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Distributional Effects of Germany's Long-Term Care Insurance

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Introduction

In 1995, statutory long-term care insurance (LTCI) was introduced in Germany as the fifth pillar of the social insurance system, in response to a significant increase in the number of people requiring long-term care (LTC). In all aging economies, LTC is becoming an increasingly urgent political and economic issue. As Germany is one of the fastest aging countries, the introduction of LTCI was pivotal to this issue. Since the introduction of long-term care insurance, there have been debates about the generosity and long-term financial sustainability of the system.

The German LTCI was implemented as a pay-as-you-go system closely modeled on the statutory health insurance and covers about 90 per cent of the population. In contrast to statutory health insurance, however, LTCI was designed to provide only partial comprehensive coverage, with the cost of LTC services borne in part by LTCI and in part privately by the patients and their relatives or, in the case of inability to do so, by social assistance. LTCI is financed through a contribution rate (i.e. wage tax) by the insured (with 1.525 per cent) and by employers (1.525 per cent).¹ The level of LTC benefits and the contribution rate are set by law. The lawmaker also specifies the assessment criteria of eligibility to receive LTC benefits.

With the introduction of LTCI benefits were available from the onset, which led to people receiving benefits without ever paying into the system. These so-called “initial windfall gains” can be observed, when a new pay-as-you-go system is introduced. However, new windfall gains also arise when massive changes are made to a social insurance system, such as a significant expansion of benefit entitlements. In the past, there have been several reforms in LTCI, which generally included the expansion of benefits and the group of eligible persons. With the growing number of elderly people, who also constitute a growing group of potential voters, these reforms became more frequent. Due to increasing societal pressures to not overburden patients and relatives, these reforms were met with minimal political and public dissent. However, to account for the resulting increase in expenses, the contribution rate had to be adjusted several times. In addition, demographic effects have been stronger than expected, and there are more people in the cohorts receiving LTC services.

¹ An exception is the federal state of Saxony, where the employee pays 2.025 per cent and the employer 1.025 per cent. In all federal states, childless persons aged 23 and over pay a supplement of 0.35 per cent without employer participation. There are exceptions for this supplement for people born before 1940 or recipients of social assistance.

Many scholars pointed out that LTCI funding was not structured in a financially sustainable way and that, given the aging population, increasingly higher contribution rates would be needed to refinance future benefits. Given the demographic shifts, the benefits for the increasing number of people in need of LTC in the future would have to be refinanced by a shrinking working population. Both effects lead, *ceteris paribus*, to an increase in the contribution rate. The alternatives to balance LTCI finances in the future are explicit or implicit reductions in benefit levels and the expansion of capital funding. However, one should be aware that forecasts of future developments are always subject to uncertainty. In particular, projections of future numbers of LTCI beneficiaries and thus, LTCI expenditures rely on uncertain assumptions as the future development of life expectancy and the development of LTC prevalence.

However, structural changes in the funding of pay-as-you-go systems such as LTCI always result in distributional effects between generations. Past changes in the generosity of the LTCI system have not affected all cohorts equally, as older generations, for example, benefit by receiving an expansion of benefit entitlements that younger generations must pay for. Any alternatives being considered for future LTCI funding also have different distributional effects, particularly between those living today and future generations.

With regard to the described trends and challenges for the German LTCI system, a detailed analysis is required. The research findings can serve as an important guide for policymakers to achieve a sustainably funded LTCI system while making distributional effects visible. This dissertation aims to identify and quantify the effects of the main drivers of generosity changes to LTCI, the effects on LTCI sustainability, as well as intergenerational distribution effects of LTCI reforms. It is structured into three articles.

The first article „*Gone With the Windfall – Germany’s Second LTC Strengthening Act and its Intergenerational Implications*” reviews the financial and distributional changes to LTCI induced by one major reform to the system, the Second LTCI Strengthening Act of 2017. Due to the debate about the generosity of LTCI benefits, the German government decided to increase benefits and expand the group of beneficiaries eligible for receiving benefits of LTCI. This reform directly led to an increase in the contribution rate to try to balance LTCI finances to account for increased spending. In this article the long-term implications of this reform are analyzed in detail, using generational accounting as a model. Then a sustainable contribution rate for LTCI under pre- and post-reform conditions is calculated. Finally, the reform-induced intergenerational financial impact on the cohorts born between 1916 and 2016 is shown. The reform’s influences on long-term financing of LTCI are detailed and the additional burden or benefit from an intergenerational perspective is exhibited. The results show that by the early 2020s, there will be fiscal pressure for further reforms. From an intergenerational perspective,

this reform can be regarded as a second windfall gain to current beneficiaries, increasing intergenerational redistribution.

The second research article „*Measuring Changes in Generosity in PAYG-systems – An Index Calculation of the German LTC Insurance*“ shows that besides demographic developments, politically motivated changes to the benefit level have a significant influence on LTCI finances and have changed the initial generosity level of the system. The present value of all future benefits and contributions for all age groups alive in 1996 is calculated and then compared to the initial windfall gains from the introduction of LTCI. On this basis a generosity index is derived, which differentiates between changes in political and demographic factors, for each subsequent year. The results show that the generosity level of the German LTCI system fluctuated for all generations living in 1996 and decreased over the period 1996 to 2019. Changes in generosity were mainly driven by political decisions and contrary to common wisdom demography played a minor role. Whereas older generations are less severely impacted by the changes in generosity, the decrease of generosity mainly concerns the younger generations, especially affecting those born after 1970.

The third research article “*Survival of the Fit? Life Expectancy and LTC Prevalence – A Projection of Long-term Care in Germany*“ analyzes the influence of changes in life expectancy and changes in LTC prevalence on the projection of the future number of people in need of LTC. The factors of future life expectancy and future LTC prevalence are selected as they are the main factors for similar forecasts. Using a cohort-component method we model how changes to these two factors affect the projected number of people in need of LTC from 2020 to 2100. Different scenarios of increasing life expectancy are applied along with an assumption with no further increase in life expectancy. The development of LTC prevalence is included in our model, with a constant rate assumed in one scenario and with two prevalence shift scenarios simulating a compression of care needs. The results show that life expectancy appears to be the more important factor, however shifts in LTC prevalence could result in significantly lower numbers of people in need of LTC in some scenarios than generally expected. It is then postulated what such projections mean for policy decisions and how reforms to the system could help stabilize LTCI expenditures in the future to ensure sustainability.

Gone with the Windfall – Germany's Second LTC Strengthening Act and its Intergenerational Implications²

1. Introduction

In all ageing economies, long-term care (LTC) is becoming a more pressing political as well as economic issue. As Germany is one of the fastest ageing countries, it has already introduced a LTC insurance scheme of the Bismarckian type in the 1990s. Since its introduction one debate concerning LTC has always been about the generosity and (long-term) financing of benefits.

In the course of this debate about the generosity of LTC insurance benefits, the Merkel administration decided to increase benefits significantly and enlarge the number of possible beneficiaries with the *Second LTC Strengthening Act*.³ To finance the reform, the contribution rate was raised from 2.35 to 2.55 per cent and a subsequent increase by 0.5 percentage points in 2019.⁴

Several scholars such as Comas-Herrera et al. (2006), Costa-Font et al. (2008), European Commission (2018), Fetzter et al. (2002), Häcker and Raffelhüschen (2006), Kochskämper (2018) or Rothgang (2010a) have shown that LTC insurance is not and never has been sustainably financed, even at the onset due to the expected demographic changes. Subsequently, a funded element in addition to the pay-as-you-go financing was introduced with the *First LTC Strengthening Act* in 2015. This LTC capital reserve fund aims at partly financing deficits which will occur after 2035.

² Lewe Bahnsen, Stefan Fetzter, Fabian Franke (*corresponding author*) and Christian Hagist. Published in: *The Journal of the Economics of Ageing*, vol. 20 (C), (2020).

³ The *First LTC Strengthening Act* increased the benefit level, especially for mentally impaired LTC recipients. In the following, we focus on the effects of the *First and Second LTC Strengthening Act*, with the effects of the *First LTC Strengthening Act* due to the implementation of the LTC reserve fund and the *Second LTC Strengthening Act* focusing on raising the benefit level. Although there is a *Third LTC Strengthening Act*, it is not going to be discussed in this paper. It strengthened the role of municipalities in the areas of counseling and providing care. In addition, the protection against billing fraud in LTC was significantly improved.

⁴ Social LTC insurance in Germany is financed by means of income-based contributions in a pay-as-you-go system. The contribution rate is set by law-makers. However, costs for LTC services, either out- or inpatient care, are only partially covered by the LTC insurance. The remainder of costs are out-of-pocket payments by either the patients or their families or in case of poverty, by other tax-financed social assistance systems. The out-of-pocket payment range is around 50 per cent of all LTC costs (Breyer, 2016). These out-of-pocket payments can comprise of nursing charges, board and lodging, investment costs and possibly a training levy as well as costs for additional services.

Within this paper, we answer the research question of the long-term implications of the recent LTC insurance reform (*Second LTC Strengthening Act*). Using the methodological framework of generational accounting, we first compute sustainable contribution rates for LTC insurance after the *First* (pre-reform) as well as after the *Second LTC Strengthening Act* (post-reform). This sustainable contribution rate serves as our macroeconomic benchmark and will offer the financial long-term adjustment requirements for LTC insurance under pre- and post-reform conditions. Second, we illustrate the future development of the contribution rate (wage tax) given the pre- and post-reform benefit levels. Finally, we calculate the reform-induced intergenerational financial impact on the cohorts born between 1916 and 2016.

As our results will show, there will be a financial pressure for LTC insurance by the 2020s at the latest. As a reaction to this financial pressure, basically four options are possible: a further increase in the contribution rate, a higher level of capital funding, and an explicit (or implicit) reduction of benefits or a combination of the three foregoing elements.⁵ However, with respect to the first option, a further increase in the contribution rate, there will be a limit depending on the public acceptance of the level of obligatory social security contributions. A significant worsening of the economic environment would most likely hinder further significant increases to the contribution rate. Similarly, it can be argued that the second option of higher capital funding has to be financed via a short-term increase of the contribution rate or other additional payments, which will reduce today's disposable income of Germany's population and will therefore be difficult to introduce with respect to the political enforceability. Moreover, the topic of an introduction of capital funding elements to ensure an adequate LTC level in the future has different aspects, which we will discuss in our conclusion.

Furthermore, the third option, an explicit cutting of benefits, seems to be a highly unlikely scenario as it would be contrary to the goals of the *LTC Strengthening Acts*, as well as oppose public and political opinion on this topic. Hence, the most likely scenario would be an implicit reduction of benefits. With respect to this option the *Medical Review Board of the Statutory Health Insurance (Medizinischer Dienst der Krankenversicherung - MDK)* plays an essential role within the LTC insurance scheme. After the introduction of the LTC insurance in 1995, the *MDK* began to classify patients quite generously and then steadily moved toward a more expenditure-reducing steady state. Thus, we will present a hypothetical scenario, in which we assume that history will indeed repeat itself and the *MDK* will reduce the current generous

⁵ A further option could be to finance parts of LTC insurance via taxes. However, as taxes are affected as well by demographic changes, this option is somehow similar to raising the contribution rate.

post-reform benefit level, by adjusting its assessment practices. Furthermore, we show the impact of such a scenario on long-term financing and intergenerational distribution effects.

Our paper is structured as follows. Section 2 presents institutional details of the German LTC insurance and the recent reforms, as well as their impact on LTC financing in the short-term. Section 3 presents data and the methodology of our long-term evaluation of LTC insurance financing. Section 4.1 then discusses the results for the pre- and post-reform scenarios and Section 4.2 shows the results for the hypothetical *MDK* scenario. The paper concludes with an outlook in Section 5.

2. Reform to LTC insurance

Since the introduction of LTC insurance there has been an ongoing debate focusing on the definition of the "need for LTC" and the associated classification. In the field of nursing care, it was criticized that LTC dependency is insufficiently substantiated and primarily oriented to everyday activities regarding mobility, nutrition, personal hygiene and home care. With respect to the definition of the "need for LTC" one main concern was the need for specialized care and assessment for patients with forms of dementia, as they require an increasingly individualized care thus generating higher costs for LTC providers.⁶ Additionally, the focus was put on aiding relatives who provide LTC at home. In order to increase their social security and ease the burden of care they were provided with expanded social security payments and further assistance in form of short-term care and additional programs.

Subsequently to this debate, the German government passed the three consecutive *LTC Strengthening Acts* between 2015 and 2017. The *Second LTC Strengthening Act* altered the system most extensively. In general, a new definition of LTC dependency and a fundamental new system to assess the need for LTC have been introduced. The main factor of the new assessment is the comprehensive coverage of all LTC-relevant aspects, regardless of whether they are due to physical, mental or cognitive impairments. The classification no longer follows a three care levels scheme with a separate assessment of restricted competence in daily matters, but a five care grades scheme uniformly for all patients.⁷ Thus, since January

⁶ Studies suggest that dementia patients cause higher costs than patients without dementia (Comas-Herrera et al., 2006; Schwarzkopf et al., 2012), as their care needs are vastly time consuming and necessitates advanced nursing staff training. The common consensus was to give nursing professionals more face time with the patient and aiding relatives wanting to nurse by themselves, higher benefits and more choices.

⁷ Under pre-reform settings, the time needed for LTC was calculated. Now the degree of autonomy restrictions is the relevant factor for classification.

1, 2017, benefits provided by LTC insurance solely depend on the stated care grade and all LTC-dependent persons within the respective care grades will have access to the same services. Table 1 depicts the pre-reform care levels and post-reform grades as well as monthly pre- and post-reform benefit entitlements.⁸

Table 1: Definition of dependency and benefits paid for in- and outpatient pre- and post-reform

Care level	Pre-Reform			Care grade	Post-Reform		
	Outpatient care		Inpatient care		Outpatient care		Inpatient care
	Cash Benefits (in Euro p/m)	Benefits in Kind (in Euro p/m)	Benefits in Kind (in Euro p/m)		Cash Benefits (in Euro p/m)	Benefits in Kind (in Euro p/m)	Benefits in Kind (in Euro p/m)
				1	(125)*	(125)*	(125)*
I	244	468	1,064	2	316	689	770
II	458	1,144	1,330	3	545	1,298	1,262
III	728	1,612	1,612	4	728	1,612	1,775
III**	-	1,995	1,995	5	901	1,995	2,005

Note: * According to post-reform § 45b Social Code Book XI, LTC-dependent persons are entitled to a relief benefit of 125 Euro. This benefit is earmarked for relieving informal caregivers and supporting autonomy of the LTC-dependent persons. ** Special hardship cases.

Source: Pre- and post-reform § 15 Social Code Book XI.

In order to ease the transition from care levels to care grades and to avoid reassessing 2.75 million recipients of benefits, rules for the transition were introduced. As of December 31, 2016, patients were reclassified within the new care grades by one or two levels higher than previously. A one-level upgrade would bring a patient from care level I to care grade 2, whereas if the patient was in need of more care due to mental impairment (i.e. dementia) a

⁸ In accordance with the literature and law we speak of cash benefits and benefits in kind. However, economically speaking both types are cash benefits as benefits are fixed in Euro. It would be more precise to speak of payments to patients (cash benefits) and payments to providers (benefits in kind).

two-level upgrade would be performed moving the patient from care level I to care grade 3.⁹ Within the new benefit scheme, especially home care benefits (cash benefits and benefits in kind) were raised to a higher degree compared to nursing home care benefits, therefore incentivizing patients to draw upon home care services.¹⁰

Table 2 shows the effects of the reform on the budget of the German LTC insurance. It offers an increase in expenditures by 24.2 per cent from 2016 to 2017, far exceeding the rise in contributions to LTC insurance (12.8 per cent). The main expenditures of LTC insurance include cash benefits and benefits in kind, both benefiting people in outpatient care as well as in inpatient care. Within these expenditure items, cash benefits increased disproportionately (46 per cent). Mainly due to a more generous cash benefit level and the introduction of the new care grade 1, which includes people who previously were not receiving benefits at all. Moreover, the numbers indicate that the new incentives for an increase of (non-professional) outpatient care may work as intended, as the position “Social Insurance Family Caregiver” offers the sharpest rise (56 per cent) of all expenditure items.

All in all, the numbers of Table 2 reveal that the *LTC Strengthening Acts* (and in particular *Act II*) are not only the most extensive, but also the most expensive reform since the introduction of LTC insurance in 1995. Evidently, the financial consequences were underestimated, which is also indicated by the recently introduced increase of the contribution rate by 0.5 percentage points in 2019.

⁹ Regardless of the upgrade, no patient is worse off after the upgrade due to a right of continuance.

¹⁰ A further incentive to pursue outpatient care rather than inpatient care has been the introduction of a uniform institutional co-payment for nursing homes, the so called *Einrichtungseinheitlicher Eigenanteil*. Whereas under the previous rules, the sum of co-payments depended on the care level (with generally lower co-payments for lower care levels) it is now independent of the care grade. Each individual nursing home sets its own uniform institutional co-payment rate. This change generally increased co-payments for lower care grades.

Table 2: 2016 and 2017 budgets of the German LTC insurance

Revenues (billion Euro)	2016	2017	+/-	Expenditures (billion Euro)	2016	2017	+/-
Contributions (employees, voluntary insured)	23.59	26.71	13.2%	Cash Benefits	6.84	9.99	46.1%
Contributions (pensioners)	5.61	6.28	11.9%	Benefits in Kind	3.83	4.50	17.5%
Contributions (unemployment/welfare)	1.18	1.34	13.6%	Nursing Home Care	12.43	14.71	18.3%
Other Contributions	1.57	1.72	9.6%	Other Care Expenditures	4.21	4.80	14.0%
Other Revenues	0.07	0.06	-14.3%	Social Insurance Family Caregiver	0.99	1.54	56.6%
				Administration & MDK costs ¹¹	1.41	1.60	13.5%
				Savings for LTC Reserve Fund	1.29	1.36	5.4%
Total revenues	32.02	36.11	12.8%	Total Expenditures	31.00	38.52	24.2%
				Surplus/Deficit	1.03	-2.42	
Assets (billion Euro)	2016	2017					
	31 Dec	31 Dec					
LTC Working Assets	9.34	6.92					
LTC Capital Reserve Fund	2.44	3.83					

Note: 'Other Care Expenditures' include: day-/nightcare ('Tages- und Nachtpflege'), short term nursing home care ('Kurzzeitpflege'), relief care ('Verhinderungspflege'), care counseling ('Beratungsbesuche'), assistive equipment ('Hilfsmittel'), care focused home improvement ('Wohnumfeldverbesserung'), additional outpatient benefits ('Zusätzliche ambulante Betreuungs- und Entlastungsleistungen') and other care expenditures ('Sonstige Leistungsausgaben').

Source: BMG (2018a).

¹¹ The LTC insurance bears half of the MDK's expenditures.

3. Data and methodology

3.1. Data and assumptions

The following analysis of long-term financial consequences due to the latest LTC insurance reform is based on the methodological framework of generational accounting developed by Auerbach et al. (1991, 1992, 1994).¹² Our database includes a population projection, the revenues and expenditures of LTC insurance before and after the reform in 2016 and 2017, age- and sex-specific micro profiles for different LTC expenditure and revenue types, a growth rate of productivity as well as a discount rate.

The German population of 2017 is the base for our population projection. For the future development of the population, we assume a constant birth rate of 1.5 children per woman of reproductive age and an increase in the life expectancy at birth from 83.41 (78.42) in 2016 to 88.80 (84.80) in 2060 for women (men). After 2060, we assume no further increase in life expectancy. For future migration, we assume a long-term net migration of 100,000 persons per year.¹³

Data regarding revenues and expenditures of LTC insurance rests on the statistics from the German Federal Ministry of Health (BMG, 2018a, also see Table 4). For our analysis, we break down the benefit payment positions into three different subcategories for care levels in 2016 and five different subcategories for care grades in 2017 (BMG, 2018b/c).

Within the framework of generational accounting, LTC insurance expenditures are distributed among the cohorts alive in 2016 and 2017 according to age- and sex-specific micro profiles for each subcategory and budget position. For this purpose, we construct micro profiles from a data set of Germany's second largest statutory health insurance provider, BARMER, which comprises routine data of 3,250,233 insured persons. Hereof, 160,179 received LTC benefits, 92,103 were in home care and 68,077 in inpatient care.¹⁴ Within the claims data set each recipient of benefits is assigned an individual ID number identical for the entire set. The data

¹² Shortcomings of generational accounting are discussed in Hagist (2008).

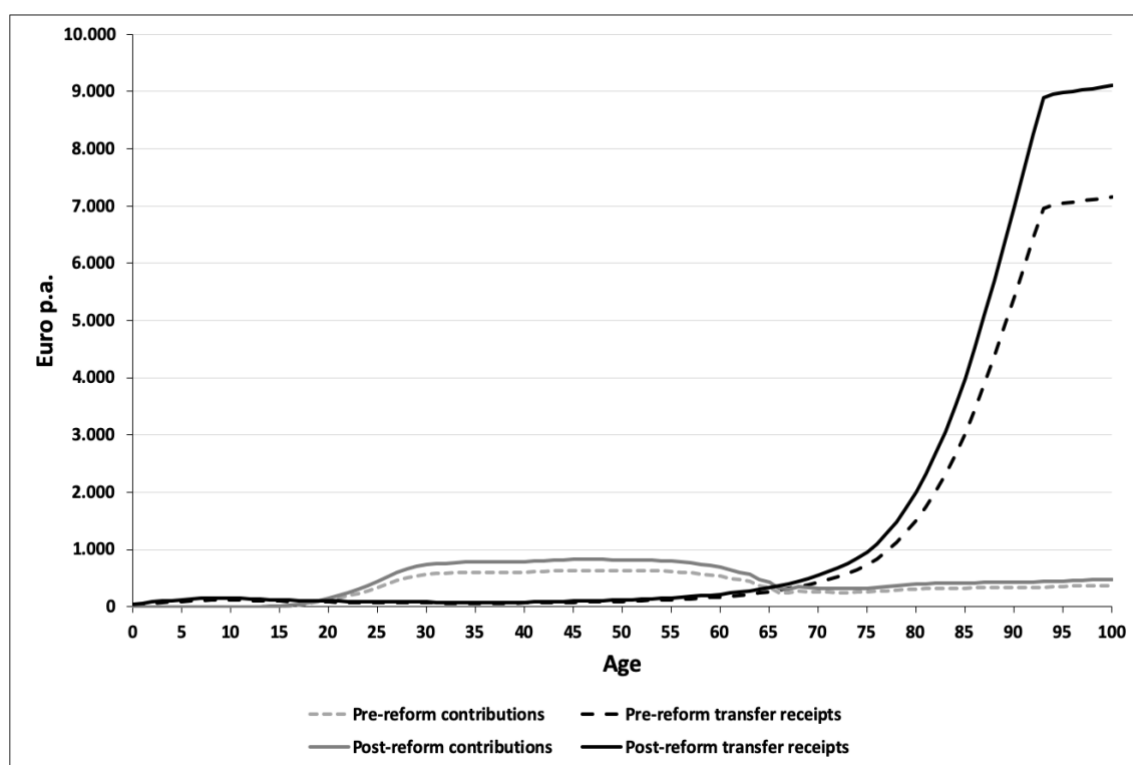
¹³ For the population projection, we use the cohort component method which goes back to Whelpton (1936). A formal description of our population projection can be found in Bonin (2001). The assumptions of this population projection are based on the 13th coordinated population projection for Germany (Destatis, 2015) but refer to more recent data taken from Destatis website.

¹⁴ Data for 2017 covers only the first quarter of 2017. Hence, care grade 1 data cannot be considered to be representative and therefore care grade 1 profiles are calculated with data from BMG (2018b, 2018c, 2018d).

is structured by sex, date of birth and care level (pre 2017) or care grade (post 2017) and individual expenditures which can be grouped in cash benefits and benefits in kind for in- and outpatient care. For every age group and sex micro profiles are constructed for each care level/grade and type of expenditure within LTC insurance before and after the reform.

For the distribution of revenues, we distinguish between age- and sex-specific contribution payments of employed persons, retirees and other revenues, for example payments for unemployed persons.¹⁵ The micro profiles for these contribution payments stem from the German Sample Survey of Income and Expenditure 2013 and the German pension insurance (RDC, 2013; Deutsche Rentenversicherung, 2017).

Figure 1: Pre- and post-reform average transfer receipts and contribution payments



Source: Own calculations based on BARMER data, BMG (2018b, 2018c, 2018d), RDC (2013) and Deutsche Rentenversicherung (2017).

Figure 1 shows the resulting average transfer receipts b_u and contribution payments c_u per year for a representative individual of a cohort aged u in 2016 and after the reform in 2017

¹⁵ In the methodological world of generational accounting, the construction of age-specific profiles is accompanied by assumptions regarding the incidence of financial budget positions on age- and gender groups. With respect to this point, we particularly assume, that the employer's contributions are borne by the corresponding employees and that the contributions paid by the statutory pension scheme are borne by pensioners.

respectively. The average post-reform contribution payments c_u steadily increase for individuals aged 15 to 45 years to a level of 830 Euro per year. With reaching retirement age of 65, the (post-reform) c_u decline to around 430 Euro. In contrast to this, the average transfer receipts b_u offer an exponential increase along with increasing age. While 65-year-old individuals receive on average 335 Euro from LTC Insurance, this amount is over twenty-five times higher for individuals aged 90 or older. A comparison of pre- and post-reform payments reveals the reform-induced generosity. While contribution payments increase at maximum by 190 Euro for 45-year-old individuals, the transfers received by individuals aged 95 or older increase from 7,100 to 9,100 Euro per year.

In general we assume that all age-specific contributions and benefits grow with an annual productivity growth rate g of 1.5 per cent.¹⁶ We assume a different growth for the contributions of pensioners due to the pension reforms in Germany from the early 2000s (Raffelhüschen et al., 2010).

With respect to the benefit receipts of LTC insurance, a uniform growth rate implies particularly that the benefit entitlements will grow at the same rate as the wages.¹⁷ Our projection also implies a constant age-related LTC prevalence over time. For a prediction on future health care expenditures Fuchs (1984) has concluded that rising expenditures for the age group 65 and above are mainly driven by the proximity to death (time-to-death). However, in the case of LTC there are some empirical findings that do not confirm the time-to-death hypothesis as they identify age as the main driving factor for rising LTC-expenditures (Werblow et al., 2007; De Meijer et al., 2011; Hackmann and Häcker, 2011, Karlsson and Klohn, 2016). As Hackmann and Moog (2009) show, the future development of LTC prevalence depends on various factors such as the relation of mortality of LTC patients to mortality of non-LTC patients, and the future development of LTC incidence rates. Furthermore, we implicitly assume a constant ratio of nursing home and outpatient care. For the impact of a shift to nursing home care on future expenditures, see Comas-Herrera et al. (2006).

¹⁶ The Social Code Book XI considers an inflation of benefit levels with reviews based on the cost development of the past three years, with the next review by the federal government in 2020.

¹⁷ It seems unclear, if this assumption is sufficient to ensure the actual level of care provided. LTC is labor intensive and it is difficult to implement technical progress permitting labor cost reductions in step with the rest of the economy. If at the same time the demand for care is inelastic, then this could result in a disproportionate increase of prices for LTC. Baumol (1967) has referred to this phenomenon as "unbalanced growth" and it is particularly relevant to the provision of LTC since demand is highly inelastic and there are few possibilities for technical progress.

Finally, we use an annual discount rate r of three per cent for our calculations (European Commission, 2017). In order to check the robustness of our results we assume two different scenarios in our sensitivity analysis, one with a higher ($g = 1.0$ per cent and $r = 3.5$ per cent) and the other with a lower ($g = 2.0$ per cent and $r = 2.5$ per cent) difference between the annual productivity growth and discount rate.¹⁸

3.2. Methodology

Our analysis of the long-term implications of the recent LTC reforms starts with the calculations of the present value of future contributions, $PV C (living)$, and the present value of future benefits, $PV B (living)$, for all generations alive in our starting year 2016:¹⁹

$$PV C (living) = \sum_{t=2016}^{2116} \sum_{u=t-2016}^{100} N_{u,t} \cdot c_u \cdot (ndf)^{t-2016} \quad (1)$$

$$PV B (living) = \sum_{t=2016}^{2116} \sum_{u=t-2016}^{100} N_{u,t} \cdot b_u \cdot (ndf)^{t-2016} \quad (2)$$

$N_{u,t}$ is the number of persons at age u in year t . For all years between 2016 and 2116, we compute the present value of contribution payments by multiplying the cohort sizes, $N_{u,t}$, with the constant age-specific contribution payment, c_u , and a net discount factor, ndf^{t-2016} , whereby $ndf = \frac{(1+g)}{(1+r)}$, with productivity growth g and interest rate r . The calculations of the $PV B (living)$ is in principle the same, using constant age- and sex-specific average benefits, b_u .

¹⁸ Please note the results of generational accounting indicators mainly react to difference of g and r . The assumption of a real interest rate $r > g + \eta$ (where η denotes a yearly population growth rate) is central to sustainability measuring concepts as generational accounting. In the context of the models of Solow (1956) and Diamond (1965) this implies that the economy is on a balanced growth path that is *dynamically efficient*.

¹⁹ In our calculations, we further distinguish between men and women. We skip this in the notification for convenience reasons.

To analyze the impact of current reforms on sustainable LTC-financing, we also compute the present value of contributions and benefits for all generations born in 2017 and after:²⁰

$$PV C (future) = \sum_{t=2017}^{\infty} \sum_{u=0}^{\min \{100, (t-2017)\}} N_{u,t} \cdot c_u \cdot (ndf)^{t-2016} \quad (3)$$

$$PV B (future) = \sum_{t=2017}^{\infty} \sum_{u=0}^{\min \{100, (t-2017)\}} N_{u,t} \cdot b_u \cdot (ndf)^{t-2016} \quad (4)$$

As an interim step, we compute the so-called intertemporal public liabilities *IPL* as the difference of future benefits ((2) and (4)) and future contributions ((1) and (3)). In addition, we consider the LTC insurance's current assets, *LTC Asset*₂₀₁₆, which comprises the working assets at the end of the year and the LTC fund:

$$IPL = PV B (living) + PV B (future) - PV C (living) - PV C (future) - LTC Asset_{2016} \quad (5)$$

Fiscal sustainability requires *IPL* to equal zero, thus we compute a necessary increase of the contributions θ :²¹

$$\theta = \frac{IPL}{PV C (living) + PV C (future)} \quad (6)$$

Finally, we derive our benchmark for a stable LTC-financing, the “sustainable contribution rate”, *SCR*, by multiplying the initial contribution rate, *CR*₂₀₁₆ with $1 + \theta$:²²

$$SCR = CR_{2016} \cdot (1 + \theta) \quad (7)$$

²⁰ In the practical calculation all relevant variables like population or cohorts' tax payments are projected for 300 years from the base year on. Afterwards a geometrical serial is used to determine the remaining net tax payments. The choice of 300 periods is nearly completely arbitrary and just reflects a good approximation point for our analysis.

²¹ This indicator reacts less sensitively to variations of the net discount factor than other sustainability indicators, for of the LTC insurance contribution rate.

²² There are various ways to make the current situation in LTC insurance more sustainable. The most straightforward way is to adjust the contribution rate. However, it is difficult to gauge the scale of adjustment necessary to achieve example the sustainability gap, see Benz and Fetzer (2006). For the topic of this study this seems adequate as in the following we will discuss the impact of current LTC insurance policy on the future development sustainability. The *SCR* serves as a benchmark indicator in our analysis of the long-term implications of the reform. It would be the constant rate required each year that would hinder a buildup of debt in the long-term. Implementing such a *SCR* would mean a shift from a pure pay-as-you-go system to a mixed system of funded and pay-as-you-go elements.

In the next step, we further show the consequences of the reform on the contribution rate over time. For this purpose, we compute yearly contributions C_t and benefits B_t for all years after 2016:

$$C_t = \sum_{u=0}^{100} N_{u,t} \cdot c_u \cdot (1 + g)^{t-2016} \quad (8)$$

$$B_t = \sum_{u=0}^{100} N_{u,t} \cdot b_u \cdot (1 + g)^{t-2016} \quad (9)$$

After that, we are able to compute the necessary yearly adjustment by closing the yearly deficits, $B_t - C_t$, via an increase of all contributions in this year, α_t . Here, we also consider temporarily available financial reserves, i.e. the working assets and the LTC fund that will be used from 2035 onward and which are labelled $TAFR_t$:

$$\alpha_t = \frac{B_t - C_t - (-TAFR_t)}{C_t} \quad (10)$$

The development of the contribution rate over time results from multiplying the initial contribution rate CR_{2016} with $1 + \alpha_t$:

$$CR_t = CR_{2016} \cdot (1 + \alpha_t) \quad (11)$$

In a third step, we want to measure intergenerational distribution effects of the reform. For this purpose, we compute generational accounts for all cohorts alive in 2016. The generational account, $ga_{\bar{u},2016}$, represents the average present value of future net payments (contribution rate minus benefits) for a cohort member of age \bar{u} in 2016 over his remaining lifetime. We hereby consider the future development of the contribution rate:

$$ga_{\bar{u},2016} = \frac{\sum_{u=\bar{u}}^{100} N_{u,2016+u-\bar{u}} \cdot (c_u \cdot (1 + \alpha_{2016+u-\bar{u}}) - b_u) \cdot (ndf)^{u-\bar{u}}}{N_{\bar{u},2016}} \quad (12)$$

Generational accounts cannot be compared between different cohorts, as for younger cohorts the remaining lifetime is longer than for older cohorts. Thus, we compute annuities from differences between pre- and post-reform generational accounts $ga_{\bar{u},2016}^{pre}$ and $ga_{\bar{u},2016}^{post}$. This computation shows the reform-induced burden or relief per remaining life year, $bly_{\bar{u},2016}$, for the cohort \bar{u} :

$$bly_{\bar{u},2016} = (ga_{\bar{u},2016}^{pre} - ga_{\bar{u},2016}^{post}) \frac{r \cdot (1+r)^{LE_{\bar{u},2016}}}{(1+r)^{LE_{\bar{u},2016} - 1}} \quad (13)$$

The term $\frac{r \cdot (1+r)^{LE}}{(1+r)^{LE-1}}$ functions as the annuity factor, in which r denotes our interest rate and LE denotes the (conditional) life expectancy for the average cohort member with age \bar{u} in 2016, taken from Destatis (2017b).

4. Results

4.1. Pre- and post-reform situations

4.1.1. Contribution rate development

Following our definition of sustainability, with *IPL* equaling zero, contributions have to be adjusted by θ . Starting from the pre-reform contribution rate of 2.35 per cent in 2016, an additional 1.37 percentage points are necessary to achieve sustainability under pre-reform conditions. Thus, our pre-reform benchmark, the sustainable contribution rate, *SCR*, amounts to 3.72 per cent. As mentioned in Section 2, the LTC contribution rate increased by 0.2 percentage points in 2017 via the *Second LTC Strengthening Act* and for the year 2019, a further increase by 0.5 percentage points was introduced. Our calculations reveal that under post-reform conditions the 2019 post-reform contribution rate of 3.05 per cent has to be increased by 1.83 percentage points to reach the post-reform benchmark, a *SCR* of 4.88 per cent. Table 3 gives an overview.

Table 3: Pre- and post-reform contribution rates and necessary adjustments

	Pre-reform	Post-reform
Contribution rate	2.35%	3.05%
<i>SCR</i>	3.72%	4.88%
θ	0.58	0.60
Necessary adjustment	1.37%	1.83%

Source: Own calculations.

A first finding of our analysis is that the necessary relative increase of the contribution rates (θ) does not change significantly under pre- and post-reform conditions. In other words, the reform does not change the leverage effect which demographic transition exerts on LTC insurance. In light of this, the recent increase of the contribution rate of 0.5 percentage points for 2019 could be interpreted as a restoring of the pre-reform leverage ratio. Nonetheless, the generous reform leads to a significant absolute increase in the *SCR* of 30 per cent compared to the pre-reform level. These results are also robust under different assumptions for the annual growth and discount factor (see Table A.1 in the Appendix).²³

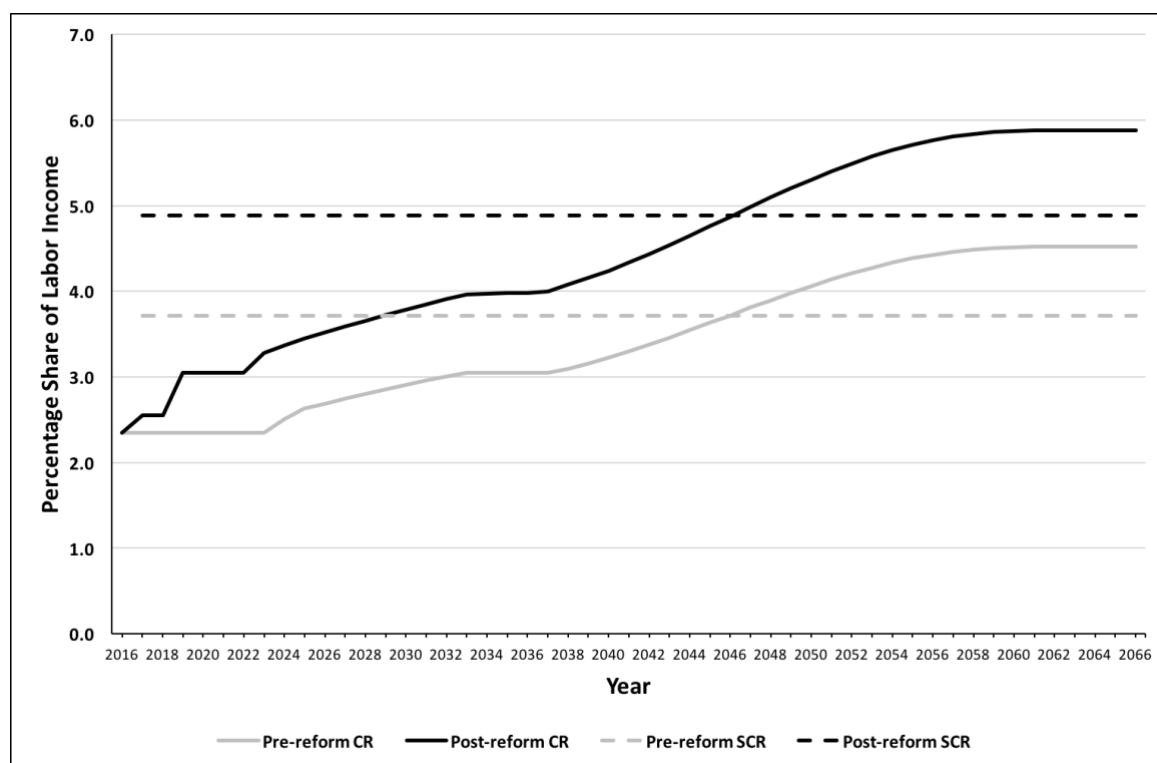
²³Under a different discount factor *ndf* of 0.976 (0.995) the value of θ is 20 per cent lower (higher) than with the baseline assumption of a *ndf* of 0.985, whereas the sustainable contribution rate *SCR* only

Our theoretical benchmark, the *SCR*, comes along with the implicit assumption of an immediate removal of any long-term financial imbalance in LTC insurance and therefore a spike in the short-term burden of private households. At least in the short-term, this assumption seems to be unrealistic.²⁴ A more realistic scenario is the (pay-as-you-go-inherent) assumption of a future increase in the contribution rate in a particular year in which the LTC expenditures (B_t) exceed LTC revenues (C_t) plus other temporarily available financial reserves (*TAFR*). The development of such a (annually adjusted) contribution rate over time is drawn in Figure 2 – again under pre- and post-reform conditions.²⁵ For reasons of comparability the pre- and post-reform *SCR* are also depicted.

varies by eight per cent. However, the main results, a constant demographic leverage effect under pre- and post-reform conditions and an increase in the *SCR* by 30 per cent, remain the same.

²⁴ Please note, our "model" of a *SCR* implies also the assumption of a new capital funding scheme in LTC insurance. As in the first years the resulting revenues under an *SCR* exceed expenditures (together with the current assets) a capital stock will be generated which will be used later to finance yearly deficits in LTC insurance. The underlying mechanism is very similar to the current LTC fund, however the amount of our intertemporal compensation via the *SCR* is even larger. We assume three per cent which can in some scenarios be considered optimistic.

²⁵ Note, that LTC projections and their sensitivity depend above all on underlying demographic assumptions (Costa-Font et al., 2008; Rothgang, 2003). In contrast to this, the different assumed growth rate and discount factor (a *ndf* of 0.976 and 0.995 instead of the baseline *ndf* of 0.985) do not change the results of LTC contribution rate projection. The maximum deviation merely amounts to -0.1 percentage points in the pre-reform scenario in the year 2073 with a *ndf* of 0.976 instead of the baseline *ndf* of 0.985.

Figure 2: Contribution rate projections until 2066

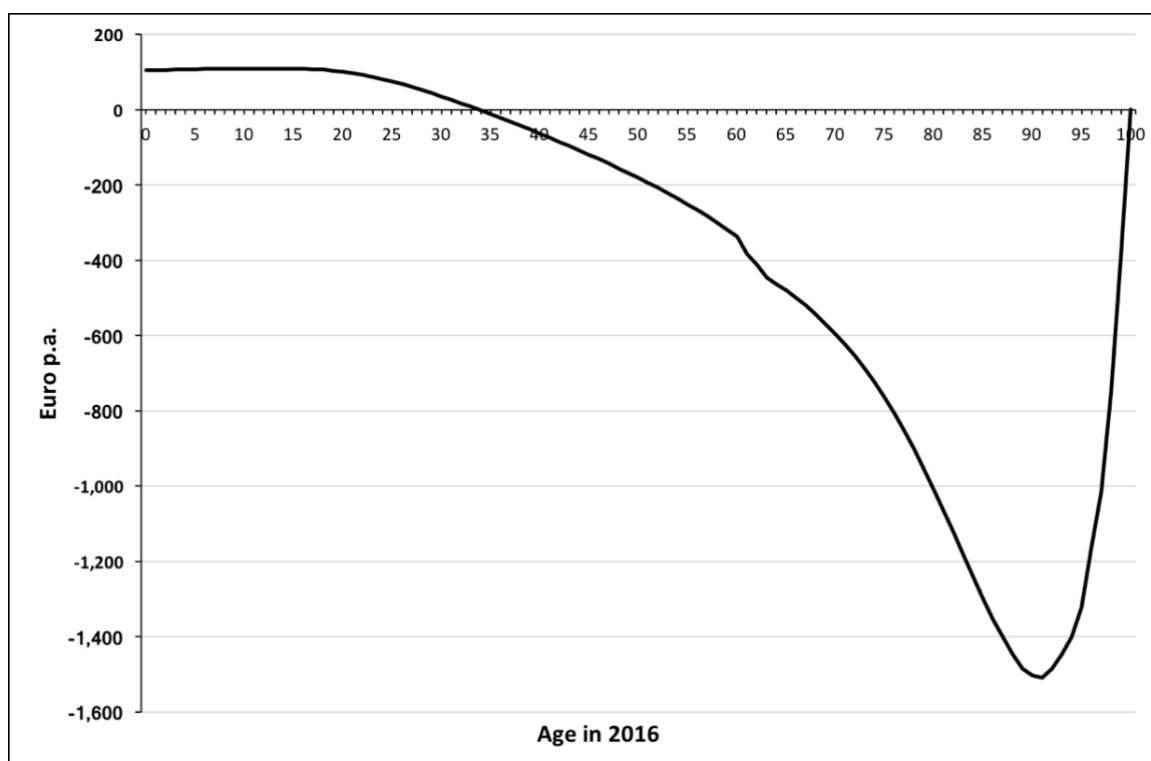
Source: Own calculations.

Our calculations reveal that under pre-reform conditions the working assets ensure a stable contribution rate of 2.35 per cent until the year 2022. After that, the contribution rate rises to 3.05 per cent by 2034, the onset of the LTC fund. The fund's assets ensure this contribution rate level until 2038. Afterwards, the contribution rate steadily increases, reaching a level of 4.52 per cent in 2060. Under post-reform conditions, our calculations offer a different picture. After the contribution rate increases in 2017 and 2019 up to 3.05 per cent, this level will be stable for only three further years with the help of available working assets. Due to the benefit expansions and the widened circle of beneficiaries induced by the *Second LTC Strengthening Act*, the contribution rate increases to 3.97 per cent between 2023 and 2034. Financial resources of the LTC fund stabilize the contribution rate until 2036. In later years, the contribution rate rises to 5.88 per cent in 2060 and afterwards.

4.1.2. Additional burden

Beside the reform-induced impact on sustainability and the contribution rate development, our research question concerns the intergenerational distributional effects of the reform. Figure 3 shows the reform-induced burden or relief per remaining life year ($bly_{\bar{u},2016}$) for cohorts of age u in 2016.

Figure 3: Reform-induced burden as annuities



Source: Own calculations.

All cohorts younger than 33 in 2016 will face an average additional burden due to the reform, at a maximum of 110 Euro per year over their remaining life. Due to the discount rate, their higher contribution payments in the near future outweigh their higher benefit receipts in the distant future. In contrast to this, all cohorts older than 33 on average benefit from the reform. The reform-induced reliefs increase up to a maximum of 1,509 Euro per remaining life year for the 91-year-old average cohort member in 2016. Older cohorts face declining reliefs as their remaining life expectancy declines. This goes along with a shorter time of benefiting from the generous reform level (the widening circle of beneficiaries of care grade 1 and the expansion of benefits, especially cash benefits). These numbers remain at about the same

level even under different assumptions regarding the annual growth rate and discount factor (see A.2 in the Appendix).²⁶

Building on the work of Samuelson (1958), we follow Feldstein (2005) as well as Feldstein and Liebman (2002) and interpret the reform-induced reliefs as a (second) windfall gain. The first windfall gain occurred with the introduction of the pay-as-you-go-financed LTC insurance in 1995. Until then, LTC beneficiaries had never paid contributions. However, they were receiving benefits, or more generally speaking, the older generations paid significantly lower contributions compared to the benefits they received. Like the introduction of a pay-as-you-go system, every widening of the benefit level involves windfall gains for those already or close to becoming LTC-dependent and losses for current and future contributors. The dimension of this second windfall can be shown, for example, by the 1926 born individual. According to Fetzter, Moog and Raffelhüschen (2002), this individual experienced a windfall gain of approximately 1,700 Euro (in prices of 2016) from the introduction of LTC insurance. The second windfall gain amounts to 1,500 Euro due to the current reform. Hence, this second windfall gain is almost 90 per cent of the first one.

4.2. Effects of adjustment in the MDK assessment structure

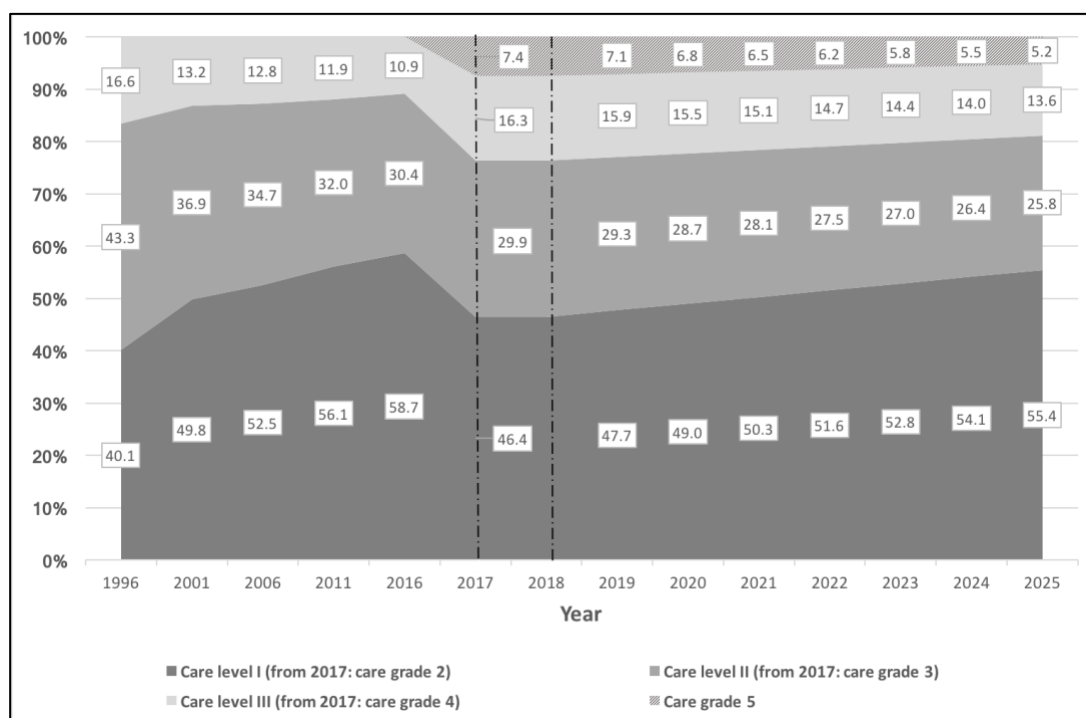
As discussed at the beginning of the paper, an unlimited increase in the LTC contribution rate seems to be implausible. A more likely mid-term opportunity to stabilize finances is an implicit cut in generosity. Within this opportunity the *MDK* plays a key role as it is responsible for the LTC assessment and thus for the structure of beneficiaries.²⁷ By looking at the *MDK*'s assessment data, we detect a similarity in the classification structure after the introduction of LTC insurance and after the latest reform. From the introduction of LTC insurance assessments tended towards overall higher care levels, while the following years until 2016 showed a more and more conservative classification. In 2017, however, with its new classification scheme, the reform led to a higher number of persons in higher care grades, similar to the early post-introduction phase. Figure 4 depicts the assessment structure from 1996 to 2017.

²⁶ A *ndf* of 0.976 instead of 0.985 leads to a slightly higher burden of about 20 Euro per remaining life year and a shift of the "break-even age" from 33 to 40 in 2016. In contrast to this a *ndf* of 0.995 leads to a lower burden of about 30 Euro per remaining life year and to the conclusion that all generations older than 26 years (instead of 33) will benefit from post-reform conditions.

²⁷ In contrast to pension and health insurance, for LTC insurance there is the possibility to use this institution to cover up necessary explicit changes to a certain extent.

Therefore, we introduce a hypothetical scenario in which we assume that history repeats itself and the assessment structure will again tend towards a more expenditure-reducing steady state. In trying to model this scenario, we assume that care grade 2 is comparable to care level I, care grade 3 to care level II and care grades 4 and 5 are comparable to care level III. Care grade 1 can be regarded as a novelty since it was introduced to widen the group of people eligible for LTC benefits. We now further assume that after the transitional period due to the new assessment system, the MDK will return to the pre-reform expenditure-reducing assessment. Hence, we postulate that from 2019 to 2025 each year the assessment structure will shift towards lower care grades. In the following we will therefore use the past shift in care level II as our benchmark.²⁸ From 1996 to 2016 the share of care level II decreased by 30 per cent. We assume that in order to make the shift from the old assessment system to the new, the MDK once again acted in a more generous way than was strictly necessary. Consequently, in our scenario 30 per cent of cases will move from care grade 5 to care grade 4, 30 per cent from care grade 4 to care grade 3 and 30 per cent from care grade 3 to care grade 2. Returning to an assessment structure closer resembling the pre-reform structure by 2025 will change the situation as shown in Figure 4.

Figure 4: Pre-reform and hypothetical post-reform LTC assessment structure



Note: Care grade 1 is not included. The dashed lines mark a break point in scaling and divide our data from the hypothetical scenario.

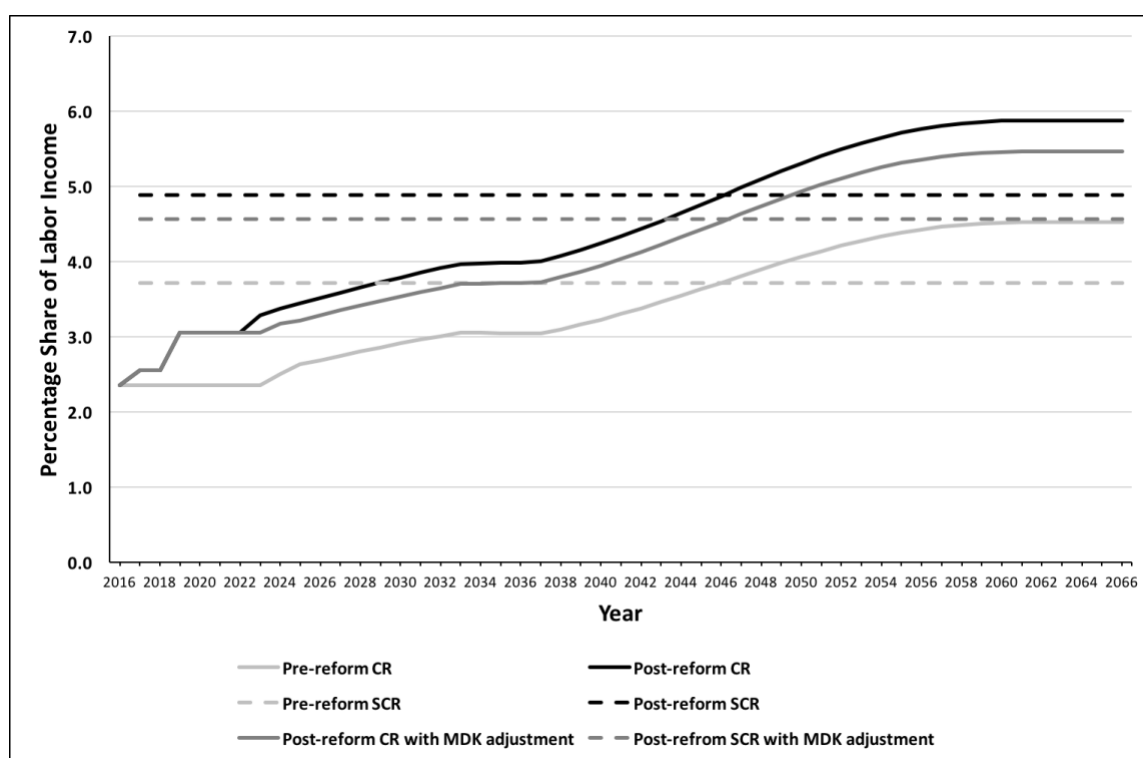
Source: BMG (2018e, 2018f).

²⁸ Care level II is the only care level that allows for the net effect of the down grading from care level III to II as well as II to I. Therefore, we assumed it to be most suitable as benchmark.

If the structure gradually moves toward the direction of the 2016 structure, we can expect a small but significant dampening effect on the expenditures of LTC insurance. In consequence, this effect would lead to a relatively smaller gap in financing. In case the assessment structure seen in 2017 does not persist and the MDK follows our assumption returning to a more conservative assessment, the *SCR* amounts to 4.57 per cent. Due to the introduction of care grade 1 and the on average higher benefits this is still much higher than the pre-reform *SCR* of 3.72 per cent.²⁹

As Figure 5 shows, given our hypothetical scenario the contribution rate will rise at a relatively slower pace compared to the post-reform contribution rate. However, even if the MDK would follow such a path the situation is still not sustainable from a fiscal point of view.

Figure 5: Contribution rate projections until 2066



Source: Own calculations.

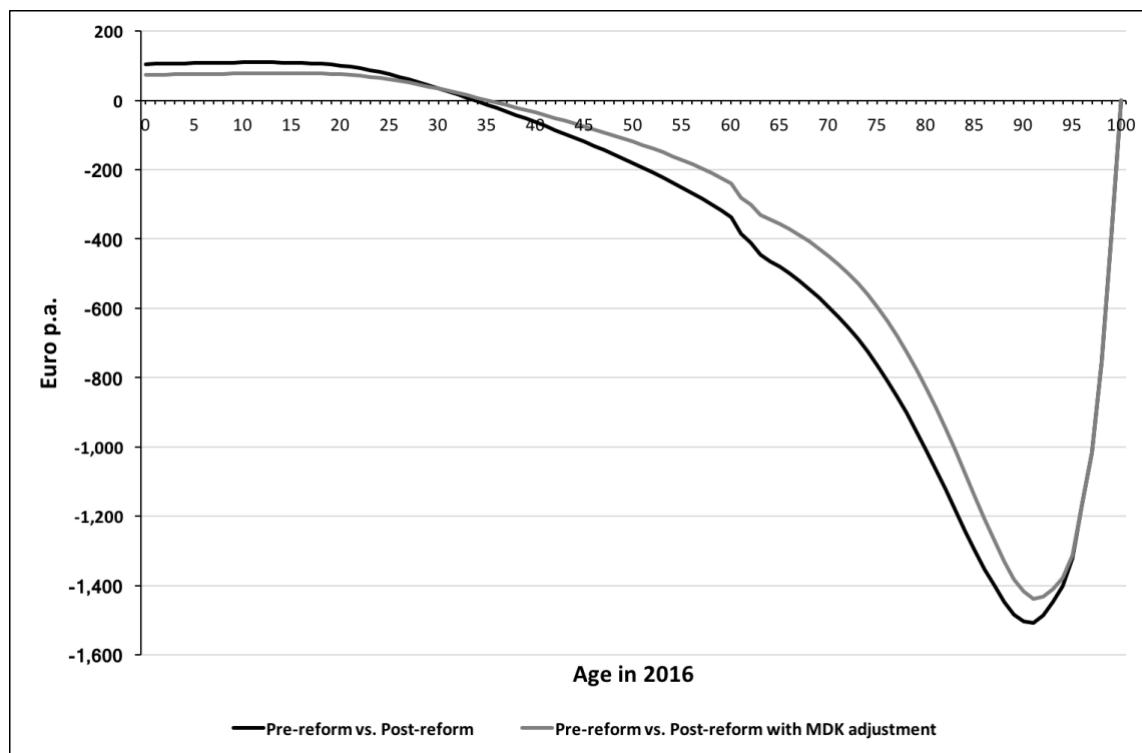
Under these conditions, the contribution could be kept stable one year longer, until 2023 when the working assets will deplete. With the onset of the LTC fund the contribution rate would still be at a level of 3.71 per cent. The LTC fund resources could keep the contribution rate stable

²⁹ See Table A.1 in the Appendix for the value of θ and the necessary increase in the contribution rate. It also depicts that results are robust under different assumptions for g and r .

for four years. In the years afterwards further increases are necessary, reaching the *SCR* of 4.57 per cent in 2046 and stabilizing again from 2060 on at 5.46 per cent.

Lower contribution rates will also have an impact on the intergenerational redistribution. The effect on the reform-induced burden or relief is depicted in Figure 6.

Figure 6: Reform-induced burden as annuities



Source: Own calculations.

Even when assuming a more conservative assessment and an expenditure-reducing steady-state, all cohorts younger than age 35 in 2016 will face an additional average burden with a maximum of 78 Euro per year over their remaining life. At the same time, all cohorts older than 35 still benefit from the reform, however less than if the *MDK* retained its assessment structure of 2017. It can be seen, that such a measure as an implicit cut can only slightly cushion the long-term effects. Until this cut unfolds its full effect, those who have benefited from the windfall gain most may already be dead or have indirectly transferred the windfall to their heirs. All in all, with implicit cuts the negative reform-induced impact could at least be reduced. However, a windfall gain still remains. As shown in Figure A.2 of the Appendix, this result persists (with a deviation of +/- 20 Euro) even under varied assumptions regarding the annual growth rate and discount factor.

5. Conclusion and outlook

From an intergenerational perspective, the *Second LTC Strengthening Act* in 2017 can be seen as a second windfall gain with an extent of almost 90 per cent of the windfall gain induced by the introduction of LTC insurance in 1995. The reform has not influenced the effect of the demographic leverage effect, but has raised the level of unsustainable financing by 30 per cent through a higher generosity of the LTC system.

Concerning the annual development of the contribution rate under the assumption of a constant benefit level, our analysis shows that the current working assets as well as the LTC capital reserve fund will be able to stabilize contribution rates for only a few years. In the long-term, our analysis reveals contribution rates to LTC insurance of almost six per cent.³⁰ However, the political enforcement of higher levels regarding the LTC contribution rate strongly depends on public acceptance (which in turn depends on the specific economic situation). Here a limited view to the LTC insurance falls short. Both the pension insurance and health insurance will face financial pressure due to the upcoming demographic transition (Hagist et al., 2009). Recent calculations modeling the impact of the demographic change on the contribution rate for all three social insurances under the conditions of status quo legislation (for LTC pre-reform conditions) offer a necessary increase from 36.65 per cent at present by a further 20 percentage points within the next 40 years (Breyer, 2016).³¹ Such high contribution rates are implausible as the resulting tax-induced wedge (the sum of tax payments and social security contributions) would immensely reduce working incentives, as well as the global competitiveness of the German economy.³²

Thus, it is our belief, that – in the medium-term – financing problems will be tackled through implicit cuts in generosity by returning to the practice of assessment of the previous years. In contrast to the national pension scheme, the *MDK* enables the government to conceal

³⁰ Our results are within the range of other estimates, which project the contribution rates of LTC insurance post reform using other approaches (see Ehrentraut et al. (2019) and Arentz et al. (2019)).

³¹ Under pre-reform conditions, the contribution rates of respective insurances are 18.7 per cent (pension), 14.6 per cent (health) and 2.35 per cent (LTC). Additionally, health insurance has an additional contribution rate of an average of 1.0 per cent, depending on the choice of statutory health insurance provider. Substantial expenditure increases are expected in particular for the pension insurance which could amount to additional 2.6 percentage points of GDP (European Commission, 2018).

³² Although our results are based on a partial equilibrium analysis, related literature on overlapping generations models supports our statement on increasing contribution rates in general (Fehr et al., 2003; Gonzalez-Eiras and Niepelt, 2008; Demange, 2009; Bruce and Turnovsky, 2013; Cipriani, 2014; Nishiyama, 2016).

changes in generosity in LTC insurance. However, as our results show even such an intervention will only be able to cushion the long-term effects on the budget for a short while. Furthermore, such interventions will take some time to be implemented and in this time the windfall gains can be scooped by the current older LTC recipients, or their heirs.

So the question arises how to proceed with the German LTC system in light of the upcoming demographic transition. German economists have been proposing the option of (a broader) capital funding of the LTC system since the beginning of LTC insurance in 1995.³³ With respect to this option, one has to distinguish at least two possibilities of a supplementary capital funding.³⁴

One possibility would be the expansion of the collective capital fund as for example proposed by Ehrentraut et al. (2019). This option would involve an immediate significant rise in the actual contribution rate and/or taxes which would then be used to stabilize the future contribution rate. In this respect, the current LTC capital reserve fund can be seen as a first step toward this option. However, the existing rules for the LTC capital reserve fund can be criticized for at least three reasons. First, as our analysis shows, the volume of the LTC capital reserve fund is far too small to balance the problem of the increasing beneficiary-contributor-ratio.³⁵ Second, and in light of the steadily increasing “oldest-old dependency ratio” from today until at least 2060, the “disbursement-timing” of the LTC capital reserve fund under the current rules seems to be chosen fortuitously.³⁶ Setting the starting point of payouts at the year 2035 to stabilize the contribution rate does not seem sufficient. And third – the existing rules of the investment policy for the current LTC capital reserve fund allow only few investments in equities, capping them at a maximum of twenty per cent, and thus hinder the chance of a better return on the invested capital. A 80 per cent investment in government bonds could also be seen as just another form of pay-as-you-go financing, this time by taxpayers. Furthermore,

³³ In contrast to a short-term perspective, from a life-cycle perspective capital funding can be seen as neutral with respect to its effect on the people's disposable income (Modigliani and Brumberg, 1954).

³⁴ A further possibility is the complete transition from the pay-as-you-go financing to a capital funded LTC-system. See Felder and Fetzer (2008) for the intergenerational effects of such a reform.

³⁵ Already prior to its establishment, the LTC fund was criticized for being too small to have a considerable impact on the future contribution rate (Bowles and Greiner, 2015).

³⁶ In this context Breyer (2016) points out the need for cohort specific saving accounts. From a theoretical point of view, the LTC capital reserve fund function is a compensation for the (future) contributors that are not born yet. Hence, it would be consequent that financial resources paid by a specific cohort into the LTC capital reserve fund should only be used to finance the LTC-benefits of the same cohort later.

with collective capital funding, there are several political-economic risks involved such as non-purposeful use of funds.

The other possibility to implement a broader capital funding of the LTC system is the extension of private capital reserves to finance LTC-expenditures. This supplementary capital reserve should balance a coverage gap between the total expenditure of LTC and the benefits paid by LTC insurance.

The design of a system of private capital reserves involves the question of intragenerational distribution. With or without LTC-specific savings, the affluent part of the population is assumed to be willing and able to use their own assets to pay for a high-quality level of LTC they prefer, thereby decreasing the assets they bequeath to their heirs. Furthermore, since 2013 voluntary private assets, in form of a supplementary private LTC insurance are subsidized by the state.³⁷ Consequently many persons with high income take out supplementary private LTC insurance. If in the future politicians decide in favor of an explicit cut to the LTC insurance benefit level (i.e. to avoid an increasing contribution rate) the resulting increase of the coverage gap will result in a two class-LTC system. Without additional legislation, the financially stronger part of the German population will be able to afford an adequate quality level of care due to their private savings. The financially weaker part of the population will get only the most essential care level, which will be paid by LTC insurance and tax-financed social assistance systems. Hence, from an equity perspective a system of mandatory supplementary private LTC insurance appears to be superior. In such a system, persons with a lower income would be compensated for their supplementary premiums by the government. However, such a system would involve a massive expansion of the private insurance companies, an option that does not enjoy popularity in the German social policy debate and again raises questions concerning the caps for equities in insurance regulations.

Thus, a further interesting and necessary topic of research would be the precise analysis of intragenerational distributional effects resulting from the design of capital funding. Furthermore, the measurement of the impact of the reform on different socio-economic groups probably could give interesting points with respect to intragenerational distributional effects. Given a possible positive correlation between income and the consumption of LTC, the reform would for example lead to a long-term shift in generosity and a difference in the qualitative level of care between the richer and the poorer, as well as to widening the gap between those with the highest level of care and those with the lowest. In this case the reform maybe

³⁷ For further information on supplementary LTC insurance, the so called '*Pflege-Bahr*', see Nadash and Cuellar (2017).

developed a third windfall for the richer parts of the current working generations, as they would benefit disproportionately from the raise in generosity of the system and the state subsidization of the premiums of their supplementary private LTC insurance by the same time.

In conclusion, one can state that changes to the quality of care, as well as to the levels of benefits will only attain the desired effect of an equal level of care for all members of society if they are combined with a well-constructed and sustainable long-term solution to the financing of LTC insurance.

Measuring Changes in Generosity In PAYG-Systems – An Index Calculation of the German LTC Insurance³⁸

1. Introduction

A statutory long-term care insurance (LTCI) has been introduced as a pay-as-you-go financed social security system in Germany in 1995. The introduction of a pay-as-you-go scheme generally results in windfall profits for generations that gain from the benefits of the system without having contributed to it during significant periods of their lifetime (e.g. Samuelson, 1958; Feldstein and Liebman, 2002; Feldstein, 2005). However, the exact amount of the windfall gains and therefore the generosity of the pay-as-you-go scheme at the time of its introduction is uncertain because payment flows between the insurance system and most generations occur at later times in which conditions could be altered by demographics or policy decisions.

As LTC services are generally claimed in older life years, an ageing insured population leads to a rise in LTCI expenditures (Fetzer et al., 2002; Comas-Herrera et al., 2006; Pickard et al., 2007; Costa-Font et al., 2008; Häcker et al., 2012). At the same time, the ageing of insured individuals leads to a lower base of contributors in younger age groups. Both effects ultimately lead ceteris paribus to a rise in contribution rates in pay-as-you-go systems. This – especially in the context of pension insurance systems is a well-known demographic financing effect – which depends on uncertain variables of demographic development and has been discussed in the literature primarily with a focus on the unsustainable financing of social security systems (Galasso and Profeta, 2004; Habermann and Fehr, 2006) However, changes in the demographic composition of the insured population could also change the initial generosity of LTCI if it leads to unexpected changes in the payment flows for those generations alive at the starting point of the system.

Besides the demographic development, politically motivated alterations may influence LTCI expenditures and contribution payments. Especially changes to the benefit level bear influence on LTCI finances and thus might change the initial generosity level of the system. The political risk in social insurance systems has been discussed in the literature mainly in the

³⁸ Stefan Fetzer, Fabian Franke and Christian Hagist. *Unpublished working paper (2022a)*. Submitted to *Journal of Pension Economics & Finance*. Research presented at *Deutsche Gesellschaft für Gesundheitsökonomie (DGGÖ)* annual conference March 19th 2019 in Augsburg.

context of pension pay-as-you-go pension systems (Diamond,1994; Borgmann and Heidler, 2006; Blake, 2008).

Concerning LTCl systems most studies with a long-term perspective focus on the prospective aspect of sustainable financing (Fetzer et al., 2002; Pickard et al., 2007; Häcker, 2007; SVR, 2011; Bahnsen et al., 2020). In contrast to these works, this paper aims to calculate and analyze the change of the initial windfall gains for all generations alive at the starting point of Germany's LTCl in 1995 and thus takes a retrospective viewpoint. For this purpose, we develop a generosity index based on the initial windfall gains for the generations alive in 1996. We track changes in financial payment flows between these generations and the LTCl system differentiating between changes in LTCl generosity, which can be attributed to either political or demographic factors.

Our paper is structured as follows: Section 2 provides a general overview of the institutional setting of the German LTCl system. Section 3 describes the method of our generosity measures and the data set underlying our calculations. Our results in Section 4 include the changes in generosity since the introduction of LTCl in Germany in 1995, which can be attributed to demographic and political risks. Moreover, we disentangle the effects of politically induced generosity changes in different age groups. Section 5 concludes with a discussion and conclusion.

2. LTCI in Germany

After two decades of political debate driven by increasing means-tested expenditures on the municipal level for LTC services, Germany established statutory long-term care insurance (LTCI) in 1995.³⁹ In contrast to the German Social Health Insurance costs for LTC services are only partly covered by LTCI. The remainder of LTC costs has to be financed either by the patient himself, by his immediate family, or by other tax-financed, means-tested social assistance systems in case of an inability to pay. On average the LTCI coverage of care expenditure is around 50 per cent (Breyer, 2016).⁴⁰ As LTCI benefits are solely pecuniary and fixed on assigned categories⁴¹, it can be characterized, in the context of the classification of social insurance systems, as a defined benefit system. However, in contrast to many pension systems, the nominal value of LTC benefits in Germany is set by lawmakers and not automatically adjusted to indexation factors (such as the development of prices, wages, or GDP).

The pecuniary and fixed LTCI benefits can be differentiated into three main categories: one category covers benefits for informal care which are paid out in cash, usually to family members providing the care. Another category covers benefits for professional outpatient care, whereby the LTCI beneficiary has to pay the remainder of the costs. The third category covers benefits for nursing home care, whereby the provider receives the benefit payments directly and the individual pays an additional sum which includes both the private payment share for the LTC service as well as the provision for boarding and lodging.⁴²

A care grade assessment done by the LTCI determines an individual's care need. There are five "care grades" (so-called "*Pflegegrade*"), with one being the lowest care grade and five being the highest. A higher care grade entails a higher LTCI benefit. In the case of care being

³⁹ Additional information on the history of German LTC insurance and more recent developments can be found in Götting et al. (1994), Evers (1998), Schneider (1999), Cuellar and Wiener (2000), Geraedts et al. (2000), Harrington et al. (2002), Nadash and Cuellar (2017), Nadash et al. (2018), and Bahnsen et al. (2020).

⁴⁰ Since an increasing number of people eventually lacked the funds to pay for LTC themselves they reverted to welfare in order to be given proper care. With an ageing population and expected increases in welfare recipients due to LTC costs, a political consensus was reached to expand the existing German social insurance system to cover LTC costs.

⁴¹ The German LTCI is split in two distinctly different systems: a private LTCI-system and a statutory LTCI-System, the so-called *soziale Pflegeversicherung*. Within the scope of this paper whenever we refer to LTCI we refer to the statutory *soziale Pflegeversicherung*.

⁴² However, in 2021 the German law initiated a new regulation stating that the self-paid costs for nursing homes that beneficiaries pay out of pocket are to be capped.

provided at home, there are additional benefits, such as provisions made for a caregiver to take a vacation. However, this also has the consequence of higher additional private payments.⁴³

Since the inception of LTCl in Germany, there has been no explicit regulation for an automatic adjustment of the benefit levels to the development of prices (e.g. inflation or prices for LTC services). Before 2008 the law only enabled lawmakers to review adjustments to benefits, without any obligation to adapt benefit levels. With the LTCl reform of 2008, the law requires the federal government to review if changes to benefits are necessary every three years using the cumulative price development of the last three calendar years, with special regard to wage development.⁴⁴ Prior to these mandated benefit adjustments at regular intervals following the general price development, changes in the generosity of the LTCl system can solely be attributed to two different explanations: either by the expansion of existing benefits to a larger group of beneficiaries or by an expansion of the types of benefits. Examples of such expansions are additional benefits for cognitively impaired benefit recipients (“*eingeschränkte Alltagskompetenz*” or *eA*) with the appropriately named LTC-benefits-Supplementation Act (“*Pflegeleistungs-Ergänzungsgesetz*”) of 2001 or the inclusion of social security contributions for relatives providing care with the Second LTC Strengthening Act (PSG II or “*Zweites Pflegestärkungsgesetz*”) from 2017.

The number of LTCl beneficiaries has significantly increased over time. From 1996 with 1.55 million people receiving benefits, this number rose to 4.57 million by 2021 (BMG, 2021a). The contributing factors for this rise are an ageing population and additional beneficiaries becoming eligible to receive benefits through changes to the law. As can be seen in Bahnsen et al. (2020), the LTCl reform of 2017 both increased LTCl expenditures due to a more generous classification of care needs (thereby expanding the number of beneficiaries) and the expansion of benefits provided (thereby expanding the types and generosity of benefits provided to beneficiaries).

From the onset of the LTCl system up until 2022, it was designed in a way that expenditures had to be fully financed by contributions of the LTCl-insured population. The increasing number of beneficiaries together with the more generous basket of LTC benefits have resulted

⁴³ Before the introduction of the Second LTCl Strengthening Act individual copayments to the nursing home were linked to the individual care level assigned to the beneficiary. After 2017 the copayment for nursing home care has been standardized for each nursing home regardless of individually assigned care grade (Social Code Book XI §84).

⁴⁴ Subsequent amendments established the requirements to review price development and adjustments to benefits in 2014, 2017 and 2020.

in disproportionately increasing expenditures over time and thus, adjustments in the contribution rate.⁴⁵ An additional rise in contributions was necessary for 2015 to finance the installation of a capital-funded element, the LTC capital reserve fund, whose aim is to partly finance benefits after 2035. Overall developments resulted in changes to the contribution rate (which is based on wages and retirement income) which has risen from 1.7 in 1996 to 3.05 in 2019. However, from 2022 onwards a supplementary tax-financed subsidy was installed to finance supplementary expenditures of a cap for the self-paid costs for nursing homes.

⁴⁵ Before the new benefits scheme of the Second LTC Strengthening Act was introduced, the pre-reform situation from 1995 to 2016 can be described as follows: Generally speaking, all persons insured in the LTC insurance are eligible for benefits on becoming impaired. According to pre-reform § 14 Social Code Book XI, people were considered LTC-dependent in case they required help in the regularly recurring tasks of their daily life for at least six months, due to physical, mental, or psychological illnesses or disabilities. Thus, based on the time and frequency of help needed people were categorized into one of three care levels.

3. Methodology and Data

3.1. Methodology

To evaluate the development of generosity within the LTCI we derive a generosity index. For this purpose, we take a purely forward-looking perspective from the year 1996.⁴⁶ As a consequence, our calculations are based on the price level of 1996 and we consider only age groups born in 1996 or before. The extrapolation of age- and sex-specific payment flows between LTCI and the population is adapted from the generational accounting method (Auerbach et al., 1991, Auerbach et al., 1992 and Auerbach et al., 1994). In the context of the main approaches for measuring liabilities and assets in pension schemes our measurement can be grouped in the closed group with future accruals approach using classical generational accounting (Fetzer and Moog, 2021).

Equation 1 shows the present value of the contributions (PVC) the generations alive in 1996 will expect to pay in the LTCI over their remaining lifetime in a specific regime, R . The PVC_R results from the (expected) cohort sizes, $N_{u,t,R}$, in year t multiplied with the average contribution payment per age (and sex) group u in year t , $c_{u,t,R}$, which is discounted to the base year with the help of the discount factor $(1+r)^{t-1996}$, whereby r reflects the real rate of interest. As we set the maximum age at 100 years, the cohort which is expected to live the longest is the one born in 1996 and the last year of consideration is 2096.

$$PVC_R = \sum_{t=1996}^{2096} \sum_{u=t-1996}^{100} N_{u,t,R} \cdot \frac{c_{u,t,R}}{(1+r)^{t-1996}} \quad (1)$$

$$PVB_R = \sum_{t=1996}^{2096} \sum_{u=t-1996}^{100} N_{u,t,R} \cdot \frac{b_{u,t,R}}{(1+r)^{t-1996}} \quad (2)$$

The calculations of the present value of benefits (PVB_R) for all generations alive in 1996 who are expecting to receive benefits from LTCI over their remaining lifetime is in principle the same, using age- and sex-related average benefit receipts, $b_{u,t,R}$ (see equation (2)).

⁴⁶ 1996 is chosen to be the base year of our calculations, as it is the first year since the introduction of LTCI (in 1995) in which all benefits were available, such as nursing home care.

As shown in equation (3) the difference between PVB_R and PVC_R can be interpreted as the windfall, WF_R , which the generations alive in 1996 gain from the introduction of LTCl over their remaining lifetime.

$$WF_R = PVB_R - PVC_R \quad (3)$$

In the next step, we distinguish different scenarios about the future development of cohort sizes, $N_{u,t,R}$, as well as the financial development of the LTCl, which is reflected in the age- and sex-related benefit receipts, $b_{u,t,R}$, and contribution payments, $c_{u,t,R}$ from a 1996 perspective. Hereby a specific scenario is labeled regime, R .

Our base regime is the regime $F1998_D1998$. For this regime $c_{u,t,F1998_D1998}$ and $b_{u,t,F1998_D1998}$ are calibrated, so that they reflect the actual values of the financial statistics of the LTCl from 1996 to 1998 in real terms of the year 1996. For all years after 1998 the $c_{u,t,F1998_D1998}$ and $b_{u,t,F1998_D1998}$ grow with the rate of Germany's GDP growth in real terms to the year 2019 and afterwards with a constant growth rate g . Thus, we implicitly assume that LTC benefit levels can only be sustained if they rise according to the development of the real GDP. For the calculation of the $N_{u,t,F1998_D1998}$ in the years 1996 to 1998 we use the cohort sizes published in official population statistics, for all years t after 1998 we use cohort sizes in line with the official population projection from 1998.

The windfall of the base regime, WF_{F1998_D1998} , could be interpreted as the expected windfall of the introduction of LTCl, as various elements (benefits for private home care, benefits for professional at-home care, benefits for nursing home care) are introduced gradually between 1996 and 1998. Hence, it serves as our benchmark for the development of generosity in LTCl. For the calculation of the generosity index in equation 4 the windfall of the base regime, WF_{F1998_D1998} is the denominator, the nominator depicts the windfall of alternative regimes. Hence a generosity index above (below) one implies that the considered regime implies an incline (decline) in the generosity of LTCl compared to the initial generosity for generations alive in 1996.

$$Generosity\ Index_R = \frac{WF_R}{WF_{F1998_D1998}} \quad (4)$$

To assess the impact of long-term care policies on different age groups, we calculate generational accounts for five age groups. For this purpose, the calculation in equations (1) and (2) is applied only for specific age groups and the resulting windfall is divided by the number of age group members living in the base year 1996. The generational accounts can

be interpreted as per capita windfalls, as they reflect the payment flows of the introduction of LTCI.

For the calculation of alternative regimes, we change the assumptions of two components. The first component F concerns the considered financial development of the LTCI, which is reflected in the calibrated average age-related payment flows. Concerning this first component, we successively update the financial development (in real terms) in LTCI, which means that for instance component F_{2010} concerns the financial development in LTCI between 1996 and 2010, and after that point in time the average age-related payment flows grow accordingly to Germany's GDP development in real terms to the year 2019 and afterward with a constant growth rate g .

The second D -component concerns demographic development and follows the same indexation as the F -component. Hence, the component D_{2019} includes the cohort sizes from 1996 to 2019 from official statistics. Afterwards, the future cohort sizes are projected in line with the most current official population forecast.

As our objective is to measure the development of generosity in LTCI between 1998 to 2019 we have 22x22 different possibilities to combine the F - and D -components in regimes (see Table 4).

Table 4: Naming system of the regimes

	D1998	D1999	.....	D2010	.....	D2019
F1998	<i>F1998_D1998</i>	<i>F1998_D1999</i>	.....	<i>F1998_D2010</i>	.....	<i>F1998_D2019</i>
F1999	<i>F1999_D1998</i>	<i>F1999_D1999</i>	.....	<i>F1999_D2010</i>	.....	<i>F1999_D2019</i>
.....
F2010	<i>F2010_D1998</i>	<i>F2010_D1999</i>	.....	<i>F2010_D2010</i>	.....	<i>F2010_D2019</i>
.....
F2019	<i>F2019_D1998</i>	<i>F2019_D1999</i>	.....	<i>F2019_D2010</i>	.....	<i>F2019_D2019</i>

Variant A development	Variant B development
------------------------------	------------------------------

Note: "F" stands for financial F-component and "D" for demographic D-component of the individual regime.

In the following, we focus on two developments of the generosity index. In the *Variante A development* the generosity of LTCI is only driven by (unexpected) changes in the demographic development over time. As we use the same financial component F1998 any changes in the windfall, WF_R , compared to the baseline windfall, WF_{F1998_D1998} are solely a result of (unexpected) changes in the cohort sizes. In contrast to this in the *Variante B development* the LTCI generosity is driven by the financial developments, which are mainly influenced by political decisions through reforms. This approach makes it possible to assess whether a change in generosity of LTCI can be attributed to demographic or political developments.

3.2. Data and assumptions

The data of our analysis includes age and sex-specific profiles for contribution payments and benefit receipts of LTCI for the calculation of the F-components and different developments of the cohort sizes for the calculation of the D-components as well as assumptions on the growth rate and the interest rate.

Demographic components (D-component)

The modelling of the demographic components (D-component) is based on the annual cohort sizes published by the German Federal Statistics Bureau (Destatis, 2021b). With respect to the expected demographic development from the point of view of the base regime for the D-component, we use data and assumptions of the most recent official population forecasts, the coordinated population projections 9th through 14th.⁴⁷ With respect to the future development of fertility, net-migration and life expectancy we use comparable moderate assumptions of each official projection, with +200.000 net-migration and a fertility rate of 1.4 and the corresponding moderate assumptions on life expectancy development. Please refer to Appendix B.1 for an overview of these assumptions on demographic development by the coordinated population projections.

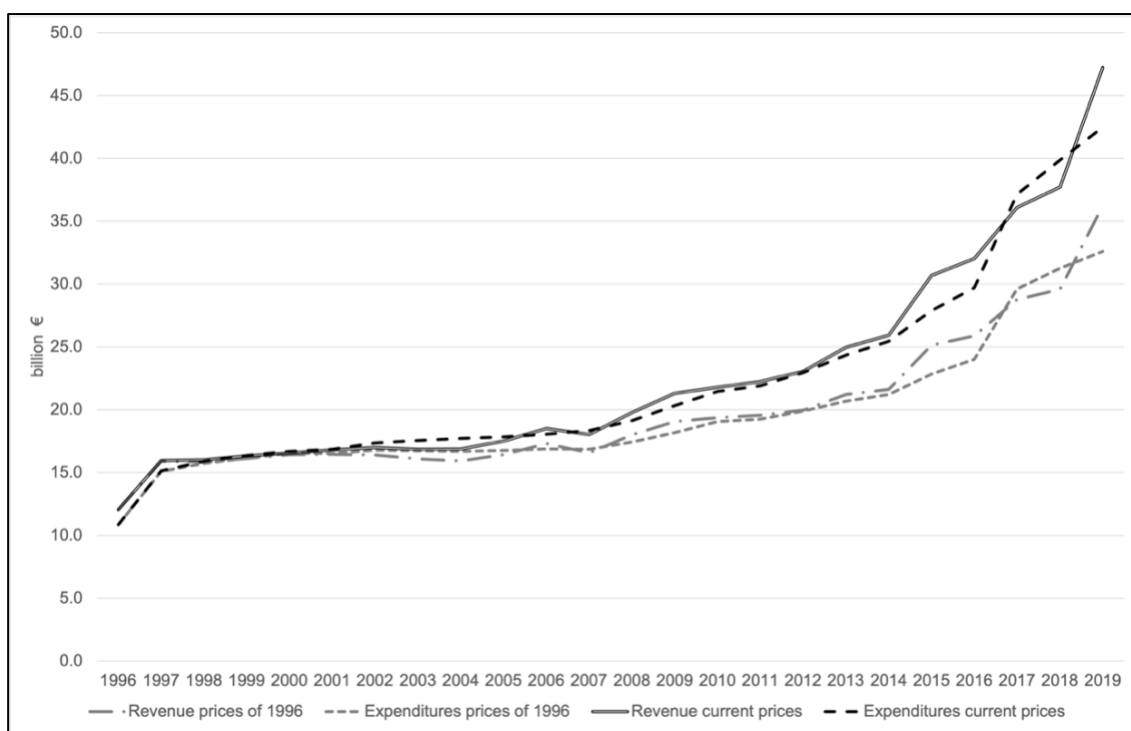
The 9th and 10th coordinated population projections calculate population development only until 2050, whereas the 11th, 12th, 13th and 14th population projections continue until 2060. For the purpose of our model, we additionally calculate the demographic development afterward of 2050 or 2060 respectively until 2096 via the cohort component method and retain the last years assumptions on migration, fertility and life expectancy of each projection.

⁴⁷ Please refer to Destatis (2000), Destatis (2003), Destatis (2006), Destatis (2009), Destatis (2015) and Destatis (2019a).

Calibrated age- and sex-specific profiles for contribution payments and benefit receipts (F-component)

The starting point for the calculation of age-related benefits receipts $b_{u,t,R}$, and contribution payments, $c_{u,t,R}$, is the financial development of LTCl (BMG, 2021b) from 1996 to 2019, which is published by the Federal Ministry of Health. We adjust the annual LTCl expenditures and revenues to the year 1996 by the inflation rate (Destatis, 2021a). Figure 7 compares the development of LTCl revenues and expenditures in nominal terms with those in real terms (with the base year 1996). The latter shows that LTCl finances remained roughly constant until 2007. Between 2007 and 2014, there was a moderate increase in LTCl revenues from 15 to 20 billion Euro (in prices of 1996), which accelerated again significantly to the year 2019, reaching a level of almost 35 billion Euro (in prices of 1996).

Figure 7: Development of expenditures and revenues of LTCl (current prices and in prices of 1996)

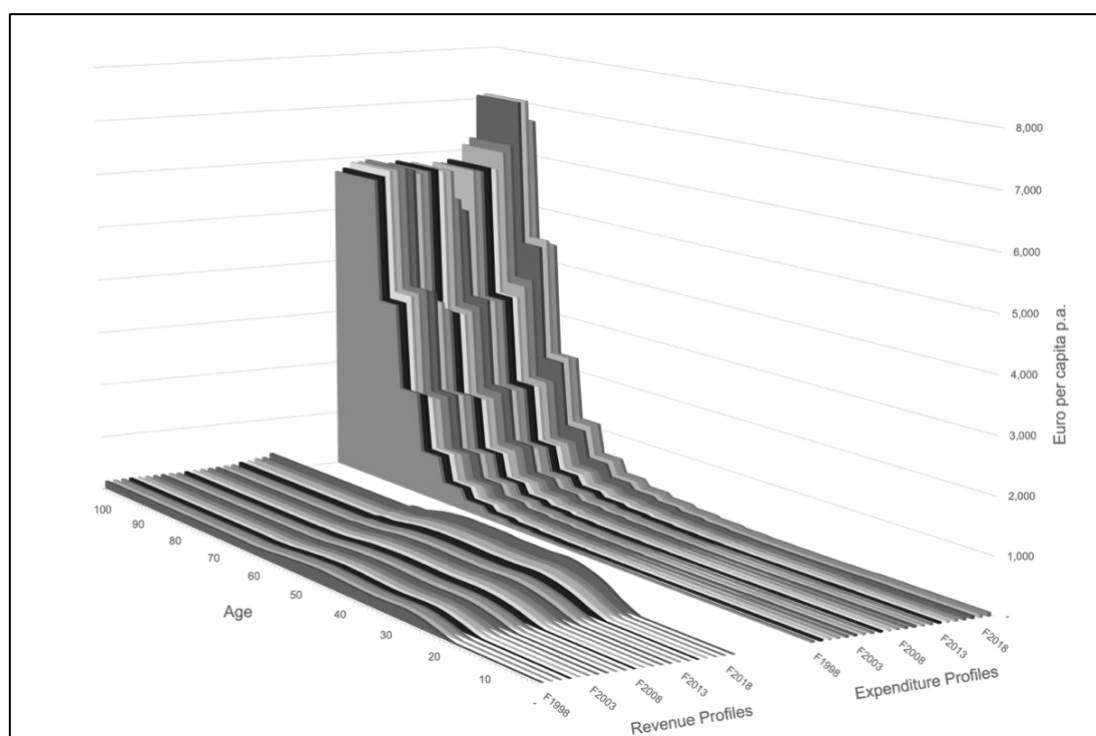


Source: Own calculations based on financial development of LTCl (BMG, 2021b) and Destatis (2021a).

The inflation adjusted development of LTCl expenditures and revenues between 1998 and 2019 further serve as a basis for calibrating age- and sex-specific micro profiles. The result of the calibration is, that the total sum of benefits (contributions) for the LTCl-insured population have to match the SHI expenditures (revenues). For the calculation of age- and sex-specific micro profiles of benefit receipts we use the official statistics on the beneficiaries of LTCl

(BMG, 2021c).⁴⁸ The age- and sex-specific micro profiles for contribution payments derive from the Income and Consumption Survey (EVS) from 1998, 2003, 2008, 2013 and 2018.⁴⁹ Figure 8 (Figure 9) shows the resulting calibrated profiles for benefit receipts and contribution payments for females (males). As can be seen the development of revenue profiles are fairly constant over the years with a spike in contributions attributed to changes on the contribution rate from 2017 onwards. Expenditure profiles show that individual benefits steadily decline since introduction until 2008 for males and to a lesser extent for females. However, both show a significant rise since 2008 onward which peaks in 2017 and further remains at a high level.

Figure 8: Development of per capita micro profiles for F1998 through F2019 by age for females

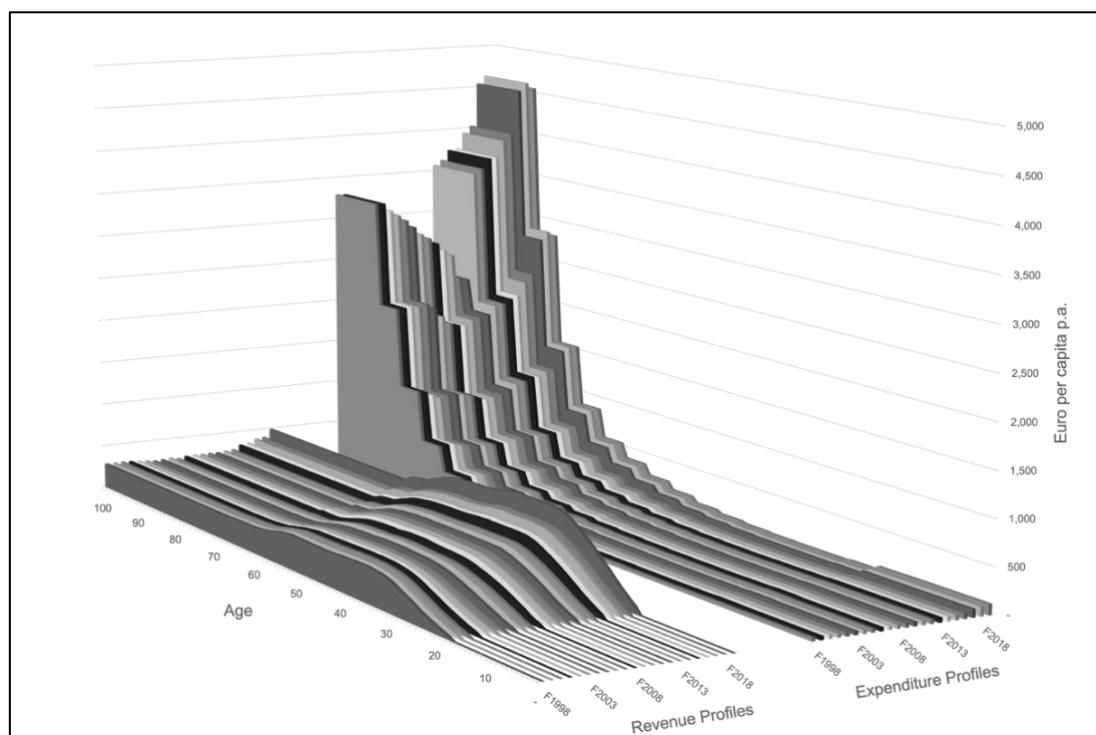


Source: Own calculations of calibrated micro profiles based on Income and Consumption Surveys (EVS; RDC of the Federal Statistical Office and Statistical Offices of the Länder, *Einkommens- und Verbrauchsstichprobe*, survey years [1998, 2003, 2008, 2013, 2018] own calculations; financial development of LTCl (BMG, 2021b) and annual cohort sizes published by the German Federal Statistics Bureau (Destatis, 2021b).

⁴⁸ In detail our calibration process works as follows: The annual number of recipients by sex and age are separated into outpatient care and inpatient care. For the target values of the calibration, we separate LTCl expenditures into outpatient care, inpatient care, and mixed expenditures (such as miscellaneous costs, administrative costs to LTCl, etc.).

⁴⁹ Income and consumption surveys are published in intervals. We use payments to the statutory health insurance as the basis for our revenue micro profiles, since these contributions are closely linked to LTCl and are consistently available in the statistics for all years monitored. Please refer to (RDC, 1998; RDC, 2003; RDC, 2008; RDC, 2013; RDC, 2018). In a first step we perform a calibration procedure for the years 1998, 2003, 2008, 2013 and 2018. For the intermediate years (1999 to 2002, 2004 to 2007, 2009 to 2012, 2014 to 2017 and 2019) we assume a linear development of the age- and sex-related contribution payment and repeat the calibration procedure.

Figure 9: Development of per capita micro profiles for F1998 through F2019 by age for males



Source: Own calculations of calibrated micro profiles based on Income and Consumption Surveys (EVS; RDC of the Federal Statistical Office and Statistical Offices of the Länder, Einkommens- und Verbrauchsstichprobe, survey years [1998, 2003, 2008, 2013, 2018]; financial development of LTCI (BMG, 2021b) and annual cohort sizes published by the German Federal Statistics Bureau (Destatis, 2021b).

Assumptions on growth and interest

As mentioned above, between the start regime of the F-component and the regime 2019 we assume that the average age-related payment flows grow accordingly with the rate of growth of GDP in real terms within these years. After 2019 we set the annual growth rate of age-related payment flows equal 1.5 % in our baseline scenario. The real interest rate to discount the payment flows to the base year 1996 is set on $r = 3\%$ p.a. Both assumptions are in line with the sustainability report of the European Commission (European Commission, 2018). However, to validate the robustness of our results we also use different assumptions on the interest rate (see section 4.3).

4. Results

4.1. Generosity development of LTCI

As the initial windfall of the introduction of LTCI, we use the windfall of the regime F1998_D1998. This initial windfall amounts to 554 billion Euro (in prices 1996) using the assumptions of the baseline scenario described above.⁵⁰ It results from the difference in the present value of benefit receipts (1,101 billion Euro) and contribution payments (547 billion Euro) for all cohorts alive in 1996. This initial windfall serves as our benchmark for generosity (i.e. the denominator of the generosity index (see equation (3))).

Table 5 shows the generosity index for each of the 22x22 combinations of F- and D-components. For instance, the generosity index for the chronologically latest combination of F- and D-Components, the regime F2019_D2019 amount to 0.68. This implies, that the generosity (measured in real terms) has decreased between 1998 and 2019 by more than 30 per cent for the generations alive in 1996. As described above, our approach allows us to identify the causes of this decline.

The Variant A development thereby offers changes in the generosity index due to changes in demography (the results of the frame with the solid line in Table 5). It shows that the level of generosity is increasing from 1.0 in the regime F1998_D1998 to 1.10 in regime F1998_D2008 and falling to 1.05 in 2019 for the regime F1998_D2019. Table 5 shows the same qualitative progression of the generosity index for all other initial F-components concerning variations of the D-component. This implies, that the generations alive in 1996 gain from the demographic development. This is mainly driven by increasing life expectancy, thereby enlarging the proportion of beneficiaries of LTCI. Another possibility which influences this index is the increased immigration with a favorable demographic make-up for LTCI financing.

⁵⁰ Financial development of the LTCI in real terms between 1996 and 1998, age-related payment flows grow in line with the rate of Germans GDP growth in real terms between 1998 and 2019 and between 2019 and 2096 with an annual growth rate of equal 1.5 %, all payment flows are discounted to the base year 1996 with a real interest rate equal of 3.0 %.

Table 5: Generosity index development for various F- and D-components with F1998_D1998 as benchmark

	D1998	D1999	D2000	D2001	D2002	D2003	D2004	D2005	D2006	D2007	D2008	D2009	D2010	D2011	D2012	D2013	D2014	D2015	D2016	D2017	D2018	D2019
F1998	1.00	1.00	1.00	1.02	1.02	1.02	1.02	1.09	1.09	1.08	1.10	1.10	1.10	1.10	1.10	1.07	1.07	1.07	1.07	1.07	1.05	1.05
F1999	0.98	0.98	0.98	1.00	1.00	1.00	1.00	1.06	1.06	1.06	1.07	1.07	1.07	1.07	1.07	1.04	1.04	1.04	1.04	1.04	1.02	1.02
F2000	0.94	0.94	0.94	0.96	0.96	0.96	0.96	1.03	1.03	1.02	1.04	1.04	1.04	1.04	1.04	1.01	1.01	1.01	1.01	1.01	0.99	0.99
F2001	0.91	0.91	0.91	0.93	0.93	0.93	0.93	0.99	0.99	0.98	1.00	1.00	1.00	1.00	1.00	0.97	0.97	0.97	0.97	0.97	0.95	0.95
F2002	0.93	0.93	0.93	0.95	0.95	0.95	0.95	1.01	1.01	1.00	1.02	1.02	1.02	1.02	1.02	0.99	0.99	0.99	0.99	0.99	0.97	0.97
F2003	0.93	0.93	0.93	0.95	0.95	0.95	0.96	1.02	1.02	1.01	1.03	1.03	1.03	1.03	1.03	1.00	1.00	1.00	1.00	1.00	0.98	0.98
F2004	0.89	0.89	0.89	0.91	0.91	0.91	0.91	0.97	0.97	0.96	0.98	0.98	0.98	0.98	0.98	0.95	0.95	0.95	0.95	0.95	0.93	0.93
F2005	0.84	0.84	0.84	0.85	0.85	0.85	0.85	0.91	0.91	0.91	0.92	0.92	0.92	0.92	0.92	0.89	0.89	0.89	0.89	0.89	0.87	0.87
F2006	0.76	0.76	0.76	0.77	0.77	0.77	0.77	0.83	0.83	0.82	0.83	0.83	0.84	0.84	0.84	0.81	0.81	0.81	0.81	0.81	0.79	0.79
F2007	0.74	0.74	0.74	0.76	0.76	0.76	0.76	0.81	0.81	0.81	0.82	0.82	0.82	0.82	0.82	0.79	0.79	0.79	0.79	0.79	0.78	0.78
F2008	0.71	0.71	0.71	0.72	0.72	0.72	0.72	0.77	0.77	0.77	0.78	0.78	0.78	0.78	0.78	0.76	0.76	0.76	0.76	0.76	0.74	0.74
F2009	0.71	0.71	0.71	0.72	0.72	0.72	0.72	0.78	0.78	0.77	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76	0.76	0.76	0.74	0.74
F2010	0.68	0.68	0.68	0.70	0.70	0.70	0.70	0.75	0.75	0.75	0.76	0.76	0.76	0.76	0.76	0.73	0.73	0.73	0.73	0.73	0.72	0.72
F2011	0.71	0.71	0.71	0.73	0.73	0.73	0.73	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.77	0.77	0.77	0.77	0.77	0.75	0.75
F2012	0.71	0.71	0.71	0.73	0.73	0.73	0.73	0.78	0.78	0.78	0.79	0.79	0.80	0.80	0.80	0.77	0.77	0.77	0.77	0.77	0.75	0.75
F2013	0.70	0.70	0.70	0.72	0.72	0.72	0.72	0.78	0.78	0.77	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76	0.76	0.76	0.74	0.74
F2014	0.67	0.67	0.67	0.69	0.69	0.69	0.69	0.75	0.75	0.74	0.76	0.76	0.76	0.76	0.76	0.73	0.73	0.73	0.73	0.73	0.71	0.71
F2015	0.64	0.64	0.64	0.66	0.66	0.66	0.66	0.72	0.72	0.71	0.73	0.73	0.73	0.73	0.73	0.70	0.70	0.70	0.70	0.70	0.68	0.68
F2016	0.64	0.64	0.64	0.66	0.66	0.66	0.66	0.72	0.72	0.71	0.73	0.73	0.73	0.73	0.73	0.70	0.70	0.70	0.70	0.70	0.68	0.68
F2017	0.78	0.78	0.78	0.80	0.80	0.80	0.80	0.87	0.87	0.86	0.88	0.88	0.88	0.88	0.88	0.85	0.85	0.85	0.85	0.85	0.83	0.83
F2018	0.80	0.80	0.80	0.82	0.82	0.82	0.82	0.88	0.88	0.88	0.90	0.90	0.90	0.90	0.90	0.86	0.86	0.86	0.86	0.86	0.84	0.84
F2019	0.65	0.65	0.65	0.66	0.66	0.66	0.66	0.73	0.73	0.72	0.74	0.74	0.74	0.74	0.74	0.71	0.71	0.71	0.71	0.71	0.68	0.68

Source: Own calculations.

The Variant B development of the generosity index shows the effects of politically motivated developments in generosity (the results of the frame with the dotted line in Table 3). It shows that the impact of policy-driven changes on the generosity of LTCl is much larger than the demographics-driven changes described above. Calculating the generosity index by keeping constant the demographic D1998 component, the level of the generosity index is continuously declining from 1.0 in the regime F1998_D1998 to 0.64 in the regime F2016_D1998 (with only a slight increase in F2011_D1998 and F2012_D1998 regimes). Most significantly we can observe that in the F2017_D1998 and F2018_D1998 regimes the generosity index increases to 0.78 and 0.80 respectively, ultimately falling to 0.65 in the regime F2019_D1998.

The developments of the years 2017 and 2018 could be generally attributed to the PSG reforms. The significant increase in expenditures is a result of the extended recipient base and higher benefit payments of LTCl. The drop in 2019 can be attributed to changes in the contribution rate which were introduced on the of January 1, 2019 to address the higher expenditures induced by the PSG reforms.

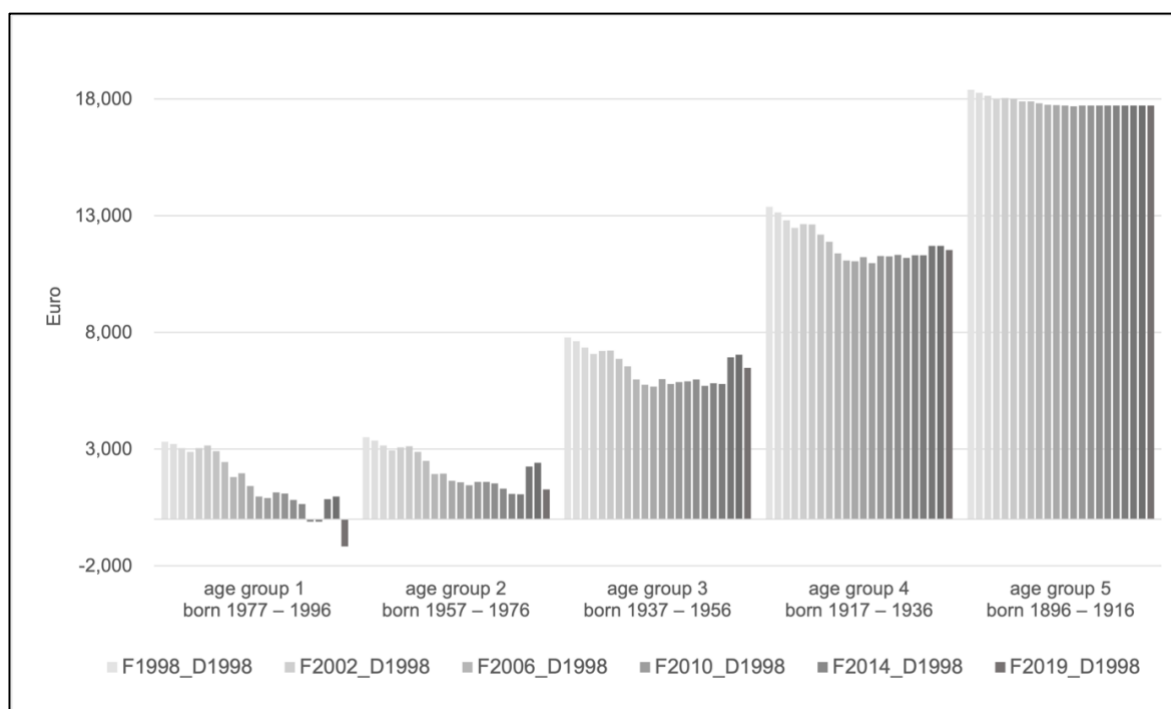
4.2. Disentangling politically induced generosity in specific age groups

In the last section, the development of generosity has been measured by the generosity index as a global indicator for all cohorts living in 1996. To further disentangle the effects for different cohorts, we calculate per capita windfalls for five age groups: Those born between 1977-1996 (Group 1), 1957-1976 (Group 2), 1937-1956 (Group 3), 1917-1936 (Group 4) and 1989-1916 (Group 5). Here we consider only the political risk, which means that we calculate generational accounts for the regimes of the Variant B development, holding the demographic development of the component D1998 constant.

Figure 10 shows the development of the generational accounts (which can be interpreted as average per capita windfalls by age group) in Euro in prices of 1996 for the regimes F1998_D1998 to F2019_D1998. The reason for the different levels of generosity for the five age groups lies in the purely forward-looking perspective from the year 1996. This means that the age groups bear different remaining life expectancies. In addition, payment flows that occur far in the future are less significant due to the present value approach. Therefore, the generational accounts of the different age groups should not be compared with each other.

In line with our findings for the generosity index, Figure 10 shows a decrease in the per capita windfalls between the regimes F1998_D1998 and F2019_D1998 for all age groups, with the last regime F2019_D1998 being significantly smaller than the initial windfall F1998_D1998. However, the effects on age group 5 barely register over the regimes, because this age group is no longer affected by many recent reforms in LTCl due to the high rates of deaths within this cohort for the period from 1998 to 2019. For the age groups 1 through 4 the per capita windfalls decrease between the regimes F1998_D1998 and F2016_D1998, followed by an increase in the regimes F2017_D1998 and F2018_D1998, which can be attributed to the PSG reforms. The increase of the LTCl contribution rate in 2019 again led to decreasing per capita windfalls of the regime F2019_D1998.

Figure 10: Per capita windfalls by age groups for regime F1998_D1998 to regime F2019_D1998

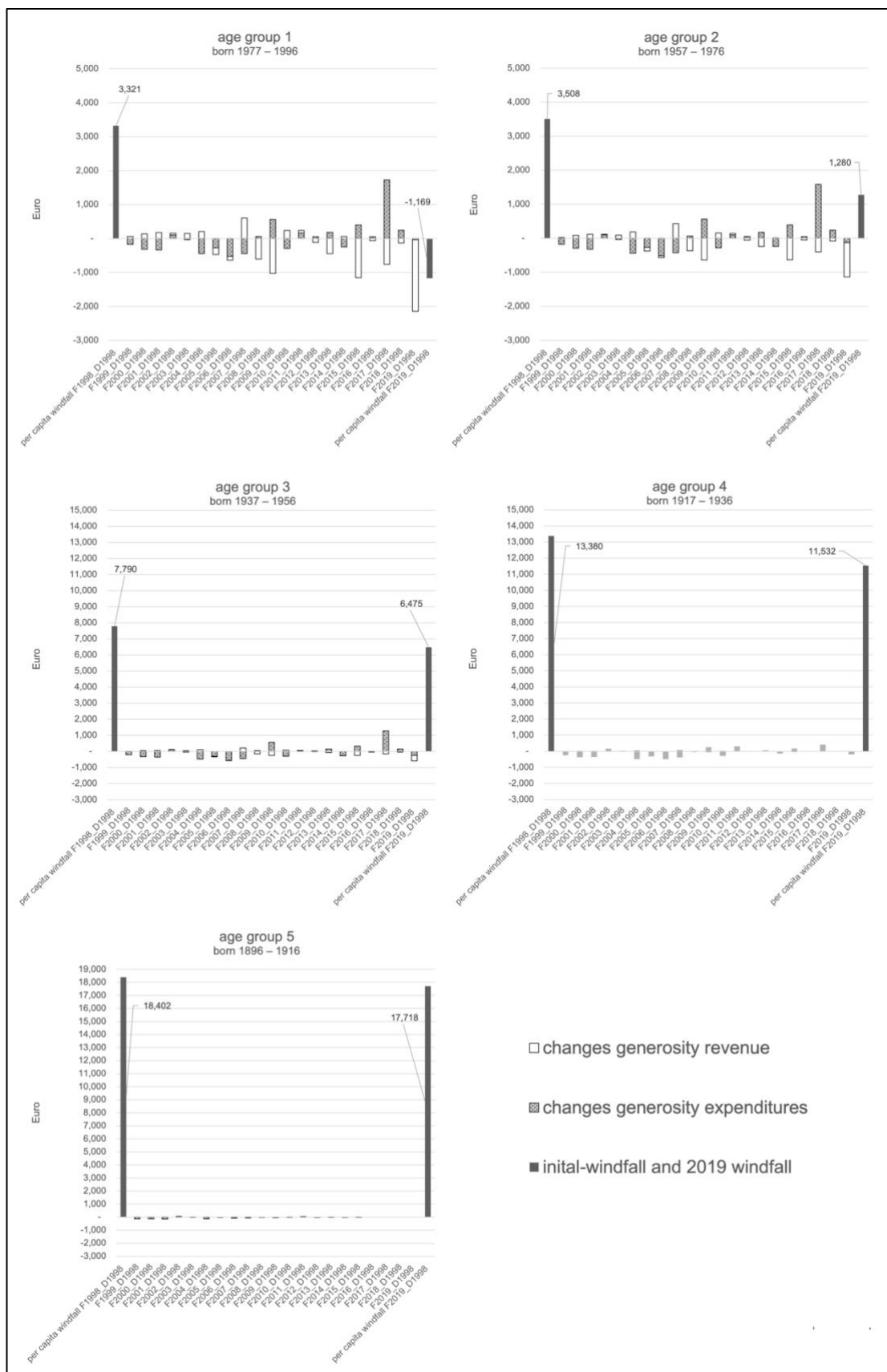


Source: Own calculations.

However, the five age groups are affected differently by this general progression across the regimes. Therefore, we additionally observe the five age groups individually. Figure 11 shows the initial per capita windfall of the regime F1996_D1998 and the overall windfall of the regime F2019_D1998 by each individual in these age groups. We further disentangle the changes in generosity attributed to changes in expenditures and changes in revenues.

The age group 1 – those born between 1996 and 1977 – shows a per capita windfall in the regime F1998_D1998 of 3,321 Euro which reduces to -1,169 Euro (total effect -4,490 Euro) in the regime F2019_D1998 (see Figure 4). This result points to the finding that this age group initially profited from a windfall – even though it was smaller than the windfall for the older age groups – which gradually reduced over the regimes and turns negative from the regime F2018_D1998 to the regime F2019_D1998. The increase of generosity in the regimes F2017_D1998 and F2018_D1998 due to a higher benefit level is fully decreased by the rise in the contribution rate 2019 and thus, the higher contribution payments of the regime F2019_D1998.

Figure 11: Windfall and changes in generosity by expenditure and revenue by age group



Source: Own calculations.

Age group 2 – those born between 1957 and 1976 – shows a more favorable development than age group 1 with an initial per capita windfall of 3,508 Euro in the regime F1998_D1998, which reduces to 1,280 Euro (total effect -2,228 Euro) in the regime F2019_D1999. As can be seen in the development of generosity over the regimes the progression for age group 2 is fairly comparable to the developments for group 1, even though its overall windfall remains positive.

The developments of generosity within the three oldest age groups show as well a comparable development. All show an initial substantial windfall, which only marginally decreases over the regimes. With age group 3 – born between 1937 and 1956 – the per capita windfall falls from 7,790 Euro in the regime F1998_D1998 to 6,475 Euro (total effect -1,315 Euro) in the regime F2019_D1998 and for age group 4 – born between 1917 and 1936 – from 13,380 Euro to 11,532 Euro (total effect -1,848 Euro). The oldest age group 5 – born between 1896 and 1916 – shows the least reduction in per capita windfalls from 18,402 Euro to 17,718 Euro (total effect -684 Euro).

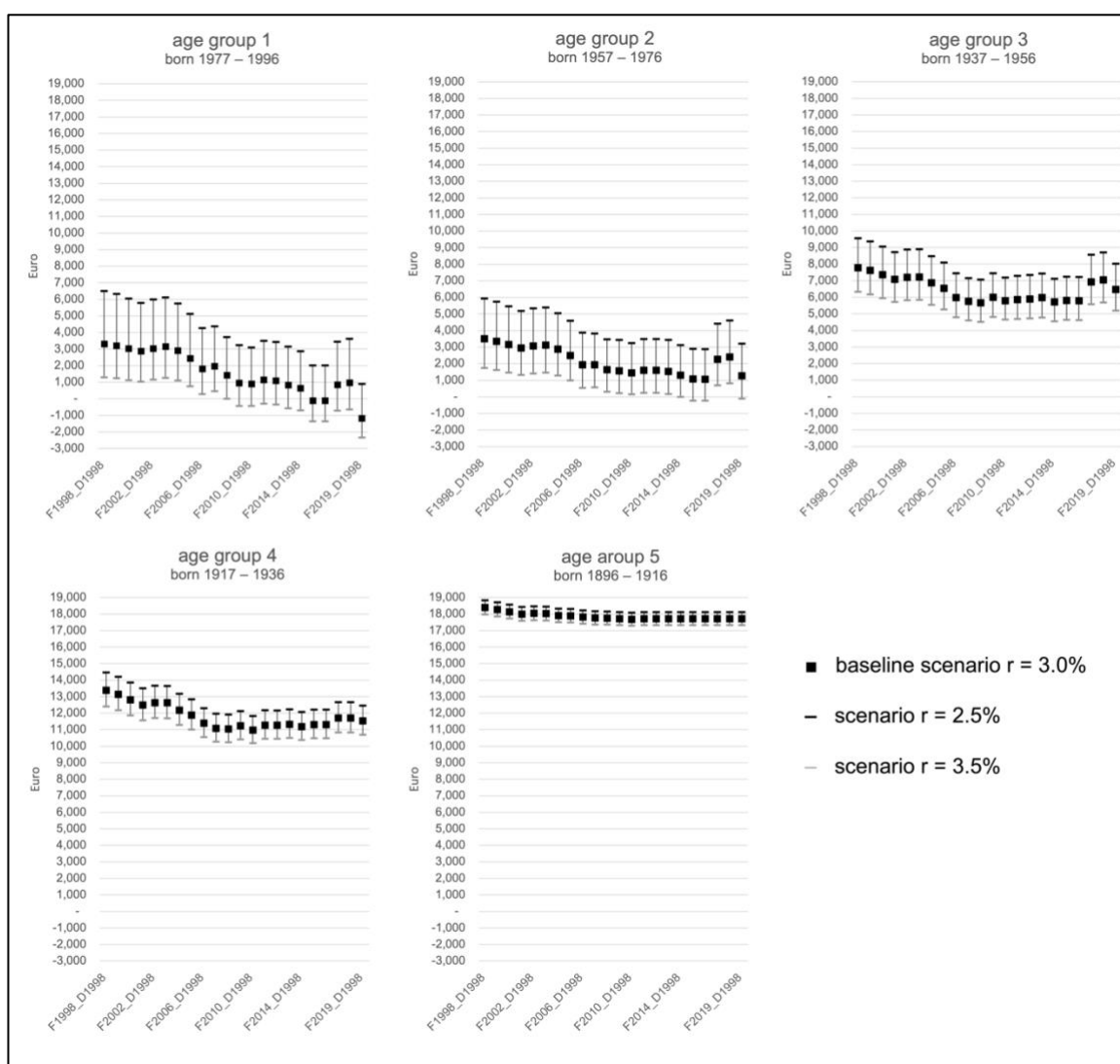
4.2. Sensitivity analysis

To check for the robustness of our model, we use different assumptions on r . Keeping the assumption of growth in line with real GDP in 1996-2019 and the growth rate $g = 1.5\%$ from our baseline scenario, we use $r = 2.5\%$ and $r = 3.5\%$ as alternative interest rate scenarios in our model.

In line with Figure 11, Figure 12 shows the sensitivity analysis of the per capita windfalls of the 5 age groups for all three scenarios. Because the per capita windfalls (generational accounts) are expressed in absolute values, a change in the interest rate has a comparatively high effect on the results. By comparing the scenario $r = 3.5\%$ with our baseline scenario $r = 3\%$, one can see that per capita windfalls shrink. The reason for this is that payment flows further into the future weigh less than those closer to the present (from a viewpoint of 1996).

For the same reason, the windfall changes in the older age groups of the scenarios are comparatively small to those for young age groups (especially the youngest age group 1). In some regimes, the higher interest rate can lead to negative per capita windfall gains. Based on the 2019 LTCl finances and continued cash flows thereafter, the youngest age group becomes a net-payer towards LTCl. In other words, at an interest rate of 3.5 per cent, an alternative investment in the capital market in 1996 would have been more attractive than membership in the LTCl.

Figure 12: Sensitivity analysis for the five age groups



Source: Own calculations.

In contrast to the per capita windfalls – which reflect absolute values – the generosity index in specific regimes is relatively robust towards changes in interest rates. Appendix B.2 lists the percentage changes in the generosity index of the scenarios with $r = 2.5\%$ and $r = 3.5\%$ per cent compared to the baseline scenario with $r = 3.0\%$. As one can see, the maximum change of the generosity index of a specific regime is less than $\pm 5\%$. The sensitivity analysis thus confirms our previously made statements, all qualitative effects are preserved.

5. Discussion

As our results show the level of generosity in LTCI has changed significantly since its introduction. The overall generosity has fallen with the expected payment flow in 1998 decreasing by 32 per cent by 2019. This can mainly be attributed to changes in political decisions regarding the eligible LTCI beneficiaries and the benefits provided to them. However, these changes in LTCI generosity affect not all age groups to the same extent.

With a decline in per capita windfall of 684 Euro, the oldest age group (born between 1896 and 1916) is not very significantly affected. The amount of the reduction for those born between 1917 and 1936 is also still moderate and is around 1,848 Euro. By contrast, the age groups born between 1957 and 1976 (-2,228 Euro) and especially those born between 1977 and 1996 (-4,490 Euro) are mostly affected by political decisions to reduce generosity.

These results may be devoid of any rational decisions. However, in Germany, the age groups of the so-called *baby boomers* (born between 1950 and 1970) are particularly large cohorts. If one also takes into account that, without the introduction of LTCI, these cohorts would have to finance their parents' care privately to a large extent, one could also conclude that the influence of generosity was ultimately determined by voter behavior. In the end, these political decisions go to the detriment of the youngest generations. Thus, the Ponzi scheme in pay-as-you-go social insurance systems remains intact.

Concerning the limitations of our study, one crucial assumption is the assumption of growth, benefits and contributions in line with the development of the economy (in terms of real GDP growth). It can be argued that political decision-makers at the beginning of the LTCI did not believe that such effects would influence LTCI expenditures, and thus, no automated balancing mechanism was intended or implemented for LTCI in Germany. However, LTC is labor-intensive and it is difficult to implement technical progress or productivity increments substituting labor costs (increases) in step with the rest of the economy. If at the same time the demand for LTC is inelastic, this could result in a disproportionate increase in expenditures for LTCI. Baumol (1967) referred to this phenomenon as "unbalanced growth" and it is particularly relevant for LTC services since the demand for care is generally highly inelastic and there are only limited opportunities for technological innovation. For this reason, there were voices from the scientific community calling for a price indexation of benefit levels (Rothgang, 1997; Fetzer et al., 2002; Häcker, 2007).

In the future, the general trend toward an ageing population with higher care needs and a shrinking contribution base is almost certain, and sharply rising contribution rates seem to be inevitable (European Commission, 2018; Bahnsen et al., 2020). To abstain from often unpopular rises in these contribution rates the newest idea of political decision-makers is a

refinancing by tax-financed subsidies to LTCl (Rothgang, 2021b; Raffelhüschen et al., 2021). However, such reform is again to the detriment of the younger generations, as they are not only contributors to LTCl but also (future) taxpayers.

All in all the history of LTCl in Germany shows that politically motivated reforms to LTCl without sustainable financing and especially without an automated balancing mechanism cause generosity levels to fluctuate for all cohorts, but will most heavily impact the younger ones. For these younger age groups, generosity levels of LTCl have become unpredictable and they are at the mercy of politically motivated changes to LTCl, without guarantees regarding the protection of their own future LTC needs.

Observing the LTCl generosity over the period 1996 to 2019, we see substantial variations in the expected value of future benefit income and contribution payments. Furthermore, this results in a high degree of uncertainty for the LTCl insured makes it difficult for them to come to optimal decisions about their provision for a privately financed portion of expected LTC costs by crowding out initiatives to privately prepare for expected LTC costs. In light of the shift towards an increasingly aged population, it becomes imperative to find a sustainable way of financing the LTCl system in a generationally fair way.

6. Conclusion

The generosity level of the German LTCl system has been fluctuating for all generations alive in 1996. Contrary to common wisdom demography only seems to play a minor role in generosity in LTCl. Changes in generosity appear to be mainly driven by political decisions. Our results show that these changes mainly concern the younger generations, especially affecting people born after 1970. Older generations are less severely impacted by these changes in generosity.

Survival of the Fit? Life Expectancy and LTC Prevalence – A Projection of Long-term Care in Germany⁵¹

1. Introduction

The aging of German society is expected to lead to a sharp increase in the number of people in need of long-term care (LTC) due to the prevalence of care needs in elderly age groups. Projections show that in the next 40 years the number of today's 4.6 million people in need of LTC (BMG, 2022) will increase by between 25 to 100 per cent: Jacobs et al. (2020) predict 5.1 million people in need of LTC by 2060, Kochskämper (2021) forecasts over 6 million by 2060, while a projection by the Federal Institute of Population Research (2021), estimates 6.2 million by 2060. Rothgang et al. (2021a) predict that there could be between 6.8 million and up to 8.3 million people in need of LTC by 2060.

If these predictions prove to be correct, Germany's health policy has to address several challenges. Fiscally, the future sustainable financing of the long-term care insurance (LTCI) as a pay-as-you-go system is difficult.⁵² In addition to more LTC cases, there will be as well a decline in the available workforce and thus a deterioration in the average contribution payments to LTCI. The future financial development of the LTCI has been illustrated primarily in studies of the future development of the contribution rate, currently at 3.05 per cent: Arentz (2019) predicts 4.1 per cent by 2045, while Bertelsmann (2019) estimates that by 2045 steadily increasing contribution rate of 4.3 per cent will be needed to maintain LTCI spending. Kochskämper (2021) projects around 4.4 per cent by the same projection year. Rothgang and Domhoff (2019) estimate a rate of 4.9 per cent by 2060, with Bahnsen et al. (2020) predicting a rate of 5.9 per cent by 2060.

However, projections on the future number of people in need of LTC as well as the development of the contribution rate to LTCI are usually based on two crucial assumptions: first, a further increase in life expectancy and second, a constant age-specific LTC prevalence rate. In our paper, these two assumptions are analyzed in further detail. In a brief review of the literature factors influencing life expectancy and assumptions about age-specific LTC prevalence are discussed. Based on the findings from this review, we develop several scenarios using different assumptions of trends in life expectancy and age-specific LTC

⁵¹ Stefan Fetzer, Fabian Franke and Christian Hagist. *Unpublished working paper* (2022b).

⁵² Long-term care insurance in Germany is divided into a private long-term care insurance system (which insures around 10 per cent of the population) and a statutory LTCI-system covering all others. Whenever we refer to LTCI we refer to the statutory system.

prevalence. For each scenario, we calculate the number of people in need of LTC for the period from 2020 to 2100.

Our paper is structured as follows: Section 2 provides a general overview of assumptions on life expectancy and assumptions on age-specific LTC prevalence rates. Section 3 describes our projection model, the assumptions used, and the underlying data set. The results for the future development of people in need of LTC are presented in section 4. Sections 5 and 6 close with a discussion and conclusion.

2. Life expectancy and LTC prevalence

2.1 Assumptions on life expectancy

In general, future population trends are determined by four factors: the current age and sex structure, the future development of the birth rate, future migration flows, and the future development of life expectancy (Rowland, 2003). These four factors therefore also influence the future development of those in need of LTC – albeit to different degrees.

The factors “future development of birth rate” and “future migration flows” play a subordinate role for LTC projections: Germany's persistently low birth rates could theoretically change in the future, but any changes would have little to no direct impact on demand for LTC services as it takes around 60 years for people to reach the age groups relevant for LTC.⁵³ The factor of migration flows is difficult to predict, as it depends heavily on unpredictable political and economic developments.⁵⁴

In contrast, the factors of the current age structure and the future development of life expectancy are very relevant for the future development of the number of people in need of LTC. Germany's current demographic structure shows large cohorts of people born before 1970. These age groups will reach the age of an increased need for LTC, starting at 60 years of age in the coming decades (Destatis, 2019a). The future development of life expectancy additionally has a direct influence on the number of elderly people who tend to be in need of LTC, with 52 per cent of the people in need of LTC being 80 years or older. However, life expectancy is also an uncertain factor.

Since the 1800s life expectancy has doubled in industrialized countries (Riley, 2005). In Germany life expectancy at birth has risen from 64.6 years for men (68.5 years for women) in 1949/1951, to 74.0 years (80.3) in 1996/1998 and 78.5 years (83.4) in 2019/2021 (Destatis, 2021c). Some scholars such as Fries (1980) have predicted an average life expectancy ceiling that would not be surpassed citing biological and demographical reasons (Olshansky et al., 1990). Fries (1980) and Olshansky et al. (1990) assumed that around 85 years would be the

⁵³ The German LTCl covers care needs of all age groups, however over 85 per cent of recipients are 60 years or older (Destatis, 2019b). Therefore, a change in the birth rate would have only a small effect on the number of people in need of LTC. For the scope of our study and to illustrate the effects of life expectancy and LTC prevalence, we assume a static birth rate and focus on LTC needs of the elderly.

⁵⁴ Rothgang et al. (2021a) compares the expected number of people in need of LTC with all assumptions of the 14th coordinated population projection (Destatis, 2019a) and shows that even with extreme assumptions on migration and fertility the expected number of people in need of LTC predicted for 2060 varies only slightly compared to moderate assumption, citing life expectancy as the dominant driver.

average life expectancy at birth that can be expected in the long run. According to Bongaarts (2005) this view on increasing longevity led to a systematic underestimation in population projections for the oldest age groups in the 1990s. Current methods used to project future life expectancy are generally based on projections of observed mortality developments (Arriaga, 1984; Klenk et al., 2016). As the derived life expectancies have risen slightly but steadily in recent decades, it can be assumed that this trend will continue with a slow increase in life expectancy in the future (Raleigh, 2019).

Life expectancy can have various influencing factors, such as sex, genetics, access to healthcare, education, nutrition, living standards, and income (OECD, 2019; Mackenbach et al., 2019). There is uncertainty in the literature about which of these factors has had the greatest impact on the development of longevity. Since sex or genetics are constants, it can be argued that variables such as access to healthcare, education, nutrition, living conditions, and income are at least partly responsible for these shifts (Felder, 2006; Mehta et al., 2017). For instance, Manton et al. (1991) argue that increased life expectancy would be the result of medical advances in the treatment of early-stage chronic diseases, such as hypertension or diabetes. Others see nutrition as a key driver in life expectancy development (Zheng et al., 2014; Fadnes et al., 2022).

Current population projections, like the 14th coordinated population projection (Destatis, 2019a) for Germany, make the assumption that life expectancy will increase to varying degrees, with no projection scenario assuming otherwise. It can be argued that key factors that can be associated with increasing life expectancy are continuously improving, therefore a (slightly) increasing life expectancy could be considered the most likely scenario for Germany in the long-term. However, concerning predictions on life expectancy development, the extrapolation of observed developments is subject to uncertainty. Unforeseeable events, such as the recent SARS-CoV2 pandemic, could occur affecting adversely life expectancy, especially amongst the elderly, which are most relevant for LTC (Islam et al., 2021; Aburto et al., 2022).

2.2 Assumptions about age-specific LTC prevalence rates

Projections of future need for LTC services are generally made on the basis of age- and sex-specific LTC prevalence rates, which describe the need of a person of specific age and sex for LTC services. These rates are based on statistically recorded cases of LTC utilization in the past. For the projection of LTC prevalence rates assumptions about the future development of the need for LTC services are made. Probably the most frequently used assumption is the so-called status quo scenario, in which age- and sex-specific LTC

prevalence rates remain static over the projection period. As a consequence, the demographic shift toward older age-groups would inevitably lead to more people in need of LTC and thus to rising expenditures for LTCI. It is conceivable that the age- and sex-specific LTC prevalence will remain relatively stable. However, it is also possible that it could increase or decrease in the future.

A constant age- and sex-specific LTC prevalence is referred to as the status quo hypothesis, an increase as the so-called medicalization hypothesis, and a decrease as in the so-called compression hypothesis. The theory of the expansion of morbidity – or medicalization hypothesis – states that lower mortality rates lead to a higher life expectancy. This in turn leads to a longer period of life spent with chronic illnesses and with the need for medical treatment and care (Grünberg, 1977). In contrast, the compression of morbidity hypothesis (Fries, 2003) is based on the assumption that as life expectancy increases the period of illness and need for medical care shrinks. The period of morbidity during a person's life would therefore be reduced to a shorter period toward the end of life. In recent decades, it can be observed that the prevalence of care needs has shifted to the end of life, which can be attributed to advances in education, healthier lifestyles, and medical developments (Fries, 2003). For the health care sector, there is evidence that both compression and medicalization theories have merit, with a compression scenario being more likely (SVR, 2009; Breyer et al., 2015; Breyer and Lorenz, 2021). There is evidence that the need for LTC appears to concentrate toward the end of life, leading to a shift in age-related LTC prevalence (Kreft and Doblhammer, 2016). In contrast to this, there are empirical findings that indicate age as the main factor in rising LTCI expenditures (Werblow et al., 2007; De Meijer et al., 2011; Hackmann and Häcker, 2011; Karlsson and Klohn, 2014;). Additionally, Hackmann and Moog (2009) point out that various factors can influence the development of the future LTC prevalence for example, the ratio between the mortality of those in need of LTC and the development of mortality of those not in need of LTC and the development of LTC incidence.

2.3 Influencing factors on LTC prevalence

Possible factors influencing the need for LTC and thus LTC prevalence are manifold. Three factors are discussed below: developments in the disease pattern of dementia increased multimorbidity and technological advances in LTC.

Cognitive degenerative conditions are commonly grouped under the umbrella term dementia (Stevens et al., 2002; WHO, 2021). Dementia tends to have a major impact on the need for care, as it limits a person's ability to perform even minor tasks independently and requires increasing supervision. It further complicates informal care provided by family members

(Etters and Goodall, 2008). This generally leads to an increasing need for LTC, as studies have shown (Comas-Herrera et al., 2011; Schwarzkopf et al., 2012; Cadieux et al., 2013). Dementia has long been a leading cause of impairment in the elderly, leading to higher utilization of LTC with an increased need for specialized care (Agüero-Torres et al., 1998; Campbell et al., 1983; Moritz et al., 1995; Sauvaget et al., 2002; Kulp and Graf von der Schulenburg, 2002). Approximately 90 per cent of all patients diagnosed with some form of dementia require highly intensive (and more expensive) LTC services compared with other patients (Rothgang et al., 2010b).

Studies have shown that by 2050 1/85th of the world's population will be living with dementia, and delaying the onset of the disease by one year could result in 9.2 million fewer cases worldwide by 2050 (Brokmeyer et al., 2007). For Germany, there are different projections of how many people will have some form of dementia. Michalowsky et al. (2019) project that the current number of patients with dementia will double by 2060. Other studies state that the number of people needing dementia-related care will reach 2.8 million in 2050 (DGB, 2019), 2.2 million (Peters et al., 2010), and between 1.5 and 3.0 million (Schulz and Doblhammer, 2012). For 2060, Milan et al. (2021) predict between 2.6 million and 3.3 million dementia-related cases. However, some studies show that there is evidence of a declining dementia incidence of up to 25 per cent since 1990 (Derby et al., 2017; Wolters et al., 2020).

The cause and risk factors which lead to dementia are largely unknown, but some appear to be consistent with for example cardiovascular diseases or diabetes. Hence targeting these through advances in drugs and treatments could lead to fewer cases of dementia or delay the onset of dementia (Rouch et al., 2015; Derby et al., 2017). As the retention of cognitive abilities is a key factor in preventing the need for LTC (Hajek et al., 2017), therefore targeting dementia directly could directly reduce LTC prevalence. The introduction of new drugs and therapies for dementia has been slow in recent decades compared with other disease treatments (Gauthier et al., 2016). Marsden and Mestre-Ferrandiz (2015) attribute difficulties in development to several reasons. One is the higher research and development cost of drugs for neurological diseases in general and for Alzheimer's disease in particular. However, looking at the number of clinical trials currently underway, there may be a realistic chance that one of these trials could lead to concrete treatments for dementia in the future (Cummings et al., 2021; Abbott, 2022).

Besides dementia, the increasing multimorbidity in older age groups is another important factor that affects the need for LTC (Kato et al., 2021). Aging is often associated with multimorbidity, and the simultaneous treatment of multiple conditions is usually associated with polypharmacy i.e. the concurrent use of different medications the interactions of which are generally unknown. The concomitant administration of different drugs is often linked to

adverse drug reactions, that are especially relevant for the geriatric population (Davies and O'Mahony, 2015), and have been associated with unfavorable health outcomes (Morley, 2014; Jokanovic et al., 2015, Zazzara et al., 2021). For example, studies have shown that certain medications or combinations of medications can have the side effect of leading to cognitive impairment, resulting in a higher likelihood of falls and fall-related injuries. Long-term effects of such injuries and decreased patient independence often leads to accelerated or premature LTC needs (Tinetti et al., 1997). Therefore, any developments that go in the direction of reducing adverse drug reactions or the need for polypharmacy (for example one drug offering which targets various age-related diseases at once) could reduce care needs.

In addition to medical developments influencing future LTC prevalence, technological advancements effecting the elderly could be another critical factor that determines the future need of LTC. Age groups that will need care in the future may not share the resistance to technology that has been a barrier to its use in the context of aging (Iwasaki, 2013; Yee-Yann et al., 2022). Emerging technologies such as wearable devices, smart pill boxes, activity assistants, automated health assessments, and smart home monitoring, to name just a few, may prove useful in maintaining independence longer for older people (Tak et al., 2010; Mostaghel, 2016). While in the past older users have perceived technology as intrusive, reliance on novel technologies may be more normalized by people who are accustomed to carrying a smartphone or wearable devices at all times and with a good degree of familiarity with digitalization. Developments in technology could significantly reduce older people's reliance on formal care, and it can be argued that due to this they would be able to live independently for a longer time, delaying the need for more expensive formal LTC services (Petersson et al., 2012; Melkas, 2013; Ollevier et al., 2020).

In summary, the future development of the (age-specific) prevalence of need for LTC services is again subject to great uncertainty. On the one hand, current developments in dementia and multimorbidity do not point to a massive decline of LTC prevalence among older people. On the other hand, it can be argued that due to advances in pharmaceuticals, treatment methods, and benefits from digitalization, LTC prevalence rates could be decreased. In the following, we will therefore model the future uncertain development of age-specific prevalence, as well as that of the future life expectancy using different assumptions.

3. Methodology and data

Our LTC projection model includes our own population projection as well as age- and sex-specific LTC prevalence rates, which we derive from official LTC statistics for 2019 (Destatis, 2019b). Our projection period covers the range from 2020 to 2100, in contrast to most other projections, which usually only run up to 2060. This gives us the opportunity to observe the development after the year 2060 and we can thus better visualize the long-term impact of the various assumptions we make.⁵⁵

Our population projection is based on the German population of the year 2020 (Destatis, 2021b). For the future development of the population, we assume a fertility rate and migration numbers according to the moderate assumptions G2 and W2 of the official 14th coordinated population projection (Destatis, 2019a).⁵⁶ For the future development of life expectancy we use four assumptions: L0 retains the current life expectancy with no further development of longevity. In contrast, the assumptions L1, L2, and L3 assume increasing life expectancy developments according to the official 14th coordinated population projection (see Table 6).⁵⁷ After 2060, our model maintains the 2060 life expectancy in the respective assumptions, with no further increases in life expectancy.

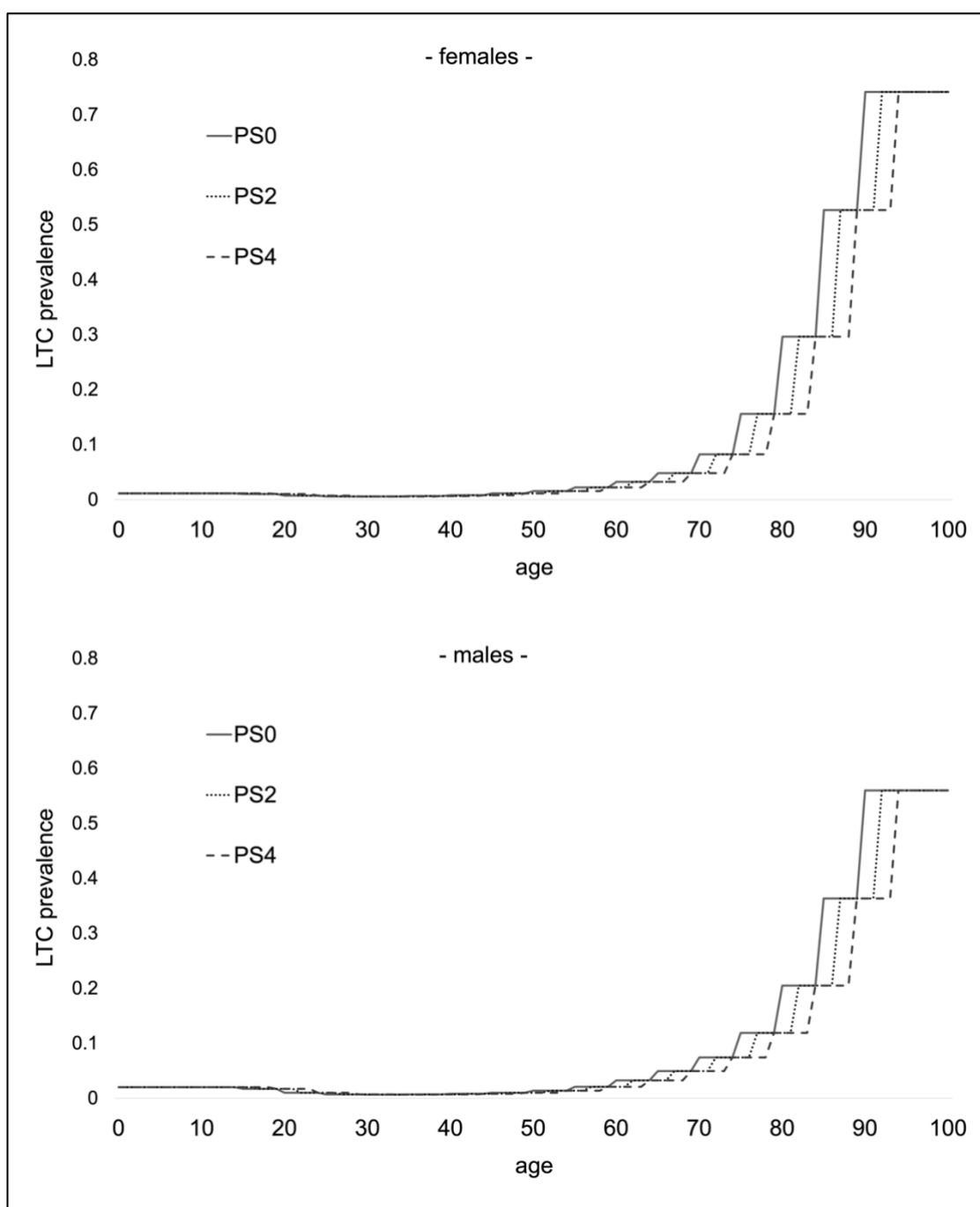
The prevalence rates for LTC dependency derive from the official LTC statistics for 2019 (Destatis, 2019b). Using data for inpatient and outpatient care for the ages of 0 to 100 years for men and women separately, we calculate separate LTC prevalence rates. To account for the evolution of LTC prevalence, we make three assumptions: a status quo assumption that maintains current prevalence rates and two prevalence shift (PS) assumptions with a 2-year shift and a 4-year shift in the onset of need for LTC towards the end of life. PS0 reflects the status quo assumption, assumption PS2 assumes a 2-year shift, and assumption PS4 assumes a 4-year shift in LTC prevalence from 2020 to 2060. After 2060, age- and sex-specific prevalence rates are assumed to remain constant. The prevalence shift assumptions can be seen in Figure 13.

⁵⁵ For our population projection, we utilize the cohort component method which dates back to Whelpton (1936). A comprehensive description of our population projection can also be found in Bonin (2001).

⁵⁶ We choose a uniform assumption on birth rate and migration for all scenarios in our model, with net-migration W2 with a decline in net-migration to 206,000 by 2030 and constant thereafter, and a birth rate of 1.6 (Destatis, 2019a). For all assumptions of the 14th coordinated population projections please refer to the Appendix C.3.

⁵⁷ Please refer to the Appendix C.2 and C.3 for a graphical representation of our populations projection results.

Figure 13: Development of LTC prevalence in the assumptions for females and males



Source: Own calculations based on Destatis (2019b).

Our model then combines each of the four assumptions on life expectancy with the three assumptions on future development of LTC prevalence and calculates the future development of the number of people in need of LTC for each of the 12 resulting scenarios (see Table 6).

Table 6: Life expectancy and LTC prevalence shift scenarios

	L0	L1	L2	L3
<i>life expectancy male / female</i>	78.4 / 83.2	82.5 / 86.4	84.4 / 88.1	86.2 / 89.6
PS0	L0-PS0	L1-PS0	L2-PS0	L3-PS0
PS2	L0-PS2	L1-PS2	L2-PS2	L3-PS2
PS4	L0-PS4	L1-PS4	L2-PS4	L3-PS4

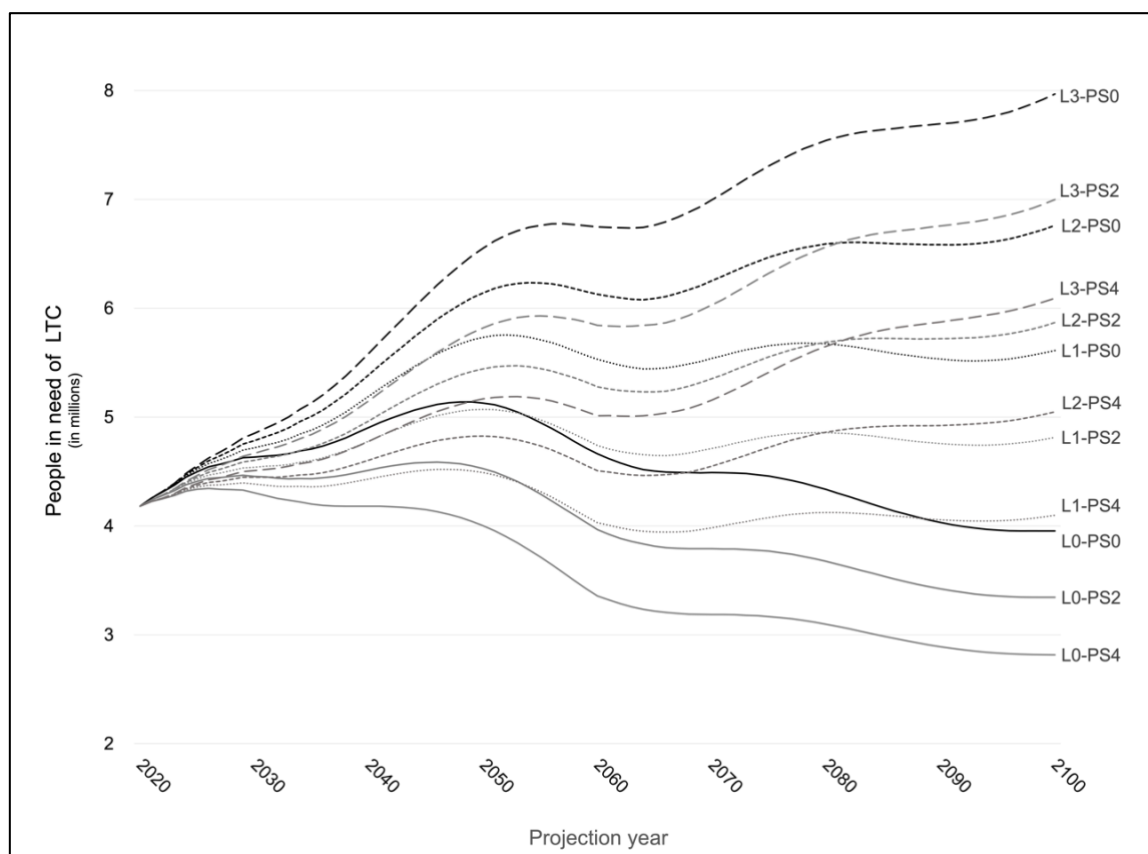
Source: Own assumptions based on Destatis (2019a).

We expect the L0-PS4 scenario to result in the smallest number of people in need of LTC and the L3-PS0 scenario to result in the largest number. However, how the other scenarios would affect the projected future number of people in need of LTC is not as clear.

4. Results

The number of people in need of LTC for all 12 scenarios, i.e. all different combinations of assumptions on life expectancy and LTC prevalence shifts can be seen in Figure 14. Compared with the 4.18 million in the base year 2020 Table 7 shows the relative change in the number of people in need of LTC for the projection years 2040, 2060, and 2080.

Figure 14: Development of people in need of LTC in the scenarios



Source: Own calculations.

Our results show that both shifts in LTC prevalence and changes in life expectancy affect the projection of people in need of LTC. The results of the various scenarios show a wide range, which expands with increasing projection year.

Regarding all scenarios, our lowest results for the number of persons in need of LTC are generated by the scenario L0-PS4, which assumes a constant life expectancy and a 4-year shift in prevalence. According to this scenario, the number of people in need of LTC starting from the base year 2020 with 4.2 million will decline steadily from 2026 onward, peaking in 2026 at 4.34 million and then decreasing to 4.2 million (0 per cent) in 2040, 3.39 million (-19.8% per cent) in 2060, and 3.10 million (-26.0% per cent) in 2080. This could be described as a "survival-of-the-physically-fittest" scenario, in which people will spend their lives with

greatly reduced care needs. It can be argued that this could be caused, for example, by factors such as pandemics, heat waves, or diseases that affect the frailest of the elderly population with the highest care needs. During the SARS-CoV2 pandemic, it was observed that risk factors leading to an increased need for care (such as hypertension, diabetes, and cardiovascular disease) greatly increased mortality from such infection (Nandy et al., 2020; Hariyanto et al., 2021). Several studies also show that people with dementia have increased mortality due to a SARS-CoV2 infection (Zuin et al., 2020; Saragih et al., 2021; Tyson et al., 2021). Therefore, even such an extreme example could theoretically be explained.

In contrast, the scenario with the highest projection of people in need of LTC is scenario L3-PS0, which assumes a large increase in life expectancy and no shift in LTC prevalence. Starting from 4.2 million in the base year 2020, the number of people in need of LTC in this scenario rises steadily to 5.6 million (+33.6 per cent) in 2040, 6.8 million (+61.3 per cent) in 2060, 7.5 million (+80.4 per cent) in 2080, and reaches the 8 million mark in the last year of our projection period, 2100. This scenario reflects the extension of morbidity hypothesis (or medicalization thesis): With declining mortality rates and resulting higher life expectancy, the assumption of a constant LTC prevalence leads to a longer time in need of LTC and thus to an increasing number of people. In other words, life is extended, but more of that time is spent in illness and in need of LTC.

In line with the assumptions of other projections, we would consider that more moderate scenarios are more likely to occur, such as L2-PS2, which combines a moderate increase in life expectancy with a 2-year shift in prevalence. In this scenario, the number of people expected to need LTC increases moderately by 18.7 per cent by 2040, 26.2 per cent by 2060, and 36.0 per cent by 2080 compared with the base year of 2020.

Table 7: Development of people in need of LTC relative to the base year 2020

	L0	L1	L2	L3
2040				
PS0	17.3%	24.1%	28.9%	33.6%
PS2	7.9%	14.3%	18.7%	23.2%
PS4	-0.0%	6.0%	10.1%	14.3%
2060				
PS0	11.5%	32.3%	46.5%	61.3%
PS2	-5.2%	13.3%	26.2%	39.7%
PS4	-19.8%	-3.7%	7.8%	19.9%
2080				
PS0	3.7%	35.7%	57.6%	80.4%
PS2	-12.1%	16.2%	36.0%	57.0%
PS4	-26.0%	-1.4%	16.2%	35.1%

Source: Own calculations.

In almost all scenarios, there is a sharp increase in the number of people in need of LTC up to the 2050s, with our moderate L2-PS2 scenario peaking in 2053. Thereafter, we can observe a slight decline until 2065, which can be attributed to the successive passing of large cohorts of people born before 1970 (i.e. the baby boomer generation). However, with our projection running to the year 2100, we can show that demographic shifts could continue to pose problems after the initial peak in numbers, as our results show a second increase (or at least a reduced decline for the L0 assumption) following the 2060s. Using our moderate L2-P2 scenario we can observe that after an initial peak in 2053 at 5.5 million, the projection drops to 5.2 million in 2065 and gradually rises again to 5.5 million in 2075. Using a conservative scenario with no changes in LTC prevalence and no advances in life expectancy (L0-PS0) the first peak can be observed in 2049 with 5.1 million, continually decreasing thereafter. The

same trend can be observed for all scenarios using a constant life expectancy assumption. Using all other life expectancy assumptions this second peak can be observed, with the lowest in L1-PS4 and the highest in L3-PS0. Results for moderate scenarios for care needs in 2075 show that this second peak can reach between 90.2 per cent (L1-PS4) and 103.8 per cent (L2-PS0) of the initial peak in each scenario. In contrast to the widely expected first peak (induced by the care needs of the baby boomer generation) this development is rarely discussed.

Overall, our results show that the future development of life expectancy is the more important factor influencing the future number of people in need of LTC, compared to the assumptions about the future development of age-specific LTC prevalence. An example of this is the comparison of the L1-PS2 scenario and the L2-PS2 scenario: In the short term (until 2040), both assumptions show the same trend. However, the assumption of a lower increase in life expectancy (L1-PS2) yields a significantly lower result in subsequent years. The relative increase in the number of people in need of LTC is only half as high from 2060 onward and shows a moderate level increase in the number of people in need of LTC of around 16 per cent in 2080 compared with the base year 2020., whereas L2-PS2 shows an increase of 36.0 per cent.

One could argue that such moderate scenarios on life expectancy and LTC prevalence would be the most reasonable assumptions to make. Since we saw in Section 2 that factors that may positively influence life expectancy are also factors that could lead to lower health impairments and thus may result in a lower need for LTC, such assumptions seem plausible.

5. Discussion

5.1 Projection models and limitations

A comparison with other studies shows that the results of our moderate assumptions are within the range of comparable projections of people in need of LTC. As most projections from other studies assume a constant LTC prevalence rate and a moderate increase in life expectancy, the L1-PS0 or L2-PS0 scenarios from our projection seem particularly appropriate for comparison.

In line with our results, the Federal Institute of Population Research (2021) estimates 6.2 million people in need of LTC for 2060 (L2-PS0: 6.1 million). In their projection, they assume constant LTC prevalence rates from 2019 from official LTC statistics (Destatis, 2019b) and the G2-L2-W1 scenario of the 14th coordinated population projection (with 2018 as base year).⁵⁸

The work of Kochskämper (2021) is probably the most comparable of all the projections mentioned in the introduction. In this projection's base scenario, the Variant 2 scenario of the 14th coordinated population projection, using the assumptions G2-L2-W2 is applied, along with constant LTC prevalence based on official LTC statistics from 2019. In line with our findings, Kochskämper (2021) predicts over 6 million people in need of LTC by 2060. In an additional scenario, an LTC prevalence shift is modeled that gradually adapts the prevalence rate in line with the rising life expectancy for each cohort. This compression scenario shows over 5 million people in need of LTC by 2060, which can be seen as comparable with our L2-PS2 scenario (5.3 million). However, we do not model a shift in prevalence for each cohort, but assume a uniform 2-year shift for all cohorts.

Rothgang et al. (2021a) use a model with various assumptions on both population development and LTC prevalence. In their base scenario, they apply moderate assumptions of population development using the V2 variant of the 14th coordinated population projection. For this base scenario, they further apply constant LTC prevalence rates based on the year 2019, which they derive from insurance data of the BARMER LTCl and the official LTC statistics for 2019. Under these conditions, their prognosis shows a peak in the expected number of people in need of LTC of 6.5 million by 2055. Another scenario with a higher increase in life expectancy (identical to our L3 assumption) shows a peak of 7 million people in need of LTC by 2057. In an additional model, Rothgang et al. (2021a) assume a degressive

⁵⁸ The 14th coordinated population projection uses 2018 as the base year, whereas the 13th coordinated population projection uses 2015 as base year. Please refer to the Appendix C.3 for an overview of the assumptions.

increase of LTC prevalence rates until 2025, after which they remain constant. They argue that the increase in LTC prevalence rates to date (particularly between 2015 and 2019) is not representative of future trends, and therefore assume a declining increase in LTC prevalence that ultimately leads to constant prevalence rates in their model after 2025. This assumption on LTC prevalence will lead to approximately 1 million additional people in need of LTC by 2025 and to an increase in the number of people in need of LTC of over 8 million by 2057 in the most extreme scenario.

In contrast the results of Jacobs et al. (2020) are slightly lower than those of our projection and the projections mentioned so far. Using LTC prevalence rates of the year 2017, which they assume to be constant, and Variant 2 of the 13th coordinated population projection (G1-L1-W2, with 2015 as base year) they project 5.1 million people in need of LTC by 2060. This comparatively low figure can presumably be attributed to the difference in the number of people in need of LTC in the base year used, with LTC statistics showing a difference of over 1 million additional people in need of LTC.⁵⁹

Having established that our results are in the range of comparable projections of people in need of LTC, the following insights can be drawn from our projection that may contribute to the literature in the field.

First, we show that in the long run, assumptions about future life expectancy trends have a larger effect on projection results than a 2-year shift in the prevalence rate. We also show the consequences that no further increase in life expectancy would have on the future number of people in need of LTC. In contrast to other studies, our projection is singular in showing results for scenarios with static life expectancy as such an outcome cannot be ruled out entirely.

Second, with our projection extending up to the year 2100, we show that the peak in the number of people in need of LTC will not necessarily be reached by the end of the 2050s which could be inferred from the other studies. Depending on the scenario regarded in our results, there could be more people in need of LTC, after only a brief decline up to the mid-2060s.

Third, our results show that the spread among the different scenarios increases very sharply, especially after 2060. However, the comparison with the work of Rothgang et al. (2021a) and Jacobs et al. (2020) shows that the number of people in need of LTC in the base year of the

⁵⁹ LTCl statistics for 2017 show 3.3 million people receiving LTCl benefits, and 4.3 million for 2020 (BMG, 2021d).

projection also has a large leverage effect on the final results of the projected number of people in need of LTC.

Regarding the limitations of our study, we can point out that our model, just like the models of the other works mentioned so far, is based on the simplified assumption of a status quo projection with an ad hoc shift in the prevalence rate. As Hackmann and Moog (2009) show in their model for the German LTC, which is based on the work of McGee and Brayne (2001), there is a very large interdependence between the variables prevalence rate, incidence rate, and (care-dependent) mortality rate. For example, they show that an increase in life expectancy, even for those not in need of LTC, leads to a higher "at-risk" population in the following year. This relation is also modeled by Milan et al. (2021) using a Markov-Illness-Death model for ten common diseases including LTC-relevant dementia. They show that especially for highly age-dependent diseases, a simple status quo extrapolation of prevalence to 2060 leads to results that fall between the compression and expansion scenarios of other more complex Markov-Illness-Death-models. It can therefore be assumed that our model will lead to plausible results in the long-term and that a more complex model incorporating additional variables would potentially yield even wider-ranging results.

5.2 Consequences for LTCI and policymakers

The amount of people in need of LTC in our results has implications for the financing of LTCI. Assuming our projections are able to serve as a basis for a simplified projection of LTCI expenditures in the future we can use our projected number of people in need of LTC and assume LTCI expenditures would rise in line. Given this one-to-one impact of the future development of care recipients on LTCI expenditures, the results in Table 2 show that these are expected to increase in most scenarios. Coupled with the demographic development which will result in an expected decline in the labor force and therefore LTC contribution payers, LTC contribution rate increases are therefore to be expected as described in the introduction to ensure the LTCI is financially sustainable.

Our results of the various scenarios using constant assumptions on the development of life expectancy indicate that an increase in the LTCI contribution rate could also be significantly lower compared to the studies mentioned in the introduction. Such financially hopeful scenarios, however, would be based on the macabre assumption that mortality among those in need of LTC will increase. It therefore seems more sensible to prepare for an increase in the number of people in need of LTC, while at the same time taking into account the uncertainty about the extent of this expansion.

With regard to a one-to-one impact of the number of people needing LTC and LTCI expenditures, however, it can be criticized that a projection using the absolute number of people in need of LTC does not account for the fact that the ratio of care grades and resulting LTCI expenditures could change. Such shifts could, for example, stem from migration towards higher (or lower) care grades and, in spite of a static number of people in need of LTC, would result in increased (decreased) LTCI expenditures. It is often assumed that a higher proportion of people in need of LTC will have to rely on more expensive inpatient care which would demonstrate a migration toward more cost-intensive LTC services (Häcker and Raffelhüschen, 2007; Unger et al., 2015; Rothgang et al., 2017). In the past, however, LTCI spending has increased at roughly the same rate as the number of people in need of LTC. Therefore, our results can probably provide a solid basis for the estimation of the future development of LTCI expenditures, bearing in mind the many uncertain factors. This leads us to the following policy implications with respect to the future design of LTCI.

For a financially sustainable LTCI, one option is to expand the capital reserves. These can then be used to offset future increases in the contribution rates. With the capital reserve fund for LTCI such an element already exists and could be expanded upon (Bahnsen et al., 2020). Another option would be to implement a self-balancing mechanism for LTCI which takes into account the uncertain development of future life expectancy and thus the expected number of people requiring LTC. As proposed by Werding et al. (2020) this could be done with the introduction of a sustainability factor, linking the adjustment of LTCI benefits to the development of wages. Fetzer and Moog (2021) for instance suggest the implementation of an automated balancing mechanism for LTCI akin to the Swedish pension system. Such ruled-based financing changes to LTCI could help make LTCI more financially sustainable, while at the same time giving certainty about expected benefits for future people in need of LTC. Reliable rules around the future costs associated with the need for LTC and the exact amount of these costs that the LTCI will cover would also provide a basis for strengthening private provision, as it should not be ignored that much of the funding for LTC services must be provided privately (Fetzer and Hagist, 2021). Having a more precise idea of expected future care costs for the individual may have a positive influence on the willingness of people to strengthen their private provision for such eventualities.

A further policy implication results from the factors that could lead to a medium to long-term reduction in the number of people in need of LTC, or at least a reduction in the severity of care needs, and thus to lower care grades with reduced associated expenditures for LTCI. In Section 2, we described how a reduction in LTC utilization could be influenced by advances in pharmaceuticals, treatment methods, the prevention of (chronic) diseases as well as the benefits of digitization. A targeted health policy would have to create the framework conditions

to promote initiatives aiming for such outcomes, through financial incentives. The sum of the financial resources spent on such incentives could possibly be less than the long-term financing of a steadily increasing number of people in need of LTC.

6. Conclusion

Projections of the number of people in need for LTC in Germany vary widely, depending on assumptions on life expectancy and LTC prevalence. We can observe that life expectancy seems to be a more important factor, rather than LTC prevalence. Despite the limited assumptions of our model, our results seem reliable when compared to other studies. All studies have a high degree of uncertainty in common about the assumptions used, especially those on life expectancy development, which diverges results, particularly in the long-term.

We argue that institutional rule-based changes to LTCl financing need to be made in order to sustainably finance LTCl as there is uncertainty about the exact degree of demand and expenditures. Increased transparency about future LTC benefits that can be expected through rule-based reforms of LTCl financing could encourage more people to make private provisions for their future care costs. Further, health policy should be geared toward facilitating positive shifts in LTC prevalence by providing incentives for such a development.

Summary

The research articles of this dissertation show that the German LTCI has had a significant impact on intergenerational distribution. The reforms to LTCI resulted in the reduced financial sustainability of the system and generosity changes for all generations, with younger age groups benefiting less since they have a longer time to go before reaping (uncertain) benefits.

As is shown in article 1, the Second Long-Term Care Strengthening Act of 2017 has further increased the already unsustainable financing of LTCI. The results - using a generational accounting model - show that the reform increased the level of unsustainable funding by 30 per cent. The distributional effects of this reform have a negative impact on cohorts younger than 33 in 2016 and are also mainly at the detriment of future generations. In contrast, all cohorts older than 33 in 2016 will on average benefit from the reform. This reform also resulted in windfall gains amounting to almost 90 per cent of the gains made when the system was originally introduced. Concerning the development of the contribution rate (under the assumption of a constant benefit level) the analysis shows that the current working assets as well as the LTC capital reserve fund will only be able to stabilize future contribution rates for a few years. In the long-term, the analysis reveals contribution rates to LTCI would have to rise to almost 6 per cent in 2060.

The results of article 2 provide an overview of the evolution of generosity of the German LTCI system from its inception up to the year 2019. This retrospective view shows that generosity generally declined until 2019, with the effects of the Second Long-Term Care Strengthening Act reversing this trend only for a short period in 2017 and 2018. Trends in generosity show that older generations generally have bigger gains from a more generous system than younger generations (especially those born after 1970). By analyzing the causes of these changes in generosity, the results show that demographic risk in the past was rather low. The generosity changes that occurred in the past can primarily be attributed to policy decisions that increase the eligibility of LTCI beneficiaries and the level of benefits they receive. Therefore, politically motivated adjustments to the system can be identified as the main cause of changes in generosity.

While political interventions heavily determined the generosity of the system in the past, the future demographic developments and in particular the size of the older cohorts will be decisive for the future financial sustainability of LTCI. When forecasting the number of people in need of LTC, the results of projections depend on the underlying assumptions, especially those on developments in life expectancy and developments in age-specific care needs (i.e. LTC prevalence). The results of article 3 lead to the conclusion that the future number of people in need of LTC will continue to increase as the elderly population of Germany

increases, however, the exact extent of this development is uncertain. The results show that increasing life expectancy has a significant impact on future demand for LTC services. However, it can be argued that the mere expansion of the age group does not necessarily lead to an increased LTC demand in the future. Several studies point to the trend toward compression of LTC needs to a later point in life. Such a reduction in LTC demand could be achieved if prevalence could be shifted to a later point in life, for example by advancements in medicine and technology. Policies directed toward achieving changes inducing such a prevalence shift could therefore be considered a higher priority of health policy. The results show that projections with moderate assumptions on life expectancy development and on LTC prevalence development can yield results that could be used as guide rails to predict future LTC demand.

It can be argued that political risk should be taken out of the equation and policymakers should create a framework for the German LTCl that includes a rule-based financing mechanism to ensure its long-term financial sustainability and reduce intergenerational distribution effects. If current trends continue and policymakers choose to provide ever higher benefits and expand the criteria of eligibility, distributional effects will continue to negatively impact younger generations. A rule-based system for benefit levels from and contributions to LTCl needs to be implemented to strive for increased intergenerational fairness and inhibit clientele policy..

Increased transparency on which benefits levels can be expected would enable private provisions for LTC to become a pivotal point in discussions around the topic. As article 3 shows the most likely projection scenarios would result in a larger number of people in need of LTC. Since the future population will lack the available workforce to contribute adequately to these expenditures without unbearably high contributions, it therefore seems necessary that the partially comprehensive coverage of LTCl should be retained and co-payments expanded. Uncertainties about the development of the contribution rate and lack of guarantees for the coverage of one's own future care needs, means that the younger age groups are at the mercy of politically motivated changes to LTCl. Clarity about future benefits and contributions would help younger generations to make reasonable decisions regarding private provisions for their future LTC expenses.

All three articles contribute to the literature and the political debate and clearly demonstrate that the impact of policy decisions is central to the sustainable financing of German LTCl. Given the uncertainty about future trends in life expectancy and prevalence of LTC, it is important to reform the system in a way that eliminates the need for ad hoc policy interventions. The results of these articles can be used to guide policy-making toward more sustainable and generationally appropriate financing of LTCl.

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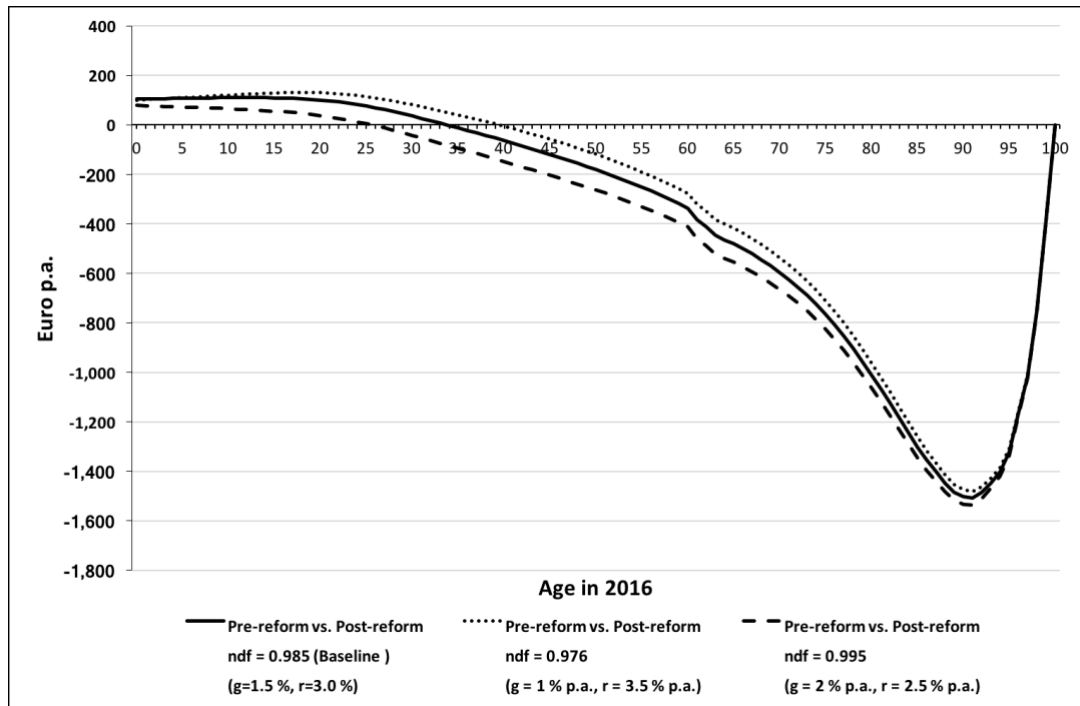
Appendix

Appendix A.1: Sensitivity analysis of the indicator SCR

	Pre-reform		Post-reform		Post-reform with MDK adjustment	
<i>ndf = 0.985 (baseline)</i>						
<i>(g = 1.5 % p.a., r = 3 % p.a.)</i>						
Contribution rate	2.35%		3.05%		3.05%	
SCR	3.72%		4.88%		4.57%	
θ	0.58		0.60		0.50	
Necessary adjustment	1.37%		1.83%		1.52%	
<i>ndf = 0.976</i>						
<i>(g = 1 % p.a., r = 3.5 % p.a.)</i>						
Contribution rate	2.35%		3.05%		3.05%	
SCR	3.44%	-7%	4.55%	-7%	4.27%	-7%
θ	0.47	-20%	0.49	-18%	0.40	-20%
Necessary adjustment	1.09%	-20%	1.50%	-18%	1.22%	-20%
<i>ndf = 0.995</i>						
<i>(g = 2 % p.a., r = 2.5 % p.a.)</i>						
Contribution rate	2.35%		3.05%		3.05%	
SCR	4.01%	8%	5.22%	7%	4.87%	7%
θ	0.71	21%	0.71	19%	0.60	20%
Necessary adjustment	1.66%	21%	2.17%	19%	1.82%	20%

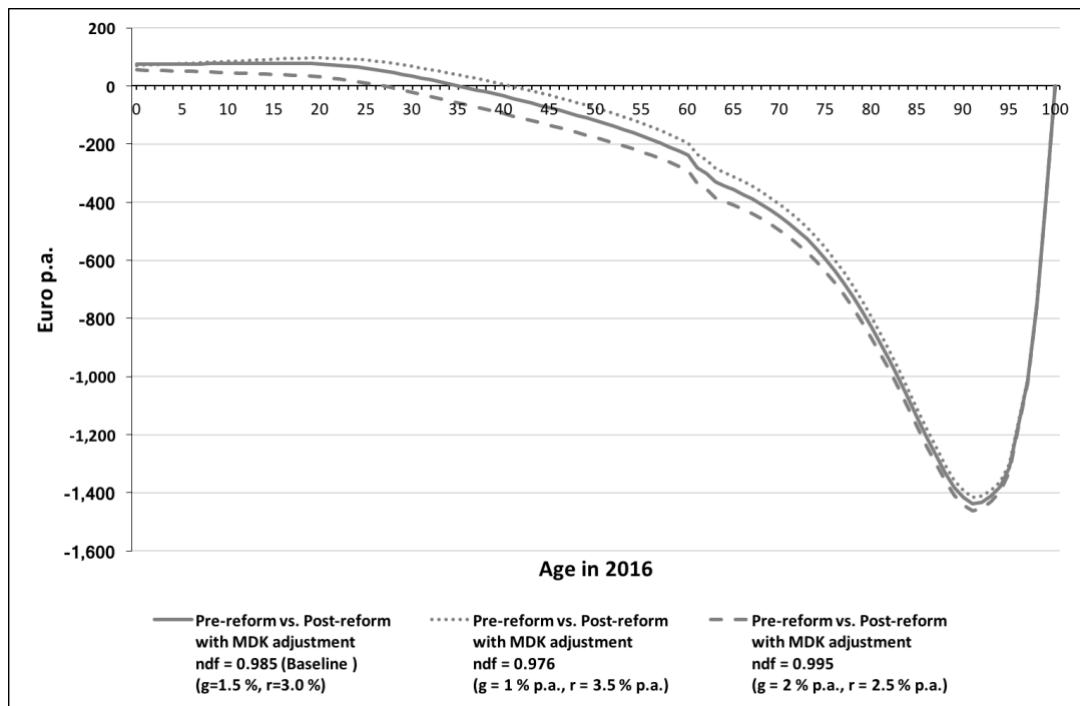
Source: Own calculations.

Appendix A.2: Sensitivity analysis reform-induced burden post-reform as annuities



Source: Own calculations.

Appendix A.3: Sensitivity analysis reform-induced burden MDK scenario as annuities



Source: Own calculations.

Appendix B.1: Assumptions of the various official coordinated population projections

	Migration	Life expectancy at birth base year male / female	Life expectancy at birth estimation male / female	Fertility rate
9 th coord. PP (1999)	+ 200,000	74.4 / 80.5 (1997)	76.4 / 82.4 (2050)	1.4
10 th coord. PP (2002)	+ 200,000	74.8 / 80.8 (2001)	78.9 / 85.7 (2050)	1.4
11 th coord. PP (2006)	+ 200,000	75.9 / 81.5 (2005)	83.5 / 88.0 (2060)	1.4
12 th coord. PP (2009)	+ 200,000	77.2 / 82.4 (2008)	85.0 / 89.2 (2060)	1.4
13 th coord. PP (2013)	+ 200,000* *decrease from 500.000 until 2021	77.7 / 82.8 (2012)	84.8 / 88.8 (2060)	1.4
14 th coord. PP (2019)	+ 206.000* *only net-migration published, decrease to 206.000 until 2026	78.4 / 83.2 (2017)	84.4 / 88.1 (2060)	1.5

Source: Destatis (2000), Destatis (2003), Destatis (2006), Destatis (2009), Destatis (2015), Destatis (2019a).

Appendix B.2: Overall windfall of various F- and D-component regimes in billion Euro

	D1998	D1999	D2000	D2001	D2002	D2003	D2004	D2005	D2006	D2007	D2008	D2009	D2010	D2011	D2012	D2013	D2014	D2015	D2016	D2017	D2018	D2019
F1998	554	554	554	567	567	567	567	604	604	601	610	610	610	610	610	592	592	592	592	592	581	581
F1999	541	541	541	553	554	554	554	590	590	587	596	596	596	596	596	578	578	578	578	578	567	567
F2000	522	522	522	534	534	534	534	569	569	566	574	575	575	575	575	558	558	557	557	557	546	546
F2001	503	503	503	514	514	514	514	548	549	545	554	554	554	554	554	537	538	537	537	537	526	527
F2002	514	514	514	525	525	526	526	560	560	557	565	566	566	566	566	549	549	549	549	549	538	538
F2003	518	518	518	529	529	529	530	564	564	561	569	569	569	569	569	553	553	553	553	553	541	542
F2004	493	493	493	504	504	504	504	537	537	534	542	542	542	542	542	526	526	526	526	526	515	515
F2005	464	464	464	473	473	473	474	505	505	502	511	511	511	511	511	495	495	495	495	495	484	484
F2006	419	419	419	427	427	427	427	458	458	455	463	463	463	463	463	448	448	448	448	448	437	437
F2007	413	413	413	421	421	421	421	450	450	447	455	455	455	455	455	441	441	441	441	441	431	431
F2008	392	392	392	400	400	400	400	429	429	427	434	435	435	435	435	420	420	420	420	420	410	410
F2009	392	392	392	400	400	400	400	430	430	427	435	435	436	436	436	420	420	420	420	420	410	410
F2010	380	380	380	388	388	388	388	417	417	415	422	422	422	422	422	407	408	407	407	407	398	398
F2011	393	393	393	402	402	403	403	434	434	432	441	441	441	441	441	425	425	425	424	424	414	414
F2012	393	393	393	402	402	402	402	434	434	432	441	441	441	441	441	425	425	424	424	424	414	414
F2013	389	389	389	398	398	398	398	431	431	428	438	438	438	438	438	421	421	421	421	421	410	411
F2014	372	372	372	381	381	381	381	413	413	411	420	420	420	420	420	403	403	403	403	403	393	393
F2015	356	356	356	364	365	365	365	398	398	395	405	405	405	405	405	388	388	387	387	387	376	377
F2016	356	356	356	364	364	364	364	397	397	395	404	404	404	404	404	387	387	387	387	387	376	376
F2017	434	434	434	444	444	444	444	481	481	478	488	489	489	489	489	470	470	469	469	469	458	458
F2018	443	443	443	453	453	453	453	490	490	487	498	498	498	498	498	479	479	479	479	478	467	467
F2019	359	359	359	367	367	368	368	403	403	401	411	412	412	412	412	392	392	392	392	392	380	380

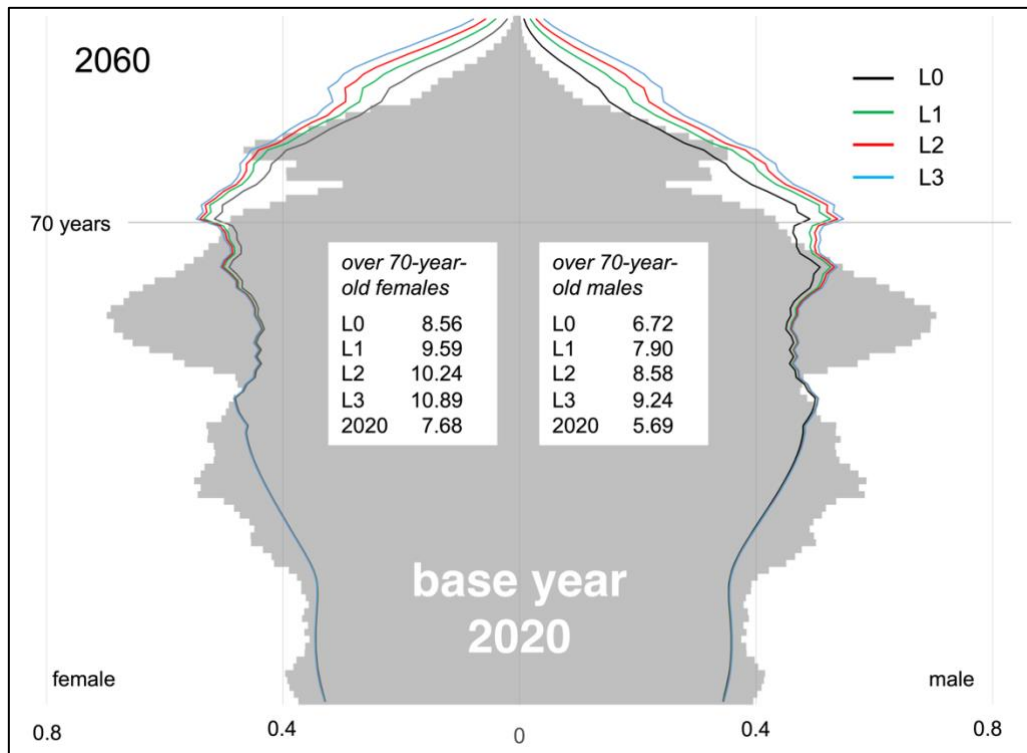
Source: Own calculations.

Appendix B.3: Changes in generosity index with different interest rates to baseline scenario $r = 3.0$

	<i>r</i>	D1998	D1999	D2000	D2001	D2002	D2003	D2004	D2005	D2006	D2007	D2008	D2009	D2010	D2011	D2012	D2013	D2014	D2015	D2016	D2017	D2018	D2019
F1998	2.5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.5%	-0.5%	-0.4%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	0.0%	0.0%
	3.5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.5%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%
F1999	2.5	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	-0.4%	-0.4%	-0.3%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.1%	0.1%
	3.5	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.4%	0.4%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.1%	0.1%	0.1%	0.1%	0.1%	-0.1%	-0.1%
F2000	2.5	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	-0.2%	-0.2%	-0.1%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%
	3.5	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	0.2%	0.2%	0.1%	0.2%	0.2%	0.3%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.2%	-0.2%
F2001	2.5	0.4%	0.4%	0.4%	0.5%	0.4%	0.4%	0.4%	-0.1%	-0.1%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.4%	0.4%
	3.5	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	0.1%	0.1%	-0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.4%	-0.4%
F2002	2.5	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	-0.2%	-0.2%	-0.1%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%
	3.5	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	0.2%	0.2%	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.2%	-0.2%
F2003	2.5	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	-0.4%	-0.4%	-0.3%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.1%	0.1%
	3.5	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.4%	0.4%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.1%	0.1%	0.1%	0.1%	0.1%	-0.1%	-0.1%
F2004	2.5	0.2%	0.2%	0.2%	0.3%	0.2%	0.2%	0.2%	-0.3%	-0.3%	-0.2%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%
	3.5	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	0.3%	0.3%	0.1%	0.3%	0.3%	0.3%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.2%	-0.2%
F2005	2.5	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.2%	0.2%	0.3%	0.1%	0.1%	0.1%	0.1%	0.1%	0.4%	0.4%	0.4%	0.4%	0.4%	0.7%	0.7%
	3.5	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.2%	-0.2%	-0.4%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.7%	-0.7%
F2006	2.5	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	0.8%	0.8%	0.9%	0.7%	0.7%	0.7%	0.7%	0.7%	1.1%	1.1%	1.1%	1.1%	1.1%	1.3%	1.3%
	3.5	-1.5%	-1.5%	-1.5%	-1.6%	-1.6%	-1.6%	-1.5%	-0.9%	-0.9%	-1.0%	-0.9%	-0.8%	-0.8%	-0.8%	-0.8%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.4%	-1.4%
F2007	2.5	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	0.5%	0.5%	0.6%	0.4%	0.4%	0.4%	0.4%	0.4%	0.8%	0.8%	0.8%	0.8%	0.8%	1.0%	1.0%
	3.5	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-0.6%	-0.6%	-0.7%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-1.1%	-1.1%
F2008	2.5	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.0%	1.0%	1.2%	1.0%	1.0%	0.9%	0.9%	0.9%	1.3%	1.3%	1.3%	1.3%	1.3%	1.6%	1.6%
	3.5	-1.9%	-1.9%	-1.9%	-1.9%	-1.9%	-1.9%	-1.9%	-1.2%	-1.2%	-1.3%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.5%	-1.5%	-1.5%	-1.5%	-1.5%	-1.7%	-1.7%
F2009	2.5	2.0%	2.0%	2.0%	2.1%	2.1%	2.0%	2.0%	1.3%	1.3%	1.4%	1.2%	1.2%	1.2%	1.2%	1.2%	1.6%	1.6%	1.6%	1.6%	1.6%	1.9%	1.9%
	3.5	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-1.5%	-1.5%	-1.7%	-1.4%	-1.4%	-1.4%	-1.4%	-1.4%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-2.1%	-2.1%
F2010	2.5	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.2%	1.2%	1.3%	1.1%	1.1%	1.1%	1.1%	1.1%	1.5%	1.5%	1.5%	1.5%	1.5%	1.8%	1.8%
	3.5	-2.2%	-2.2%	-2.2%	-2.2%	-2.2%	-2.2%	-2.2%	-1.4%	-1.4%	-1.6%	-1.3%	-1.3%	-1.3%	-1.3%	-1.3%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-2.0%	-2.0%
F2011	2.5	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	1.5%	1.5%	1.6%	1.4%	1.4%	1.4%	1.4%	1.4%	1.8%	1.8%	1.8%	1.8%	1.8%	2.1%	2.1%
	3.5	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-1.7%	-1.7%	-1.8%	-1.6%	-1.6%	-1.6%	-1.6%	-1.6%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.3%	-2.3%
F2012	2.5	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	1.6%	1.5%	1.7%	1.4%	1.4%	1.4%	1.4%	1.4%	1.9%	1.9%	1.9%	1.9%	1.9%	2.2%	2.2%
	3.5	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-1.7%	-1.7%	-1.9%	-1.7%	-1.6%	-1.6%	-1.6%	-1.6%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.4%	-2.4%
F2013	2.5	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	1.8%	1.8%	1.9%	1.7%	1.7%	1.7%	1.7%	1.7%	2.2%	2.2%	2.2%	2.2%	2.2%	2.5%	2.5%
	3.5	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.8%	-2.0%	-2.0%	-2.2%	-1.9%	-1.9%	-1.9%	-1.9%	-1.9%	-2.4%	-2.4%	-2.4%	-2.4%	-2.4%	-2.7%	-2.7%
F2014	2.5	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.0%	2.0%	2.1%	1.9%	1.8%	1.8%	1.8%	1.8%	2.3%	2.3%	2.3%	2.3%	2.3%	2.7%	2.6%
	3.5	-3.1%	-3.1%	-3.1%	-3.1%	-3.1%	-3.1%	-3.1%	-2.2%	-2.2%	-2.4%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.6%	-2.6%	-2.6%	-2.6%	-2.6%	-2.9%	-2.9%
F2015	2.5	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	2.8%	2.8%	2.9%	2.6%	2.6%	2.6%	2.6%	2.6%	3.2%	3.2%	3.2%	3.2%	3.2%	3.6%	3.6%
	3.5	-4.1%	-4.1%	-4.1%	-4.1%	-4.1%	-4.1%	-4.1%	-3.1%	-3.1%	-3.2%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-3.5%	-3.5%	-3.5%	-3.5%	-3.5%	-3.8%	-3.8%
F2016	2.5	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	2.8%	2.8%	3.0%	2.6%	2.6%	2.6%	2.6%	2.6%	3.2%	3.2%	3.2%	3.2%	3.2%	3.6%	3.6%
	3.5	-4.1%	-4.1%	-4.1%	-4.1%	-4.1%	-4.1%	-4.1%	-3.1%	-3.1%	-3.2%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-3.5%	-3.5%	-3.5%	-3.5%	-3.5%	-3.8%	-3.8%
F2017	2.5	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.0%	2.0%	2.1%	1.9%	1.8%	1.8%	1.8%	1.8%	2.3%	2.3%	2.3%	2.3%	2.3%	2.7%	2.6%
	3.5	-3.1%	-3.1%	-3.1%	-3.1%	-3.1%	-3.0%	-3.0%	-2.2%	-2.2%	-2.4%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.6%	-2.6%	-2.6%	-2.6%	-2.6%	-2.9%	-2.9%
F2018	2.5	2.6%	2.6%	2.6%	2.7%	2.6%	2.6%	2.6%	1.9%	1.9%	2.0%	1.7%	1.7%	1.7%	1.7%	1.7%	2.2%	2.2%	2.2%	2.2%	2.2%	2.5%	2.5%
	3.5	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	-2.1%	-2.1%	-2.2%	-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	-2.4%	-2.4%	-2.4%	-2.4%	-2.4%	-2.7%	-2.7%
F2019	2.5	4.5%	4.5%	4.5%	4.6%	4.6%	4.6%	4.6%	3.5%	3.5%	3.6%	3.3%	3.2%	3.2%	3.2%	3.2%	3.9%	3.9%	3.9%	3.9%	3.9%	4.4%	4.3%
	3.5	-4.9%	-4.9%	-4.9%	-4.9%	-4.9%	-4.9%	-4.9%	-3.8%	-3.7%	-3.9%	-3.6%	-3.6%	-3.6%	-3.6%	-3.6%	-4.2%	-4.2%	-4.2%	-4.2%	-4.2%	-4.7%	-4.7%

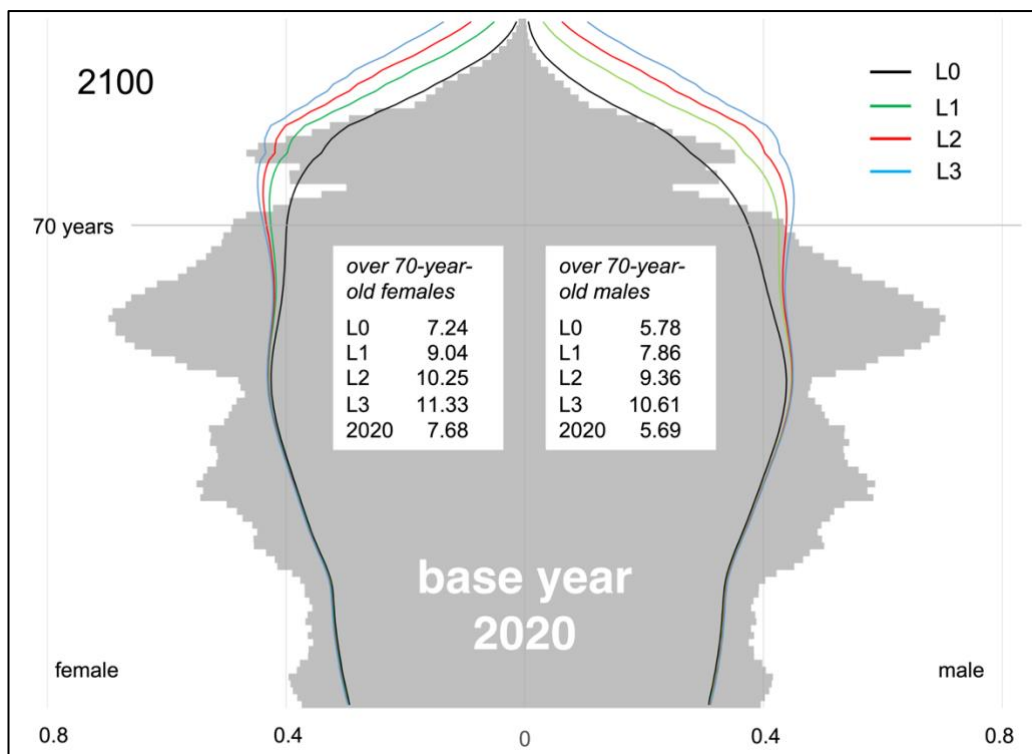
Source: Own calculations.

Appendix C.1: Population projections for 2060 using the different life expectancy assumptions (in million)



Source: Own calculations.

Appendix C.2: Population projections for 2100 using the different life expectancy assumptions (in million)



Source: Own calculations.

Appendix C.3: Comparison of the 13th and 14th coordinated population projection assumptions.

		13th coordinated population projections		14th coordinated population projection	
fertility G	G1	1.4		G1	1.43
	G2	rising to 1.6 until 2026, then constant		G2	1.55
				G3	1.73
life expectancy L	L1	84.8 (m) / 88.8 (f)		L1	82.5 (m) / 86.4 (f)
	L2	86.7 (m) / 90.4 (f)		L2	84.4 (m) / 88.1 (f)
				L3	86.2 (m) / 89.6 (f)
migration W	W1	Decrease from 500.000 in 2014, to 100.000 in 2021, then constant		W1	Reduction to 110.500 in 2030, then constant
	W2	Decrease from 500.000 in 2014, to 200.000 in 2021, then constant		W2	Reduction to 206.000 in 2026, then constant
				W3	Reduction to 300.000 in 2030, then constant

Source: Destatis (2015) and Destatis (2019a).