Long-Term Care in Germany: Projections on Public Long-Term Care Insurance Financing

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1. Introduction

As a general trend in OECD countries the rate of mortality has been declining for decades while fertility remains below replacement rate. As a consequence, the population is aging.[1] Against this background problems connected with the provision of long-term care for an increasing number of elderly people have become a major concern for Western welfare states, leading to respective legislation in Austria, Germany, Japan, and Luxembourg, and ongoing debates in England, France, and Italy about the necessity to introduce new social security systems.[2] Any social security system for long-term care, however, will have to deal with increasing associated costs for long-term care not only as a result of demographic developments but for other reasons as well.

In this paper, the financing implications for the statutory public long-term care insurance (LTCI) in Germany shall be examined. In section 2 basic information about this insurance system is provided, in section 3 a simulation model is introduced, and in section 4 the development of the number of LTCI beneficiaries is discussed. Based on the respective results, expenditure can be calculated (section 5). Using information about contributory income (section 6) the contribution rate necessary to finance the insurance system can be derived (section 7). In section 8, the major findings are summarized.[3]

[1] See, e.g., Höhn (1996) and Enquete Commission (1998, chapt. 1).

[2] For an overview, see Eisen and Mager (1999), Igl and Stadelmann (1998), MISSOC (1999), OECD (1996), Sieveking (1998), Schulte (1997), and Pacolet *et al.* (1998), as well as the respective contributions to this volume.

[3] To better assist the reader all equations have been compiled into a technical appendix.

2. THE NEWLY INTRODUCED LONG-TERM CARE INSURANCE IN GERMANY

In 1995 a statutory long-term care insurance (LTCI) was introduced in Germany covering about 90% of the population.[4] Those who have private health insurance are obliged to buy private long-term care insurance guaranteeing at least as much coverage as public funds do. As a result, more than 99% of the population is eligible for respective benefits.[5] Public long-term care insurance is almost entirely financed through contributions calculated as a legally fixed percentage of individual gross earnings up to a contribution ceiling. Following the pay-as-you-go principle contributions are spent within the same period. The building up of a capital stock is not intended.

There are three grades for those eligible for LTCI benefits: those who are in considerable (grade I), severe (grade II), or extreme (grade III) need of care. Severity of need is measured with respect to the ability to perform activities of daily life without help. Benefits, which are not means-tested, depend on these three grades of severity of need. Benefits include cash benefits for family care, benefits in kind for professional home care, and a certain allowance for nursing home care. Beneficiaries in home care are allowed to choose between (and even combine) cash and benefits in kind. Table 1 contains the respective amount of money.

Table 1: **Monthly LTCI benefits (in Euro)**

Grade of severity	Home care		Nursing home care[a]
	Family care	Professional care	
I	205	384	1,023
II	410	921	1,279
III	665	1,432	1,432
Special Cases		1,918	1,688

[a] Figures are valid until 31.12.2004. In general, however, there is an upper limit of 1,432 Euro per case (special cases excepted) and a ceiling on the average at 1,279 Euro per month.

In addition to those listed above, LTCI provides further benefits. These are in order of budgetary relevance:

[4] For a more detailed description of the institutional arrangements, see NAEGELE and REICHERT as well as KNÜVER and MERFERT in this volume; see also IGL and STADELMANN (1998), SCHULTE (1996), and ROTHGANG and SCHMÄHL (1995).

[5] In contrast to the Japanese system, benefits are not limited to the elderly in Germany.

- contributions to the pension funds for non-professional caregivers;
- funding for day care, night care, or short-term nursing home care;
- payments for substitutes while non-professional caregivers are on holiday; and
- special equipment and teaching arrangements for non-professional caregivers.

By adding administrative costs, the overall expenditure amounted to 16.673 billion Euro in the year 2000.

Finally, the adjustment mechanism for the amount of benefits must be explained. These amounts are neither indexed to prices or income, nor is there any provision for regular increases. Rather, increases depend on discretionary decisions made by the federal government, taking into account the effects on the contribution rate.

3. The Simulation Model

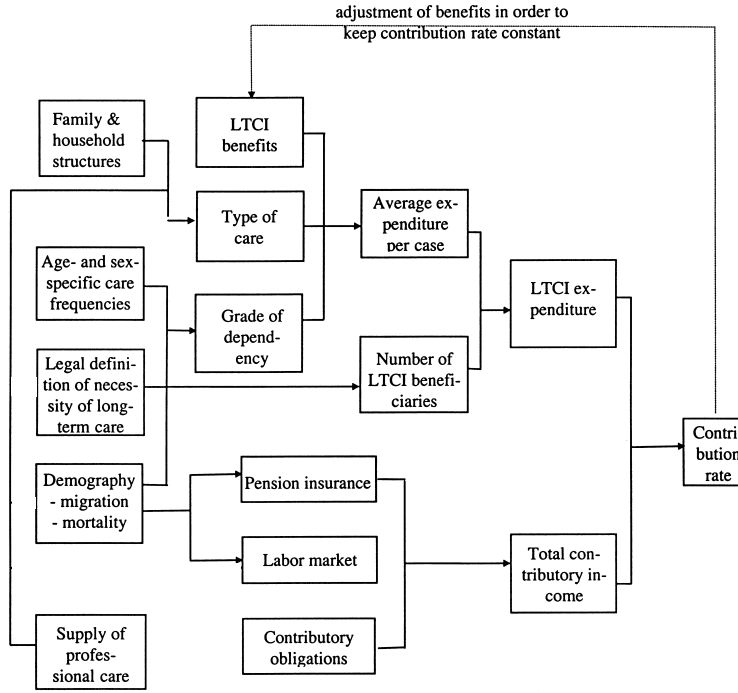
Figure 1 contains the major factors determining the necessary contribution rate of the public long-term care insurance in Germany. Since LTCI is a pay-as-you-go system, the necessary contribution rate can be derived as the quotient of LTCI expenditure and total contributory income.[6] Of course, LTCI expenditure can be calculated as a product of the number of beneficiaries and the average expenditure per beneficiary. Apart from the legal definition of being in need of care, the number of beneficiaries depends on age- and sex-specific care frequencies on the one hand, and level and structure (age and sex) of the population on the other. Average expenditure per beneficiary is determined by the grade composition of beneficiaries, the type of care chosen and the respective LTCI benefits. The former depend on numerous other factors, while the development of the latter can be influenced through repercussions from the development of the contribution rate. The sum of contributory income consists basically of income from employees, pensioners, and unemployed, thus resting on developments in the labor market and the pension insurance. Both are, once again, heavily influenced by demography.

[6] Contributions have been paid since January 1995, benefits, however, have only been granted since April 1995. Due to this schedule and other introductory effects, a small capital stock has been built up in the 1990s which yields additional income and can be used to cover temporary deficits. Effects, however, are small and only transitory (see Rothgang (2002c) for details). Hence, in the following a pure pay-as-you-go scheme is assumed.

In order to calculate future contribution rates, assumptions must therefore be made about:

- the population size and structure;
- care frequencies;
- utilization patterns;
- LTCI benefits and their adjustments; and
- the number of contributors and their respective contributory income.

Figure 1: **Determinants of LTCI contribution rate**



4. The Number of Beneficiaries and its Development

Demographic information is taken from the "9. koordinierte Bevölkerungsvorausberechnung", the latest forecast released from the Federal Statistics Office, which contains four versions (Table 2). Version 0, 1, and

2 differ only with respect to migration, while version 2a assumes an even higher decline in mortality than version 2.[7]

Table 2: **Assumptions of the Demographic Forecasts of the Federal Statistical Office**

	Version			
	1	2	0	2a
Fertility				
constant 1,400 children per 1,000 women	X	X	X	X
Mortality				
Life expectancy of new-borns in 2050: male: 78.1 years, female: 84.5 years	X	X	X	
Life expectancy of new-borns in 2050: male: 80.1 years, female: 86.4 years				X
Migration				
Declining migration of German descendants; long-term annual net migration of foreigners:				
100,000	X			
200,000		X		X
0			X	

Source: Federal Office of Statistics, translation by author.

The respective care frequencies are estimated through the relative frequencies of LTCI beneficiaries among their age group and sex in the year 1999. While these frequencies are kept constant over time in model 1, declining care frequencies are assumed in model 2 (Table 3).[8] The rationale for this assumption is Fries' (1980) "compression of morbidity" hypothesis, which states that an increase in life expectancy might lead to reduced age-specific morbidity.[9]

[7] The alternative scenario 2a must be regarded as a reaction on criticism from demographers who claimed that in former forecasts the Federal Statistical Office was too restrictive with respect to gains in life expectancy (see Rothgang (2002a)).

[8] Declining age-specific morbidity is also assumed in projections published by the OECD (Jacobzone *et al.* (1998); Jacobzone (1999)).

[9] The dispute between those who follow Fries and those like Verbrugge (1994) who expect the additional lifetime to be spent in poor health is not yet settled. For a more in-depth discussion with respective references, see Rothgang (2002c).

Table 3: **Model assumptions for the calculation of the future number of beneficiaries**

Model 1: Constant age- and sex-specific morbidity
• Population according to recent forecast from the Federal Statistical Office.
• Constant age- and sex-specific care frequencies over time (1999 figures).
Model 2: Declining age- and sex-specific morbidity
• Population according to recent forecast from the Federal Statistical Office.
• Declining age- and sex-specific care frequencies: An increase in (further) life expectancy of persons aged 65 of one year yields a shift of care frequencies to the right of half a year.

Figure 2: **LTCI beneficiaries (baseline model)**

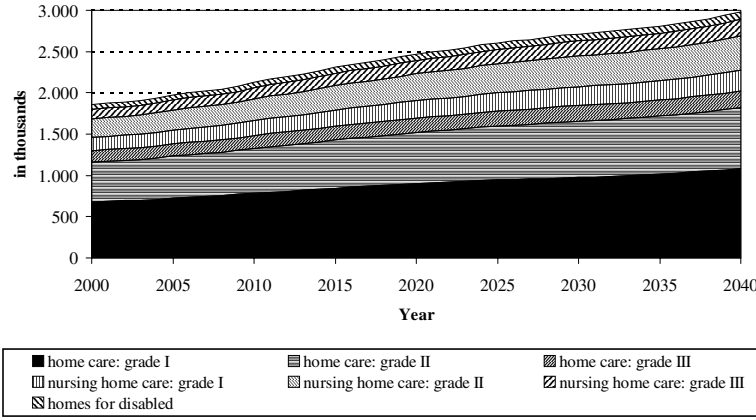


Figure 2 contains the results from model 1 with demographic version 1. This combination is hereafter referred to as the "baseline model". According to this baseline model the number of LTCI beneficiaries rises from 1.857 million in 2000 to 2.983 million in 2040, which is an overall growth of about 60.6% representing an average annual growth of 1.2% (geometrical mean). Interestingly enough, the growth rate is much higher for people in nursing home care (72.9%) than for people in home care (55.4%)[10] due to a higher institutionalization rate among very old persons in need of care (see ROTHGANG (2002b) for details).

[10] Since benefits for nursing home care for the elderly and nursing home care for the disabled differ, both types are distinguished in Figure 2. The given growth rate, however, relates to both types of nursing home care. For nursing home care for the elderly the growth rate is even higher (74.3%).

The robustness of this forecast against changes in demographic and morbidity assumptions can be checked by variations of migration and mortality patterns[11] and care frequencies. Table 4 shows the respective effects.

Table 4: **Growth in number of beneficiaries in the years 2000–2040 in percentage of figures in 2000**

Morbidity	Demographic Forecast			
	Version 0	Version 1	Version 2	Version 2a
Constant (model 1)	55	61	63	76
Declining (model 2)	35	40	42	45

Column 2 vs. column 4: "migration effect"
Column 4 vs. column 5: "mortality effect"
Row 2 vs. row 3: "morbidity effect"

The number of immigrants, which are assumed to be fairly young, has only a small influence on the number of LTCI beneficiaries ("migration effect"). Respected increases reach from 55% (no net immigration) to 63% (high net immigration of 200,000 per year). An increasing life expectancy, on the other hand, is highly relevant if age-specific care frequencies remain constant ("mortality effect"). According to version 2a the growth in numbers of LTCI beneficiaries therefore increases to 76%. Declining morbidity produces even greater effects. According to model 2 the increase in the numbers of LTCI beneficiaries will only be 40% in version 1 of the demographic forecast ("morbidity effect"). Moreover, with declining morbidity (model 2) the effect of increasing life expectancy almost vanishes with an overall growth rate of 45% in version 2a, which is only slightly higher than the rate in version 2. Thus, the mortality effect might be countered through a "morbidity effect" of similar weight.

5. Expenditure According to Different Utilization Patterns

Overall LTCI expenditure can be calculated as product of the number of beneficiaries and average expenditure per beneficiary. In order to compute the latter, information about utilization patterns are needed. The "purely demographic" model 1 assumes that the utilization figures of 1999 remain constant over time. Model 2, on the other hand, assumes a shift towards professional care (Table 5).

[11] Since long-term care predominantly occurs in advanced years, fertility figures are fairly irrelevant. See Rothgang (2002b) for respective simulations.

Table 5: **Model assumptions for the calculation of LTCI expenditures**

Model 1: Constant utilization patterns
• Number of public LTCI beneficiaries according to demographic forecast and constant care frequencies.
• Constant utilization patterns with respect to home versus nursing home care and with respect to family (80%) versus professional (20%) home care over time.
Model 2: Growing share of professional care-giving
• Number of public LTCI beneficiaries according to demographic forecast and constant care frequencies.
• Growing share of nursing home care (+0.5 percentage points per year) and declining share of family care within home care (-0.5 percentage points per year).

The latter assumption is based on at least three secular trends, which will briefly be explored:

- the declining caregivers' potential;
- the growing female work participation; and
- changes in family and household structures.[12]

The declining caregivers' potential is due to demographic changes. Today about 80% of all main caregivers are women (SCHNEEKLOTH and MÜLLER 2000: 54), and it is difficult to imagine that the share of male caregivers might increase significantly in the future. More than half of all caregivers are aged between 40 and 64 (ibid.). Hence care-giving is predominantly carried out by "middle-aged women". As the ratio of middle-aged women per LTCI beneficiary is going to decline heavily (see ROTHGANG 2002a), it is hard to imagine that the amount of family care given will not decrease accordingly.

Moreover, caregivers bear a heavy burden, which makes it hard to continue working in the formal labor market. Since younger women are better educated and thus receive higher incomes, opportunity costs for a withdrawal from the labor market will increase for future generations. Hence, a declining willingness to care has to be expected (ENQUETE COMMISSION 1994: 145).

Finally, the consequences of changes in family and household structures have to be considered. Over the past decades the share of elderly living in single households has constantly increased.[13] A continuation of this trend is to be expected for the future (see HULLEN (2002); YI *et al.* (2002); ALDERS and MANTING (2002)). Since care potential is lower in single households this will add to the trend towards professional care.

[12] For a more detailed discussion, see ROTHGANG (2002a).
[13] See ROTHGANG (2002a) with further references.

Figure 3: **LTCI expenditures with constant benefits (baseline model)**

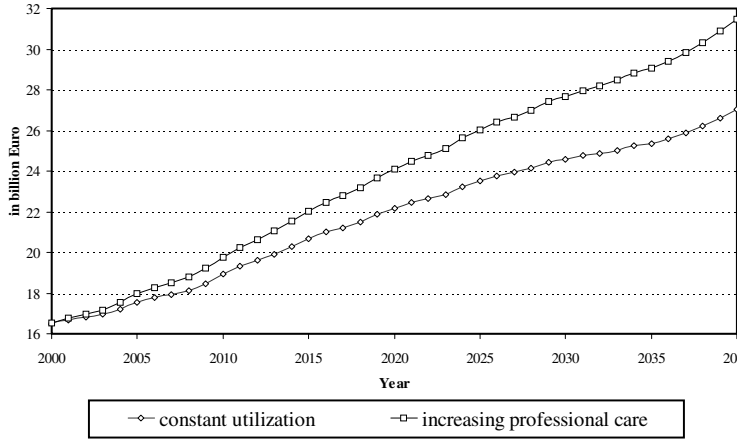


Figure 3 shows the resulting expenditure figures for both models with constant benefits based on the (demographic) baseline model. With constant utilization patterns (model 1) the growth in expenditure closely follows the growth in the number of beneficiaries. Small extra expenditures result from structural shifts (age, severity of care requirement) within the beneficiaries. As model 2 reveals, however, a declining amount of family care adds considerably to the expenditure, which is then estimated to be at 31.4 billion Euro by 2040.

Table 6 shows the overall growth rates for both models and all demographic versions. According to this, more than a doubling of expenditures between the years 2000 and 2040 follows if mortality and utilization effect are simultaneously taken into account.

Table 6: **Growth in LTCI expenditure in the years 2000–2040 in percentage of figures in 2000**

Utilization patterns	Demographic Forecast			
	Version 0	Version 1	Version 2	Version 2a
Constant (model 1)	58	64	66	80
Declining family care (model 2)	84	90	93	109

Column 2 vs. column 4: "migration effect"
Column 4 vs. column 5: "mortality effect"
Row 2 vs. row 3: "utilization effect"

6. CONTRIBUTORY INCOME

Among other factors demography influences the total contributory income (see Figure 1). Since more than 70% of all contributions come from the employed, some scholars even assume that the sum of contributory income develops proportionally to the number of persons at working age (see, e.g., ERBSLAND (1995), KNAPPE and RACHOLD (1997), WILLE *et al.* (1998), KNAPPE and RUBART (2001)). This, however, is an inadequate assumption which does not account for high unemployment and low labor force participation by both the elderly and women as an initial condition. Therefore labor supply and demand must be considered separately with employment calculated as a minimum of supply and demand with some "natural" unemployment (see HOF 2001 for a similar approach). Table 7 contains the model assumptions for the respective simulations. Three models are distinguished: While the purely demographic model 1 regards (age- and sex-specific) potential labor force participation rates as given, model 2 allows for changing rates. Using figures from the Institute for Employment Research (Institut für Arbeitsmarkt- und Berufsforschung der Bundesanstalt für Arbeit = IAB) a higher labor force participation rate for the elderly and for women is assumed, while the respective rates for twens are assumed to be declining due to longer periods of formal education. Model 3 differs from model 2 through the recognition of rising wages.

Table 7: **Model assumptions for the calculation of contributory income**

Model 1: Purely demographic projection
• Separate forecasts of the number of contributors and average individual contributory income for employees, pensioners, unemployed and other contributors, based on 1999 figures.
• Constant average contributory income per type of contributor over time.
• Potential labor force according to constant age- and sex-specific participation rates (IAB). Employment as minimum of potential labor force and jobs with a given "natural" rate of unemployment of 4% of the labor force.
Model 2: Demographic projection with changing labor force participation
• As in model 1, but with changing labor force participation (IAB).
Model 3: "Realistic" projection
• Number of beneficiaries as in model 2.
• Growing wages at an annual rate of 1.7%, and 2.7% (as soon as there is labor shortage).
• Demographically induced additional expenditures for pensions are partly financed by cuts in pension.

Figure 4: **Labor market (model 2)**

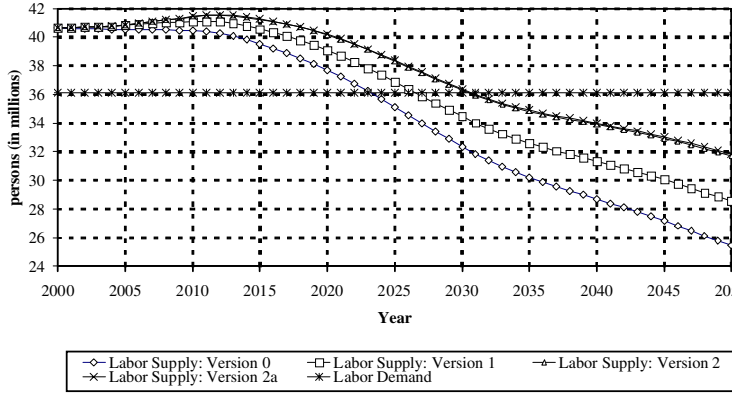


Figure 4 shows the labor market development based on model 2. For about 10–15 years the labor supply remains more or less unchanged. Thereafter there is a constant decline. Depending on migration assumptions between the years 2020 and 2030 the labor supply (already reduced by 4% to account for "natural unemployment") will fall short of labor demand, thus leading to declining employment from then onwards. These curves are mirrored in Figure 5 which plots the development of total contributory income (model 2). Since pensioners also contribute to LTCI the sum of contributory income will increase for more than two decades with a constant level of employees and an increasing level of pensioners. However, as soon as there is labor shortage, a sharp drop in total contributory income will automatically follow (see Figure 5).

The simulations reveal that – due to demographic change – the potential labor force will decline. Due to high unemployment and a considerable hidden labor force,[14] this process will only start to effect the total sum of contributory income in about two or three decades. Thereafter, a declining labor force will lead to a diminishing total sum of contributory income as long as wages remain constant. If immigrants can fill available jobs, net immigration will help to slow down the above process, but it cannot stop it.

[14] "Hidden labor force" refers to those people who would want to work, but – under present labor market conditions – do not even register as unemployed because they believe they have no chance of finding a job anyway.

Figure 5: **Total sum of contributory income (model 2)**

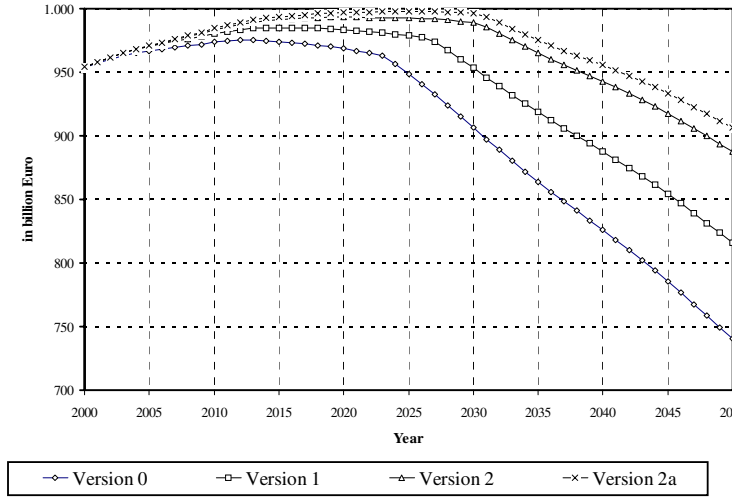


Table 8 shows the overall growth rates of total contributory income for all models and all demographic versions of the demographic forecast. In addition to net immigration, changing labor market participation also helps to slow down the process, but cannot stop it. Obviously, rising wages overshadow all other effects. On the other hand they will lead to increasing LTCI expenditures – given the benefits are adjusted in order to cover increasing remuneration for professional care. Thus, rising wages increase expenditures as well as contributions.

Table 8: **Growth of total contributory income in the years 2000–2040 in percentage of figures in 2000**

Labor Force Participation Rates	Demographic Forecast			
	Version 0	Version 1	Version 2	Version 2a
Constant (Model 1)	-17	-11	-5	-4
Changing (Model 2)	-13	-7	-1	0
Changing (Model 3)	95	103	107	108

Column 2 vs. column 4: "migration effect"
Column 4 vs. column 5: "mortality effect"
Row 2 vs. row 3: "effect of changing labor market participation"
Row 3 vs. row 4: "effect of rising wages"

7. Contribution Rate and Real Purchasing Power

Combining the simulations for expenditures and total contributory income yields the contribution rate that is needed to finance long-term care insurance within a purely pay-as-you-go system. Table 9 contains the model assumptions for the three models that are calculated. The purely demographic projection (model 1) combines the purely demographic models on expenditure and contributory income. Model 2 also allows for changing behavior patterns, namely a growing share of professional care and changing labor participation rates. Model 1 and 2, however, assume constant benefits, wages, and prices.[15] Their main purpose is to isolate the influence of demography and behavior. Only model 3 is "realistic" insofar as rising wages and prices are taken into account. The basic assumption is that wages grow faster than general prices (rising real gross earnings) and that prices of professional long-term care follow wages rather than inflation. The latter assumption is based on Baumol's "cost disease" hypothesis as well as specific conditions on the labor market for nurses.[16] The real question is how LTCI benefits respond to rising prices of professional long-term care.

Three adjustment scenarios are distinguished within model 3 in the following:[17]

- Scenario A: Benefits are adjusted in order to keep the contribution rate stable.
- Scenario B: Benefits are adjusted along with prices of long-term services in order to keep constant the real purchasing power of LTCI benefits. Since long-term care is very labor intensive it is assumed that prices of care follow nurses' wages, which are assumed to increase in line with average gross earnings. As long as real wages grow, benefits therefore must be adjusted at a rate above general inflation.

[15] An alternative interpretation would be that all prices, wages, and benefits grow at the same rate, and that given figures are already deflated.

[16] Baumol's basic idea is that the rationalization potential for personal social services is much lower than for industrial products. Thus, prices for those services increase at a faster rate than general inflation if wages in both sectors grow in line (see Baumol (1967), Baumol and Oates (1972)). Since labor shortage for nurses is to be expected in the near future and the demand for nurses is growing, there is reason to believe that nurses' wages will rise at least in line with wages in other industries.

[17] See Rothgang (1997: 272) for a formal derivation of the respective adjustment rules.

- Scenario C: Benefits are adjusted according to general inflation. Given that real wages rise and prices of care follow wages, this leads to diminishing real purchasing power for LTCI services.

Table 9: **Model assumptions for the calculation of contribution rate**

Model 1: Purely demographic projection
• Growth of expenditure according to expenditure model 1.
• Growth of total contributory income according to model 1.
• Starting point: necessary contribution rate for 1999.
Model 2: Demographic projection with changing behavior patterns
• Growth of expenditure according to expenditure model 2.
• Growth of total contributory income according to model 2.
• Starting point: necessary contribution rate for 1999.
Model 3: "Realistic" projection
• Growth of expenditure according to expenditure model 2 plus regular adjustments for LTCI benefits.
• Growth of total contributory income according to model 3.
• Starting point: necessary contribution rate for 1999.

Table 10: **Growth in contribution rate in the years 2000–2040 in percentage of figures in 2000**

Model	Demographic Forecast			
	Version 0	Version 1	Version 2	Version 2a
Purely demographic (Model 1)	90	83	74	86
Demographic with changing behavior patterns (Model 2)	113	105	95	108
"Realistic" (Model 3) with different adjustments rules				
Scenario A	0	0	0	0
Scenario B	118	111	101	116
Scenario C	-6	-6	-7	0

Column 2 vs. column 4: "migration effect"
Column 4 vs. column 5: "mortality effect"
Row 2 vs. row 3: "effect of changing behavior patterns"
Row 3 vs. row 5: "effect of rising wages"
Row 4 vs. row 5 vs. row 6: "effects of different adjustment rules"

Table 10 shows the overall growth in contribution rates for all three models and the four demographic scenarios. According to model 1 the demographic effect alone leads to a rise in the contribution rate of 74–

90%. In general, net immigration slows down this process while excess gains in life expectancy reinforce it. However, in model 1 the migration effect is stronger than the mortality effect.

Changing behavior patterns produce higher expenditures through an increase in professional care and higher income through additional labor force participation. According to model 2 the former effect is stronger than the latter, thus causing higher contribution rates than in model 1. The highest growth rates with more than a doubling of contribution rate for all demographic scenarios result from model 3 with adjustment of benefits along with prices of long-term services in order to keep constant the real purchasing power of LTCI benefits. In this case rising wages effect the income as well as the expenditure side. Since pensions, however, are assumed to grow slower than wages, an additional increase of the contribution rate follows.

Table 10 also reveals the adjustment mechanism as the key variable in determining contribution rate development. Thus, Figure 6 shows the development of the contribution rate for the three adjustment rules within model 3 for the demographic baseline version. While scenario B produces a constant rise in the contribution rate leading to a rate of almost 3.8% by the year 2040, scenario A and C yield (almost) constant contribution rates.

Figure 6: **Contribution rate according to different adjustment paths (baseline model)**

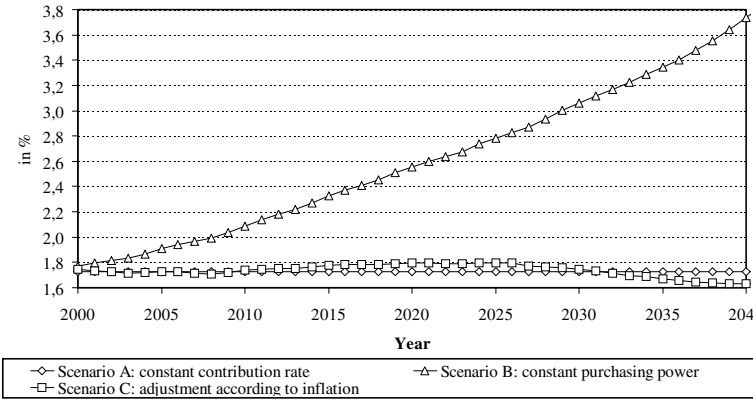
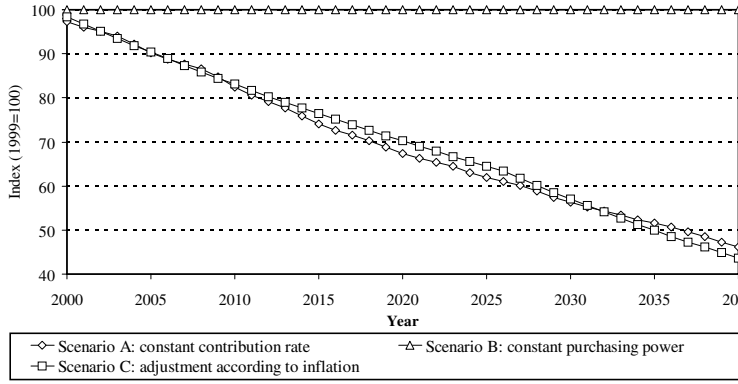


Figure 7: **Real purchasing power according to different adjustment paths (baseline model)**



The "price" for stabilizing the contribution rate, however, is a dramatic decline in real purchasing power. As Figure 7 demonstrates, in the year 2040 real purchasing power will be less than half as much as in the year 2000 if benefits are linked to inflation (Scenario C) or if benefits are adjusted in order to yield constant contribution rates (Scenario A).[18]

Hence, it is impossible to stabilize the contribution rate and real purchasing power at the same time. Rather, politicians will have to choose the lesser of two evils, a rising contribution rate or a declining purchasing power.

8. CONCLUSION

Some general conclusions can be derived from the above simulations:

First, demographic change will lead to a growing number of people in need of care and hence to more and more LTCI beneficiaries. With age- and sex-specific care frequencies that are constant over time, demographic projections, as released by the Federal Office of Statistics, lead to an increase of LTCI beneficiaries and thus LTCI expenditure of about 1.2% per year (geometrical mean). Among other factors, these results from the

[18] According to scenario C, inflation-linked adjustments can almost be financed by a constant contribution rate. This result depends on assumptions about real wage development. If real wages rise slower than assumed, even inflation-linked adjustments produce growing contribution rates, but also a less dramatic decline in real purchasing power.

baseline model depend on migration, mortality, and morbidity patterns. Additional (net) immigration, however, does not change findings significantly; whereas declining mortality on the other hand does, and declining morbidity even more so. Fortunately, declining mortality, which produces additional expenditures, and declining age-specific morbidity, which reduces expenditures, might be related. Therefore, the morbidity effect might counter the mortality effect.

Second, LTCI expenditure also depends on utilization patterns which are in part influenced by demographic development as well. There are good reasons to assume a shift from family care towards professional care leading to considerable extra expenditure. Allowing for such a shift, the baseline model yields an average annual growth rate for overall LTCI expenditure of slightly more than 1.6% (geometrical mean).

Third, a growth rate of that kind can easily be financed from economic growth if LTCI benefits are kept constant. The assumed rise in overall contributory income, however, is due to rising real wages with a declining number of contributing employees. Since expenses for long-term care predominantly depend on wages, the very reason that causes an increase to overall contributory income would therefore lead to a dramatic decline in real purchasing power of LTCI benefits, if adjustment is restricted to inflation or in order to keep contribution rate constant. If benefits are adjusted in line with (average) real wages, the contribution rate increases due to an increasing number of beneficiaries, a shift in utilization patterns, and a declining number of contributing employees. According to the simulation, the contribution rate then approaches 3.8% by the year 2040, which is more than twice as high as the starting value.

Though numerical results of any simulation depend heavily on the input parameters, the trade-off between a constant contribution rate and constant purchasing power following from the above calculations is robust against changes in parameters. Politicians, therefore, unavoidably face a tragic choice between two evils, and it is up to them to find their way between Scylla and Charybdis.

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Technical Appendix: Basic Equations Used

Number of LTCI beneficiaries

The future number of LTCI beneficiaries for a certain type of care and grade of need of care (N_{kl}) for a given year can be calculated as the sum of all products of age- and sex-specific care frequencies for this type and grade (P_{ijkl}) and respected population figures (A_{ij}):[19]

$$N_{kl} = \sum_i \sum_j P_{ijkl} \cdot A_{ij} \qquad (1)$$

with
$i = 1, 2$ sex
$j = 1, \ldots, 100$ age
$k = 1, 2, 3$ type of care
$l = 1, 2, 3$ grade of need of care.

Formula (2) yields the overall number of LTCI beneficiaries for each year:

$$N = \sum_k \sum_l N_{kl} \qquad (2)$$

Overall expenditure

Overall LTCI expenditure (E) can be calculated as product of the number of beneficiaries (N) and average expenditure per beneficiary ($\overline{E}$):

$$E = N \cdot \overline{E} = \sum_k \sum_l N_{kl} \cdot \overline{E}_{kl} \qquad (3)$$

with
$k = 1, 2, 3$ type of care
$l = 1, 2, 3$ grade of need of care.

Total sum of contributory income

The total sum of contributory income of all contributors (= Gesamtsumme der beitragspflichtigen Einnahmen) can be calculated as the product of number of beneficiaries (A) and average contributory income per contributor:

$$Y = \sum_i Y_i = A \cdot \overline{Y}_i \qquad (4)$$

[19] Used frequencies relate the number of public LTCI beneficiaries to population figures (publicly and privately insured).

Taking account of changing structures of contributors makes it necessary to distinguish at least four groups of contributors: the employed (*e*), pensioners (*p*), the unemployed (*u*), and other contributors[20] (*s*). Thus, the total sum of contributory income is:

$$Y = A_e \cdot \overline{Y}_e + A_p \cdot \overline{Y}_p + A_u \cdot \overline{Y}_u + A_s \cdot \overline{Y}_s \quad (5)$$

For the projections each of these 8 independent variables has to be calculated.

Contribution rate

Since LTCI is a pure pay-as-you-go system, overall contributions (*C*) must be equal to overall expenditure (*E*):[21]

$$C = E \quad (6)$$

Contributions depend on the overall contributory income (*Y*) and the contribution rate (*R*):

$$C = R \cdot Y \quad (7)$$

Hence, the contribution rate necessary to balance the LTCI budget can be calculated as the ratio of overall expenditure and contributory income:

$$R = E \,/\, Y \quad (8)$$

If small letters denote respective growth rates, then:

$$r = (e - y) \,/\, (1 + y) \quad (9)$$

Since the LTCI budget for the baseline year 1999 is fairly balanced,[22] the legally fixed contribution rate of 1.7% that yielded this balance can be taken as a starting point. Using the growth rates for overall expenditure and sum of total contributory income (see above) contribution rates can be calculated.

[20] This group contains mainly the self-employed and persons in rehabilitation.

[21] Contrary to old-age insurance there is no contribution from federal or state budget. In the short run, however, a temporary deficit or surplus may occur.

[22] In 1999 overall expenditure of 16.35 billion Euro was only marginally higher than overall income (16.32 billion Euro). In 2000 expenditure was 16.67 billion Euro and income 16.49 billion Euro (http://www.bmgesundheit.de/themen/pflege/finanz/ergebnisse.htm; July 2001).

Real purchasing power

In scenario A and C real purchasing power of LTCI benefits is changing over time. Real purchasing power (X) is given as:

$$X = B \,/\, P \tag{10}$$

with X = amount of care received
B = LTCI benefits (in cash)
P = price index for long-term care.

With respect to growth rates it follows:

$$x = (b - p) \,/\, (1 + p) \tag{11}$$