistic scenario, United Kingdom.

pared with the baseline scenario in Fig. 6. There is a considerable difference between the two extreme scenarios. The pessimistic scenario peaks as late as in 2051 with more than £ 20 billion in total LTC expenditure. The optimistic scenario, on the other hand, peaks in 2037 with LTC expenditure of £ 11.9 billion. As already noted, the baseline scenario peaks in 2040 with £ 15.0 billion of LTC expenditure. Thus, the

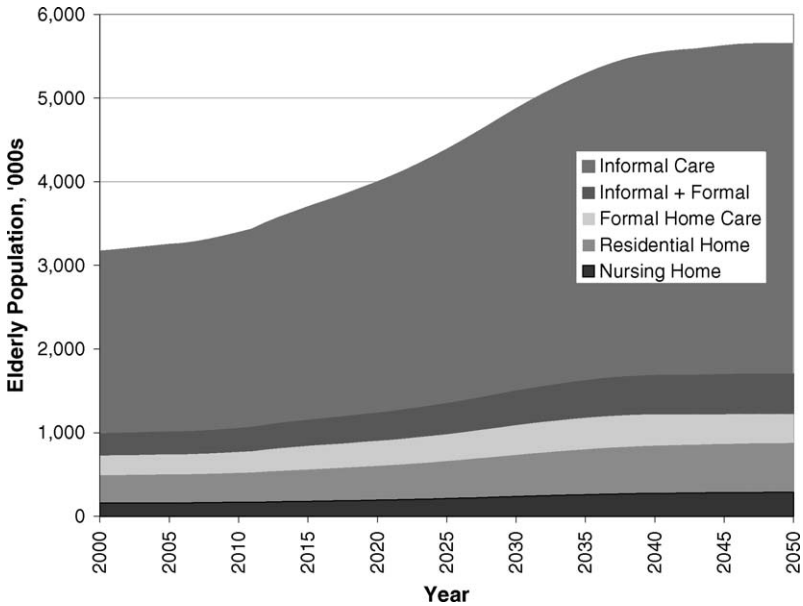

Fig. 15. Number of individuals in each care setting: pessimistic scenario.

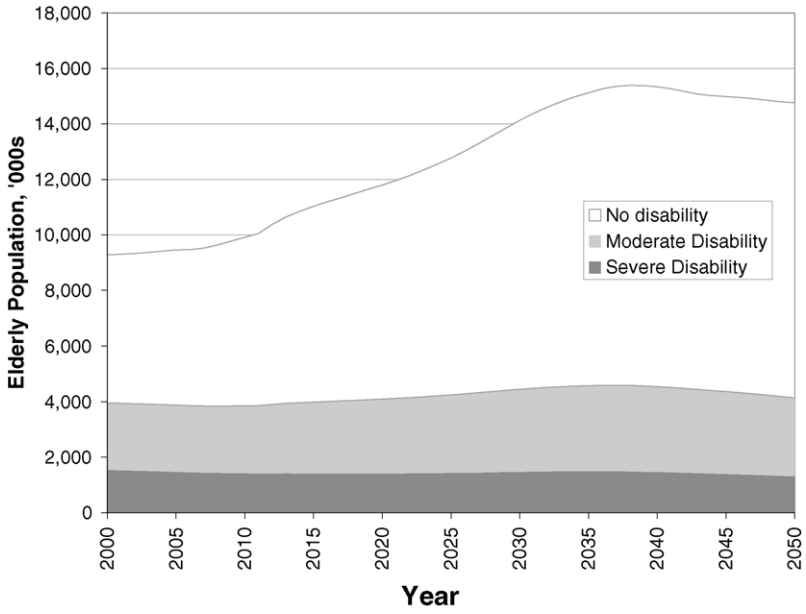

Fig. 16. Projected number of older people by severity of disability: optimistic scenario, United Kingdom.

baseline scenario is somewhat closer to the optimistic scenario.

In general, the span between the two extreme alternative scenarios is considerable. In 2030, total costs for formal LTC is projected to amount to £ 17.5 billion according to the pessimistic scenario. The corresponding figure for the optimistic scenario amounts to £ 11.4 billion (i.e. 35% lower).

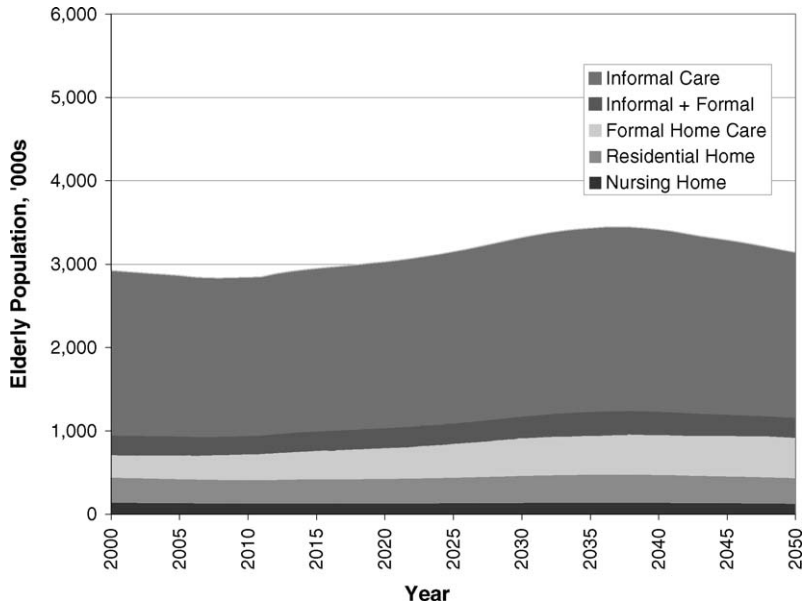

Fig. 17. Projected number of older people by care setting: optimistic scenario, United Kingdom.

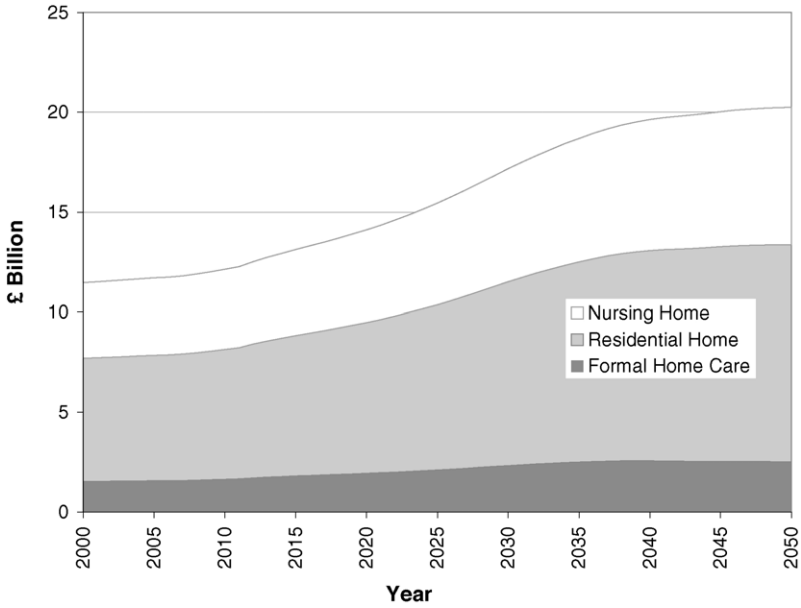

Fig. 18. Total costs of formal care services: pessimistic scenario, United Kingdom.

The figure for the baseline scenario is £ 13.8 billion.

Finally, we offer a comparison of the implications for the public funding of LTC under the three scenarios (Fig. 20), assuming that the eligibility rules are the same in all three cases. It transpires that the assumptions made regarding the future development of disability have a considerable impact on the contribution rates

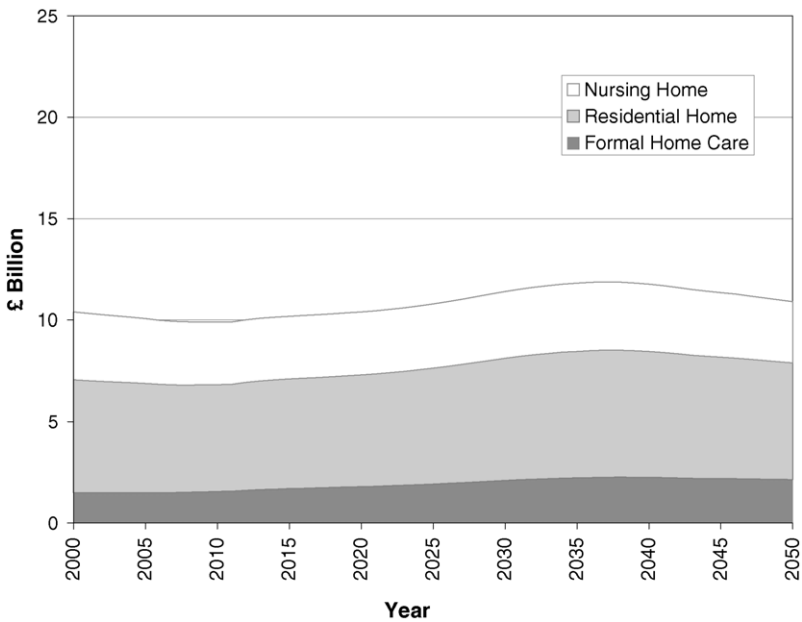

Fig. 19. Total costs of formal care services: optimistic scenario, United Kingdom.

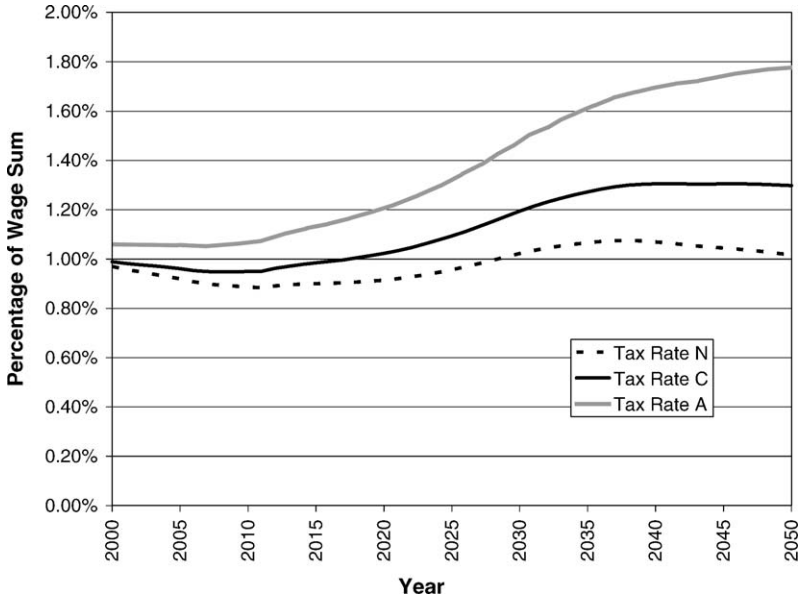

Fig. 20. Implied contribution rate for different scenarios.

needed to finance LTC. In the pessimistic scenario, the tax burden increases almost continuously over the projection period, reaching a peak at 1.8% around 2050. The optimistic scenario, on the other hand, would temporarily allow for some tax cuts, and the required contribution rate remains fairly constant throughout.

3.5.1.4. Informal care. In this section, we alter the baseline assumptions in two ways. Firstly, we allow for the two alternative scenarios concerning health improvements in the population. This assumption has implications for demand for care (as the number of dependent people changes) and supply of care (as the number of healthy potential caregivers changes). Secondly, we analyse the effects of having male care-giving patterns converge to those of females (and vice versa) over the first two decades of the projection period. Interacting these changes in assumptions with each other, we arrive at nine alternative scenarios. The six combinations which involve either the central or the pessimistic health scenario are shown in Fig. 21.

In Fig. 21, thick black curves (CM, CB and CF) refer to the central health scenario, whereas the three thinner grey curves (AM, AB and AF) refer to the pessimistic health scenario. Within each health scenario, the top curve (CF and AF, respectively) correspond to the scenarios where male care-giving patterns converge to female ones during the first 20 years of the projection period. Similarly, the lowest curves within each health scenario (CM and AM) represent the opposite assumption that female care-giving patterns converge to the male ones. Finally, the two remaining curves (AB and CB) correspond to the baseline assumption that care-giving patterns within each population group remain constant. We have excluded the optimistic health scenario (base N) in the figure, since in this case, no deficit of carers arises under any assumptions on the care-giving patterns.

It is obvious from Fig. 21 that with the baseline health assumptions (base C), scenarios assuming convergence to female care-giving patterns (CF) or no convergence (CB) are not very problematic. In the latter case (CB), a small deficit of care supply occurs towards the end of the projection period, corresponding to at most 2% of demand for informal care. By contrast, if we assume convergence to female care-giving patterns (CF), there is no deficit at all.

In the pessimistic health scenario, on the other hand, the balance between supply of, and demand for, informal care is constantly deteriorating throughout the projection period, especially in the cases of convergence to male care-giving patterns (AM) or constant care-giving

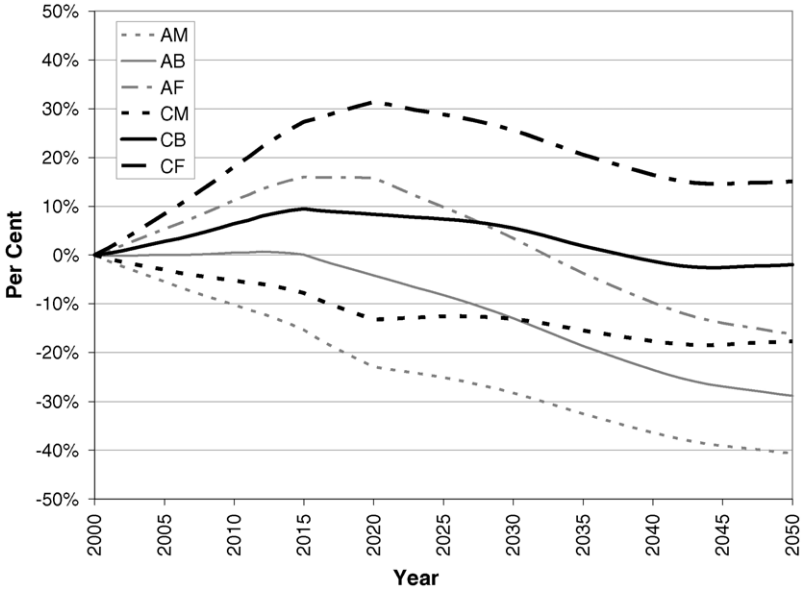

Fig. 21. Excess supply of informal care expressed as a percentage of total demand.

patterns (AB). By 2020, the most pessimistic combination of assumptions (health scenario N and male convergence; AM) projects a deficit corresponding to 23% of the total amount of care demanded. This is equivalent to 33 million weekly hours of care or around 1.6 million carers (assuming 20 h per carer per week). By 2050, this gap has widened to around 41% or around 3.5 million carers. If, instead, we assume that care-giving patterns remain constant (scenario AB), the gap between demand and supply is somewhat smaller; in this case it corresponds to 4.2% of demand (496,000 carers) in 2020 and 29% of demand (2.7 million carers) by 2050.

However, even with the assumptions of the baseline health scenario, a convergence towards male care-giving patterns (scenario CM) is problematic. In this case, the balance between demand and supply deteriorates rapidly between 2000 and 2020 and then fluctuates between 10 and 20% of demand for the rest of the projection period. This corresponds to between 10 and 20 million hours of care per week, or between 500,000 and 1 million carers.

In conclusion, we have found that the availability of informal carers is, potentially, a severe problem for some scenarios, including all the scenarios based on pessimistic health assumptions (Basis A). On the other hand, if the improvement in health among the elderly is in line with our optimistic health improvement scenario (Basis N), there may well be a sufficient supply of carers under any of our assumptions regarding the care-giving assumptions. Furthermore, it seems that altering assumptions on care-giving patterns has a stronger effect in the short term (2000–2030), whereas altering health assumptions has a stronger effect in the long term (2030–2050).

4. Conclusion

Long-term care is a very complex issue and the development of demand for LTC services is determined by, inter-alia, the prevalence of disability in the population, economic factors, the institutional environment, preferences, family structures, and the interaction between them. In order to project the future development of the LTC sector, it is necessary to focus on the aspects that are deemed particularly important. In this paper, we have focused mainly on how the prevalence of disability among the older people interacts with the institutional environment and the general development of the economy, assuming that all other aspects are unchanged throughout the projection period. Further-

more, we restrict our attention to the core set of LTC services (institutional care and personal home care) for which there are reliable disability data available.

Our projections of future needs for care have produced many interesting results. We have been able to show that, given our central assumptions, the demand for long-term care will start to increase considerably about 10 years from now, and reach a peak somewhere after 2040. The most important increase will be in informal care, since the number of older recipients is projected to increase from 2.2 million today to 3.0 million in 2050. In relative terms, the increase is similar in all care settings, amounting to between 30 and 50% compared to the levels today. The most noticeable increase is in formal home care, however, which is projected to be almost 60% greater than the current level in 2040. Yet, since those services are relatively cheap, this item has a relatively small impact on total spending.

The increasing demand for care will influence total costs. The total costs of formal long-term care as defined in this paper amount to around £ 11 billion today and will, in constant prices, increase to around £ 15 billion around 2040. A more appropriate way to measure the total costs of care is to put it in relation to the economy. We have done so by modelling the age distribution of the labour force (as a proxy for productivity) and have found that the increased demand will put an upward pressure on the tax monies necessary to cover LTC costs. This contribution rate will increase from around 1.0% today to 1.3% in 2050 under our baseline assumptions.

Our central assumption of future improvements in health status results in projections that produce somewhat more favourable results than many previous studies. Ref. [9] projected an increase in the volume of formal LTC services by 61% between 1995 and 2031. In our baseline scenario, the corresponding increase is around 32%. The model in [8] projected an increase in total LTC services by 40% between 2001 and 2031. We estimate the increase to be only 31%. When our findings are contrasted with the results of the latest published version of the PSSRU model [9] we find that: (i) the projected increases in the disabled older population are considerably higher in the PSSRU model, (ii) the institutionalised population, in particular, increases more in the PSSRU model, but (iii) due to different assumptions regarding the macro-economy, these differences do not transmit into the projections of the LTC sector as a proportion of the economy. A more detailed account of the differences between our results and those of the PSSRU model is provided in Appendix A.

Hence, comparing the effects of our relatively pessimistic baseline assumption concerning the prices of LTC services (i.e. that they follow wage inflation, a phenomenon known as Baumol's disease) and the relatively optimistic assumptions regarding the health status of the older people, it transpires that the former dominates as far as the public finances are concerned. Thus, despite the fact that we allow for a continuous improvement in the health of older people, our approach delivers more pessimistic prospects for the public finances than alternative approaches.

It transpires that our findings are relatively sensitive to the assumptions made concerning the trend in future disability rates in the older population. When we contrast our baseline scenario with a more pessimistic one—assuming no future health gains—we find that total costs keep on growing for longer and peak only in 2051 at a total of £ 20 billion (£ 80 billion when informal care is also considered). This translates into an implied tax rate of 1.8%, which is considerably higher than in the baseline scenario (1.3%). On the other hand, if a more optimistic scenario is considered, we get much more favourable results. In this case, we have total care costs peaking in 2037 at £ 11.9 billion (£ 45 billion when informal care is included), which translates into an implied tax rate of 1.1%.

Regarding informal care, we find that under the baseline and optimistic scenarios, there is likely to be a sufficient supply of care to meet demand provided care-giving patterns remain as they are. However, if female care-giving patterns converge to those of males, then under the baseline health improvement scenario, there would be a shortage of between 10 and 20 million hours of care per week. This change in care-giving pattern is quite possible given recent trends in greater employment rates amongst females. As regards the pessimistic health improvement scenario, the results suggest that there would be a substantial shortfall in informal carers over the next 50 years, even if male care-giving patterns converge to those of females.

In conclusion, the choice of health improvement scenario has a significant impact on the results, with the baseline scenario being somewhat closer to the optimistic than the pessimistic one. Nevertheless, the three scenarios follow each other quite closely until 2015; a

time period during which demographic changes do not yet have a significant impact on the demand for care. This means that the UK has some respite before it has to handle the important changes that are to come. Our analysis suggests that the main emphasis in this discussion should be put on investment in, and policies towards, formal care. This is because our projections indicate that the provision of informal care should only be a problem under the 'pessimistic' health improvement scenario, or under the baseline scenario if, for example, informal care provided by females decreases substantially. An important aspect to the latter will be the balance which is struck in the future between work and caring responsibilities.

A summary of the results is provided in Table 4.

Table 4
Summary of results

	2000	2020	2040	2060
Disabled older population ('000s)				
Scenario A	4251	5360	7397	7276
Baseline	4098	4688	5833	5204
Scenario N	3956	4095	4546	3607
Formal LTC consumers ('000s)				
Scenario A	999	1245	1695	1683
Baseline	950	1106	1401	1301
Scenario N	937	1023	1222	1083
Informal LTC population (65+, '000s)				
Scenario A	2441	3089	4316	4305
Baseline	2243	2532	3144	2810
Scenario N	2234	2254	2468	1939
Total costs, formal care (£ billion)				
Scenario A	11.5	14.1	19.6	19.9
Baseline	10.6	11.9	15.0	13.8
Scenario N	10.4	10.4	11.8	9.9
Total costs (£ billion)				
Scenario A	44.1	55.4	77.4	77.5
Baseline	40.6	45.7	56.8	51.1
Scenario N	40.3	40.5	44.8	35.9
Implied contribution rate (% of wage sum)				
Scenario A	1.06	1.21	1.70	1.77
Baseline	0.99	1.02	1.30	1.24
Scenario N	0.97	0.91	1.07	0.95
Excess supply of informal care (%)				
Scenario A	0	−4.18	−23.53	−29.38
Baseline	0	8.35	−1.27	2.78
Scenario N	0	21.48	25.07	46.27
Convergence F[a]	0	31.38	16.41	20.71
Convergence M[b]	0	−13.21	−17.63	−13.71

[a] Scenario assuming male provision of care converging to female provision between 2000 and 2020.

[b] Scenario assuming female provision of care converging to male provision between 2000 and 2020.

Appendix A. Comparison with the PSSRU model

In Table A1, we provide a comparison between our results and the results in [5]. Some caution when interpreting the results is advisable, since the models differ in many crucial aspects. In the table, PSSRU results are presented in bold, and our results are in non-bold.

Starting with 1, the large discrepancy between the two models is attributable to the fact that the PSSRU model is based on the population of England whereas our model is based on the population of the United Kingdom. Once this difference is corrected for, the two sets of figures are consistent—since they are both based on forecasts by the GAD.

Regarding 2, it seems that the PSSRU definition of dependency is somewhere between our definitions of 'severe' (OPCS 6–10) and 'moderate' (OPCS 1–5) disability. Whichever comparison is chosen, it is quite clear that the assumption of constant dependency rates by age and gender in the PSSRU model tends to lead to higher disability rates being projected.

In 3, it becomes obvious that the range of services included in the definition of LTC is much wider in the PSSRU model: in that model, almost 20% of the older population receive home services, compared to around 5% in our model. On the other hand, the projected growth rates in this care setting are quite similar.

Turning to institutional care, it seems that the definitions are more coherent (points 4–6), whereas the projected growth rates differ dramatically. This difference is largely due to the discrepancies in the projections of future dependency as described above.

The public spending item, and the distribution of total costs over public and private payers, needs some clarification. The PSSRU model starts out with a public share of 64%, whereas our model has a public share of 40%. This is partly due to the fact that the PSSRU model includes services which are more heavily subsidised (NHS care and various home care services). A further factor could be that our estimates are based on rules, whereas the PSSRU model takes actual public payments into account.

Table A1
Comparison between the PSSRU model and our results

	Projection	Unit	2001	2010	2020	2031	Percentage change, 2001–2031
1. Number of older people	PSSRU	000s	**7821**	**8455**	**10073**	**12049**	**54.1**
	Cass: baseline		9299	9909	11794	14378	54.6
2. Number of people with some dependency	PSSRU	000s	**2567**	**2773**	**3258**	**4020**	**56.6**
Total	Cass: baseline		4099	4181	4688	5479	33.7
Severe	Cass: baseline		1496	1494	1612	1858	24.2
3. Number of users of home services	PSSRU	000s	**1532**	**1653**	**1935**	**2416**	**57.7**
	Cass: baseline		496	521	610	736	48.3
	Cass: pessimist		507	539	640	784	54.6
4. Number of people in residential care homes	PSSRU	000s	**238**	**257**	**293**	**373**	**56.7**
	Cass: baseline		311	312	343	401	28.8
	Cass: pessimist		337	355	411	510	51.3
5. Number of people in nursing homes	PSSRU	000s	**134**	**145**	**168**	**213**	**59.0**
	Cass: baseline		143	142	153	177	23.6
	Cass: pessimist		159	168	194	242	52.2
6. Number of people in institutions	PSSRU	000s	**397**	**430**	**493**	**627**	**57.9**
	Cass: baseline		454	453	496	577	27.1
	Cass: pessimist		496	523	605	752	51.6
7. Public long-term care expenditure	PSSRU	£ bn	**7.5**	**8.8**	**11.4**	**16.3**	**117.3**
	Cass: baseline		4.2	4.3	4.7	5.6	32.2
	Cass: pessimist		4.5	4.8	5.6	6.9	53.3
8. Total long-term care expenditure	PSSRU	£ bn	**11.6**	**13.8**	**17.7**	**25.3**	**118.1**
	Cass: baseline		10.6	10.7	11.8	13.8	29.9
	Cass: pessimist		11.5	12.1	14.1	17.5	52.1
9. Total LTC costs, share of GDP/tax[a]	PSSRU	%	**1.46**	**1.42**	**1.44**	**1.64**	**12.3**
Total LTC costs expressed as tax rate	Cass: baseline		2.48	2.38	2.55	3.01	21.4
	Cass: pessimist		2.69	2.71	3.05	3.82	46.9
Public LTC costs expressed as tax rate	Cass: baseline		0.98	0.95	1.02	1.21	23.6
	Cass: pessimist		1.06	1.07	1.21	1.51	42.4

[a] The PSSRU model describes LTC costs as a share of GDP, whereas we work with an implied contribution rate by comparing total LTC costs to aggregate earnings.

The growth rates of total costs diverge due to the assumption of a 1% cost inflation (1.5% for health services) in the PSSRU model. If this inflation is disregarded, the growth in costs would be around 60%, which is still considerably more than our projection of around 30%. Again, the main explanation behind this is the difference in trends in disability.

Finally, remembering that the two models use different bases for computing the aggregate burden of LTC costs on taxpayers, we may compare the results in point 9. The models agree in the finding that the LTC costs as a share of the total economy are going to decrease in the short term, and then increase again in the long term. However, the increase in our model is about twice the increase in the PSSRU model. This difference is probably attributable to the fact that the PSSRU model disregards the unfavourable demographic situation, with a shrinking work force, that develops after 2020.

It seems, in fact, that the PSSRU model is closer to our 'pessimistic' scenario. The numbers of people in different settings and total costs as projected in our pessimistic scenario are much closer to the findings of the PSSRU model. However, even our pessimistic scenario falls short of the increases projected by the PSSRU model which typically projects changes a couple of percentage points above ours.

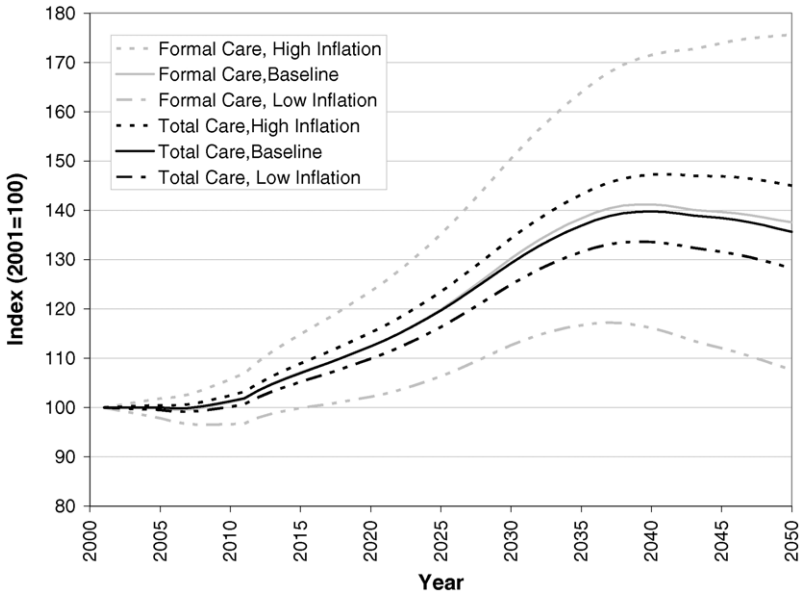

Fig. B1. LTC service volumes for different inflation scenarios.

Appendix B. Sensitivity analysis: cost assumptions

We analyse the implications of three cost inflation scenarios for the overall costs of care in the LTC sector. Results are given in Fig. B1. The figure shows indices of the overall resources needed in formal care only, and in the entire LTC sector, for different assumptions regarding the relative prices of formal services. The total volume, presented as an index with base year 2000, is derived by multiplying the number of care recipients in different settings with the unit cost in the different settings. Hence, the different scenarios allow for the future increases in unit costs to diverge from general wages. Accordingly, the 'high inflation' scenarios imply that the costs of either formal care services, or all care services (including informal care; these scenarios are labelled 'total care' in the figure) increase 0.5% faster per year than wages do. Similarly, the low inflation scenarios imply that care unit costs increase 0.5% slower than wages do.

According to Fig. B1, the high inflation scenario (the grey dotted line in Fig. B1) implies that LTC costs increase by 35% between 2001 and 2030. This should be compared to the effect of using the pessimistic health scenario instead of the baseline 1, where the increase during the same period is almost 50%. If, instead, we make the assumption that only the value of formal care services deviates from general wage inflation, we get a greater impact. In this case, the high inflation scenario, represented by the grey dotted line, results in a total volume increase of 50%, whereas altering the health scenario instead results in an increase of 53%. In conclusion, modest changes in the health assumptions have a greater impact than considerable changes in the inflation assumptions, a finding which seems to justify our focus on different health scenarios as opposed to changing inflation scenarios.

References

[1] Robinson R, Dixon A. United Kingdom health care systems in transition. Copenhagen: European Observatory on Health Care Systems; 1999.
[2] Werth, Martin. Long term care. Faculty and Institute of Actuaries; 2001.
[3] Fries J. Aging natural death and the compression of morbidity. New England Journal of Medicine 1980;303:130–5.
[4] Gruenberg EM. The failures of success. Milbank Memorial Foundation Quarterly/Health and Society 1977;55:3–24.
[5] Manton KG. Response to an introduction to the compression of morbidity. Gerontologica Perspecta 1987;1:23–30.

[6] ONS. Healthy life expectancy at birth and at 65 in Great Britain and England, 1981–2001. London: Office for National Statistics; 2002.
[7] Rickayzen BD, Walsh D. A multi-state model of disability for the UK: implications for need for long term care for the elderly. British Actuarial Journal 2002:8.
[8] Nutall SR, Blackwood RJL, Bussell BMH, Cliff JP, Cornall MJ, Cowley A, et al. Financing long-term care in Great Britain. Journal of the Institute of Actuaries 1994;121(l):1–68.
[9] Wittenberg R, Pickard L, Comas-Herrera A, Davies B, Darton R. Demand for long-term care: projections of long-term care finance for elderly people. PSSRU, University of Kent; 1998.
[10] Wittenberg R, Pickard L, Comas-Herrera A, Davies B, Darton R. Future demand for long-term care, 2001 to 2031. Projections of demand for long-term care for older people in England. PSSRU Discussion Paper No. 1980. University of Kent, 2003.
[11] The Royal Commission on Long Term Care. With respect to old age: long term care—rights and responsibilities. London: The Stationery Office; 1999.
[12] Richards E, Wilsdon T, Lyons S. Paying for long term care. London: Institute for Public Policy Research; 1996.
[13] House of Commons Health Committee. Long-term care: future provision and funding, vol. I. Report Together with the Proceedings of the Committee, HC 59-1. London: HMSO, 1996.
[14] Mayhew LD. Health and elderly care expenditure in an ageing world, RR-00-21. Laxenburg, Austria: International Institute for Applied Systems Analysis; 2000.
[15] Martin J, Meltzer H, Elliot D. OPCS surveys of disability in Great Britain. Report No. 1: The prevalence of disability among adults. London: HMSO; 1988.
[16] Walsh DEP, Rickayzen BD. A model for projecting the number of people who will require long-term care in the future. Part III. The projected numbers and the funnel of doubt. Actuarial Research Paper No. 125. London: City University, 2000.
[17] Government Actuary. 1996-based national population projections. London: The Stationery Office; 1998.
[18] Department of Health. Health and personal social services statistics, 2004. http://www.performance.doh.gov.uk/HPSSS/.
[19] Karlsson M, Mayhew L, Plumb R, Rickayzen B. An international comparison of long-term care arrangements. An investigation into the equity, efficiency and sustainability of the long-term care systems in Germany, Japan, Sweden, the United Kingdom and the United States. Actuarial Research Paper No. 156. London: Cass Business School, 2004.
[20] Bajekal M. Care homes and their residents. London: The Stationery Office; 2002.
[21] Pickard L, Wittenberg R, Comas-Herrera A, Davies B, Darton R. Relying on informal care in the new century? Informal care for elderly people in England to 2031. Ageing and Society 2000;20(6):745–72.
[22] Netten A, Curtis L. Unit costs of health and social care. PSSRU; 2003.
[23] Laing, Buisson. Calculating a fair price for care—a toolkit for residential and nursing care costs. London: Rowntree; 2001.
[24] Netten A, Rees T, Harrison G. Unit costs of health and social care. PSSRU; 2001.
[25] Inland Revenue. Income tax and personal incomes, Information on the Internet, 2003. www.inlandrevenue.gov.uk.
[26] National Statistics. New earnings survey. London: National Statistics; 2001.
[27] Department of Work Pensions. Family resources survey, Great Britain 2000–01. London: DWP; 2001.
[28] Pickard L. The decline of intensive intergenerational care of older people in Great Britain, 1985–1995. In: Population trends. Office for National Statistics; 2002.