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Bellagos LTC Social Insurance System

2018 Student Research Case Study Challenge

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1 Executive summary

The citizens of Bellagos, a politically and economically stable government of a developed nation, rely on the Social LTC Insurance Program introduced on March 1998. Given a shift in the demographics and a rise in the expenses, the sustainability of the LTC insurance program in the upcoming years is under pressure. This report first proposes a demographic and economic prospective projection model to estimate future contributions. Secondly, we applied a discrete Markov chain model to calculate the LTC expenses. Based on our results, we observed the system to be in deficit in the next decade. We propose a set of recommendations to ensure the program sustainability meets citizensf́uture needs. To conclude possible trade-offs and data limitations are discussed.

2 Analysis methodology

2.1 Mortality and population projection

We projected Bellagos' population for the next decade, considering fertility, mortality and migration patterns as described in the general approach on United Nations (2017). The current Bellagos' population pyramid was built based on the representative households sample from 2017 census (see Figure 1). We assume the fertility rate to remain constant at 1.51 births per woman (average over the 2013–2017 period) and a fertile women's age range from 15 to 49 years old. The historical rates of mortality by age and gender from 2005, 2010 and 2015 were projected using the Lee Carter method (Carter and Lee, 1992), where the time varying index (k_t) was projected throughout a linear pattern extrapolating

the values of k_{2005} and k_{2015} given that only three years information was available. We assume zero-migration in the population projection given that no additional information is available. The results for male and female log force of mortality are presented in Figure 2.

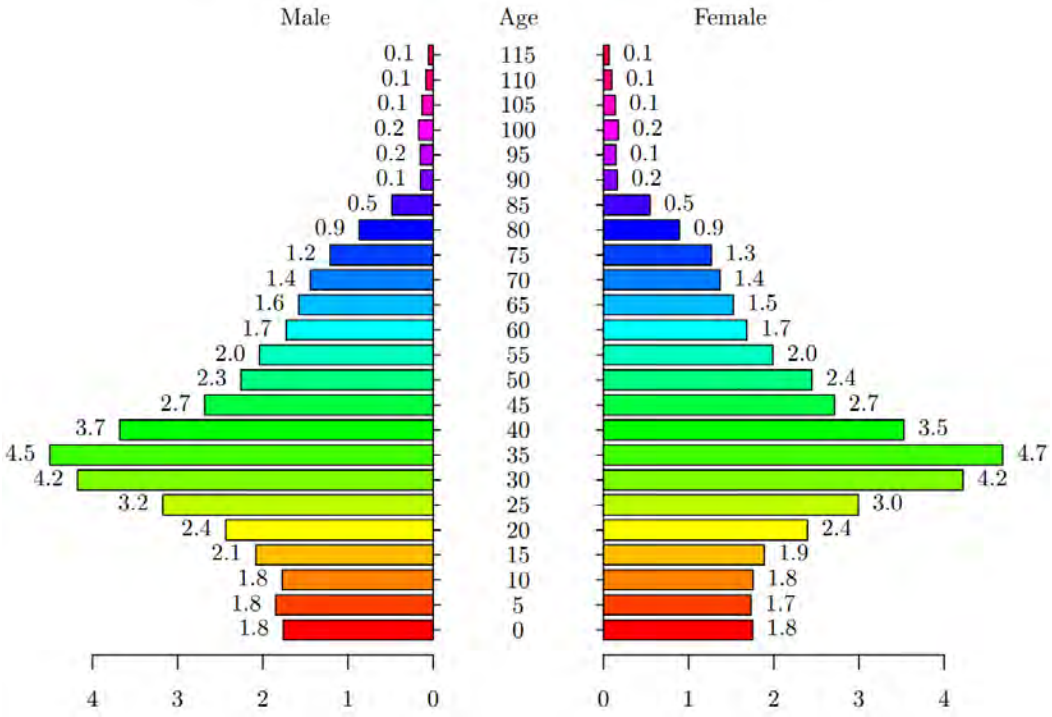
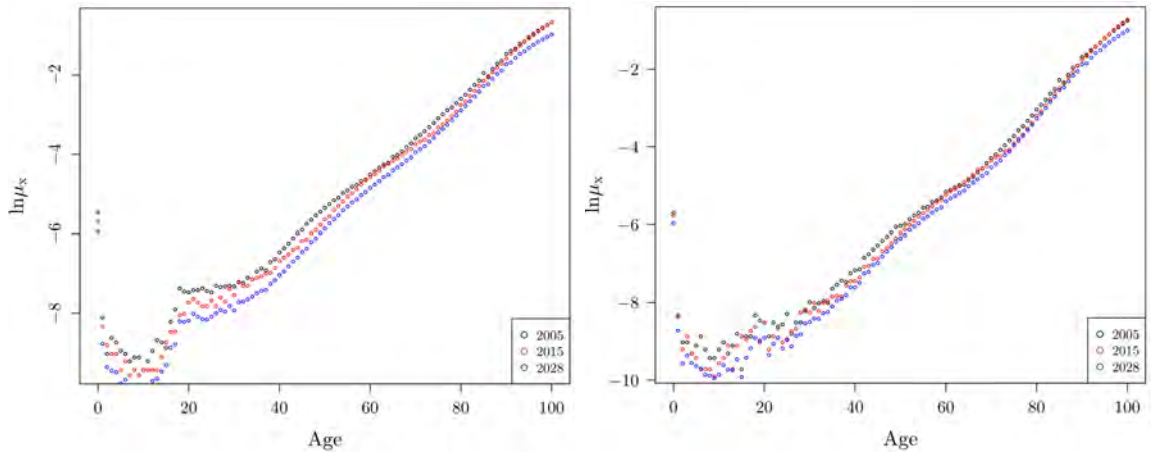


Figure 1: Demographic pyramid by age and gender for the year 2017 (in millions).

2.2 Program funding

The Bellagos LTC Insurance Program is funded using a tax-based contribution system reliant on state-levied taxes. Therefore, given the two government-mandated tax-based contributions, the total amount of funds available to cover LTC and program administration costs for each projected year is given by

$$TF_t = 0.90\% \cdot TIH_t + 1.05\% \cdot TIC_t,$$



(a) Male (b) Female

Figure 2: Logarithm of force of mortality by age and gender in 2005, 2015 and 2028.

where TF_t is the total funds, TIH_t the total households with child taxable income and TIC_t is the total childless households taxable income at the end of each projected year t.

In order to estimate the total income for both household segments (i.e., with children and without children), the contributors participation force was estimated by age and gender as the ratio between the healthy population with positive earnings and the total population. Due to data limitations, we assumed that this proportion remains constant trough the projected years.

To forecast the total amount of contributions, we assumed the household salary per age and gender to be equal to the average on the corresponding age-gender group. Furthermore, we also assumed that whenever the age is greater than 64, the average income is equal to the pension. This is an important remark, as the average income at any projected year is given by the future value of the average salary. We use as compounding factor, the estimated real wage growth rate for the active workers and the estimated inflation rate for retirees. Given the unfavorable trend in both real wage growth and inflation in

Bellagos we assumed that both rates will remain at the 2017 level. Consequently, the total taxable income by age and gender at every future period can be expressed as the product of the projected population (see Section 2.1), the average income of the population segment and the contributors participation force.

Households without dependents currently living in the household aged 18 or younger have to pay an additional childless employee income tax of 0.15%. Therefore, it is fundamental to estimate the childless population proportion, that we assume to be the ratio of the childless members relative to the total population. Thus, the total available funds from childless members, can be estimated as the product of the additional income tax, the total taxable income and the childless household proportion. As a consequence, the remaining funds will be subject to a standard income tax of 0.90%. Refer to Appendix A for detailed formulae and Table 4 in Appendix C for the numerical values of the parameters.

2.3 Program expenses

The estimation of the expenses relies first on forecasting the number of dependent elderly in need of LTC and second on the consideration of the related LTC expenses. To obtain the future number of dependent by year, we use a discrete Markov chain model as recommended in such cases (Haberman and Pitacco, 1999; Pitacco, 2014). We differentiated six-states, namely, healthy state (0), four care levels (1 to 4) and death state (5). Figure 3 illustrates the defined Markov chain.[1] The projected number of elderly in need of LTC per type of care and care level is presented in Table 1.

[1]Only the transitions with a probability larger than zero are represented. For readability, the transitions from the care level 1 to the care level 3 and from the care level 2 to the care level 4 are illustrated by dashed arrows.

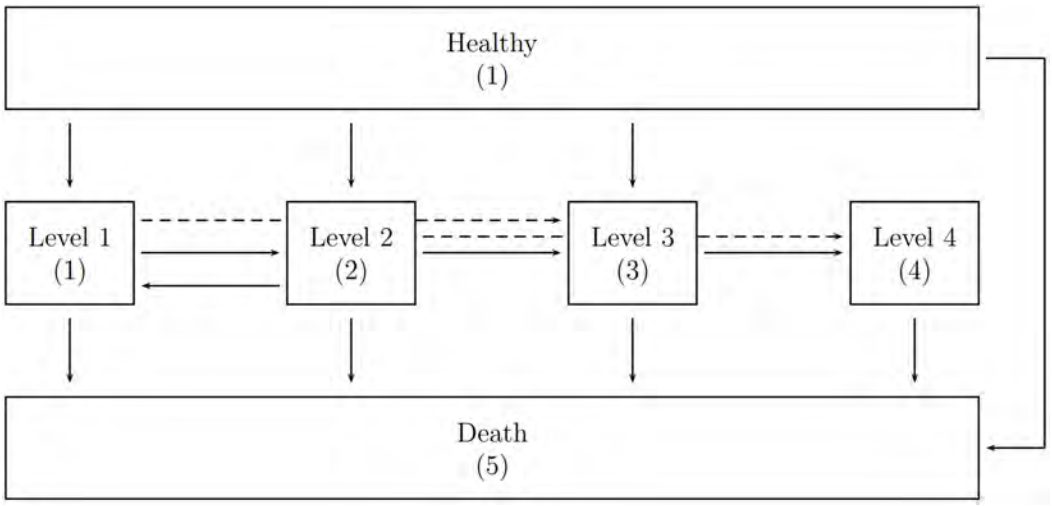


Figure 3: Illustration of the six-states Markov model.

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Care at home											
Care Level 1	1.07	1.20	1.26	1.29	1.30	1.30	1.28	1.26	1.25	1.24	1.24
Care Level 2	0.77	1.01	1.20	1.36	1.48	1.57	1.63	1.68	1.72	1.74	1.77
Care Level 3	0.29	0.38	0.44	0.49	0.53	0.55	0.57	0.59	0.60	0.60	0.61
Care Level 4	0.09	0.09	0.10	0.10	0.11	0.13	0.14	0.15	0.15	0.16	0.17
Care in an institution											
Care Level 1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Care Level 2	0.03	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06
Care Level 3	0.12	0.16	0.19	0.21	0.22	0.23	0.24	0.25	0.25	0.25	0.26
Care Level 4	0.65	0.67	0.72	0.79	0.87	0.95	1.03	1.11	1.18	1.24	1.30

Table 1: Projected number of elderly in need of LTC by type of care and care level (horizon 2028).

Based on the households representative dataset, we estimated the types of care ratio conditional on the care level, i.e., we calculated the ratio of people being cared for at home and the ones being cared for in an institution knowing their care level. Furthermore, we computed the eligibility ratio by dividing the number of elderly greater than 64 with at least two years of contribution over the total number of people aged 65 and older. The total annual government expenditures on care payments are obtained by multiplying the number of people at each type of care and care level combination with the historical 2017 average payout. Finally, we apply an administrative expense loading to the annual gov-

ernment expenditures. These numbers are assumed to remain constant through the next decade. Complete formula of the expense calculation is presented in Appendix B. The numerical values of the parameters used for the baseline scenario are laid out in Table 4 in Appendix C.

Among the numerous data limitations we faced in modeling the expenses, the most important one relates to LTC mortality, which is assumed to be three times the population mortality. This assumption leads to a maximal survival age in LTC of 101 years for male and 102 for females. Such assumption is not realistic, since the household representative dataset contains a non–negligible number of elderly older than these ages. Additionally, the transition matrix through care level should vary by age and gender.

3 Sustainability assessment

A LTC social system must both be financially sustainable and ensure the coverage of the dependency risk of the elderly population. Therefore, we assessed the sustainability of the Bellagos system by considering the balance, defined as the difference between contributions and expenses of a given year. A positive balance reveals a financially sustainable situation while a negative one highlights the opposite.

Throughout our analysis, we identified three characteristics of the current system to maintain. Firstly, the fact that the system is tax-based (similar to the one in place in Germany, see Swiss Re, 2014) allows to share the financing through three stakeholders: government, workers and private sector. In fact, we outlined the involvement of the private sector in the financing of the social system which is not common in other systems in

place in OECD countries (Colombo et al., 2011). Tax-based systems are also independent of interest rate changes which is an important risk in capital based systems. Secondly, we propose to maintain the incentives provided for informal care. While we can hardly measure the effect of the current informal care incentives provided, we think that, on a short- to medium-term horizon, such policy can both provide a solution to overcome the shortage of caregivers and address the willingness of elderly for staying longer at home. Finally, setting higher contributions for childless workers must be preserved since younger generation will pay for future contribution and can potentially be informal care providers.

However, the current system is threaten by important financial, demographic, economic and caregiver shortages risks. In Figure 4, we illustrate the evolution of the contributions, the expenses and the balance per year until 2028. Our forecast estimates that the financial balance of Bellagos' LTC system will become negative within the next five years. Notice that there is a remarkable increase in the deficit since our model predicts that the system expenses will growth at a faster rate than contributions motivated by the mortality improvement and the transition to higher care levels (see Table 1). Furthermore, it is important to notice that an important improvement in the LTC mortality or a weaker economic outlook can worsen the predicted figures.

From our best estimates, we stress-tested the predictions considering two scenarios. First, we assumed the mortality of LTC to be only twice the population mortality instead of three times (Figure 5a). Second, we use a real wage growth rate obtained from a linear regression applied to the available data which reached negative values down to -1.48% (Figure 5b). The latter scenario was observed in countries like Switzerland and Norway

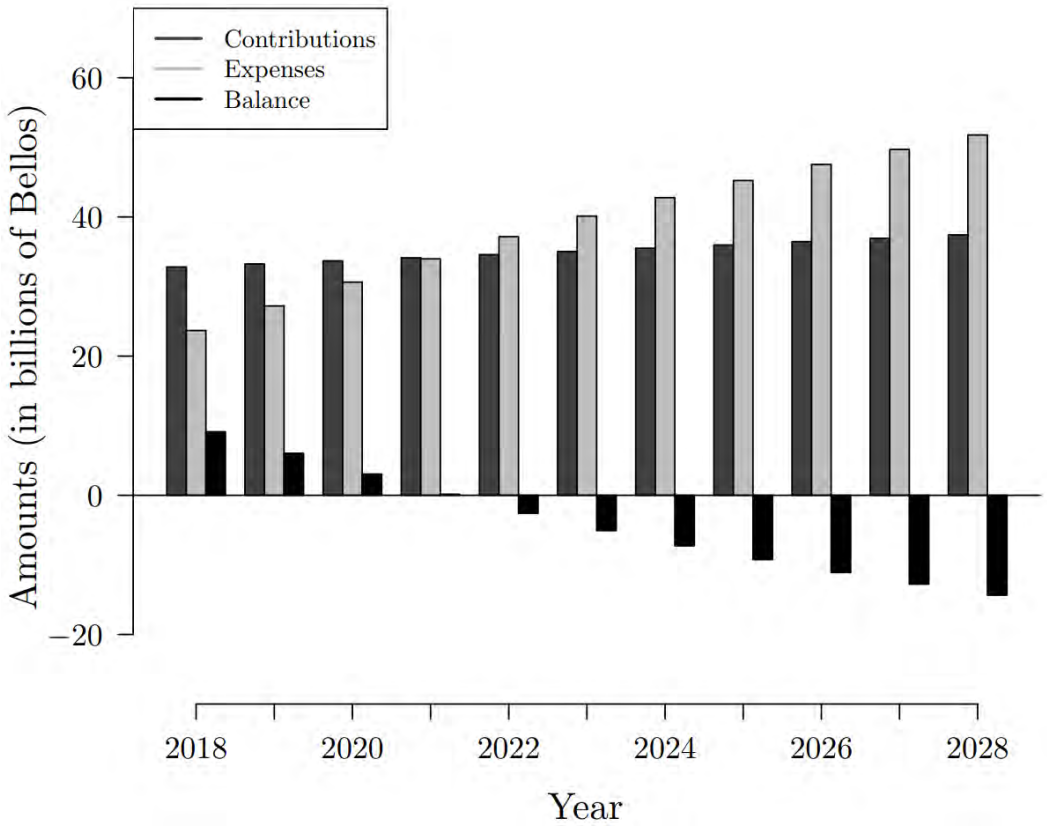
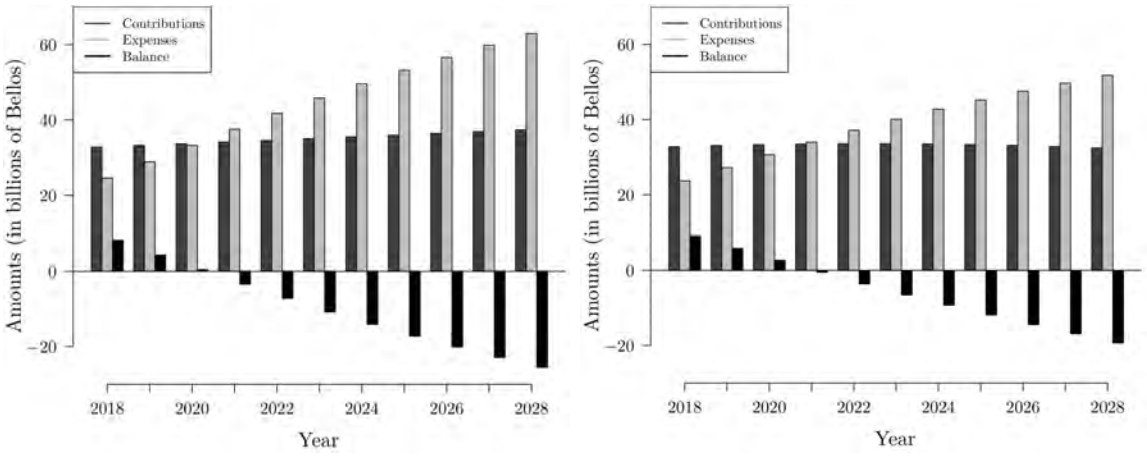


Figure 4: Best estimates of contributions, expenses and balance by year until 2028.

in 2016 .[2]



(a) Mortality (b) Real wage

Figure 5: Stress-test scenarios of contributions, expenses and balance by year until 2028.

[2] `http://stats.ocd.org`

4 Recommendations

The main objectives of the government are to ensure the financial sustainability of the system, to maintain the current coverage of the population and to overcome the shortage in caregivers and infrastructure (Rockinger and Wagner, 2016). Four actions are proposed in order to make the system financially sustainable without affecting the coverage level (i.e., the eligibility criteria and the amounts benefits).

Our main recommendation is to foster the recently implemented informal caregiver allowance program. An increase in the coverage provided by the informal care can be reached by providing incentives in the purchase of care related products and technologies, which can encourage care given by non-professionals. We evaluate the effect of such policy, considering a participation in the informal caregiver program of 25% for care levels 1 and 2 and 15% for care levels 3 and 4.

Another action is to modify the standard income and additional childless employee tax. While we are aware that the citizens with fewer income perceive that contributions are too high, the statistics reveal that the disposable income (after covering basic living expenses) is enough to cover additional contributions. Therefore, we assess to increase the standard and the childless income tax to 1.10% and 0.25%, respectively. An alternative plan could be a progressive income tax, i.e., an increasing contribution rate with respect to salary.

The last proposal is to reduce administrative expense costs by paying directly care facility providers and not using two different payment processes (in-network/out-of-network).

We consider the administrative expense rate to decrease from 12.5% to 11%.

Finally, we also encourage the development of private insurance for facing the future LTC expenses (Brown and Finkelstein, 2009; Swiss Re, 2014). In particular, we believe that the government could undertake a tax deduction politic for private LTC premiums. We cannot provide empirical evidence on this, but it is clearly a current topic of debate in different developed countries (Costa-Font et al., 2015).

Alternative actions were evaluated as described on Table 2. We present the resulting balance of the LTC system when taking these actions in Table 3.

	Description of the action
Action 1	Increase of participation in the informal caregiver program of 25% for care levels 1 and 2 and 15% for care levels 3 and 4
Action 2	Increase of the standard income tax from 0.90% to 1.10%
Action 3	Increase of the additional childless employee income tax from 0.15% to 0.25%
Action 4	Reduce administrative expenses from 12.5% to 11.0%
Action 5	Increase of proportion of people treated at home from 70% to 75% and 11% to 15% for care level 3 and 4, respectively
Action 6	Increase eligibility age from 65 to 66
All changes	Apply actions 1 to 6
Recommendation	Apply actions 1 to 4

Table 2: Different considered actions to ensure sustainability of the LTC system.

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Base	9.13	6.04	3.05	0.14	-2.59	-5.08	-7.27	-9.26	-11.10	-12.77	-14.36
Action 1	11.46	8.69	6.05	3.51	1.14	-1.02	-2.89	-4.58	-6.14	-7.55	-8.90
Action 2	15.64	12.64	9.74	6.92	4.28	1.87	-0.22	-2.11	-3.86	-5.43	-6.93
Action 3	11.46	8.40	5.44	2.57	-0.13	-2.60	-4.75	-6.70	-8.51	-10.15	-11.70
Action 4	9.44	6.40	3.46	0.59	-2.09	-4.55	-6.70	-8.65	-10.46	-12.10	-13.67
Action 5	9.50	6.48	3.55	0.70	-1.97	-4.42	-6.56	-8.51	-10.31	-11.94	-13.50
Action 6	11.57	9.18	6.88	4.76	2.94	1.26	-0.23	-1.51	-2.53	-3.40	-4.23
All changes	21.94	19.71	17.54	15.62	13.82	12.21	10.80	9.64	8.65	7.74	6.95
Recommendation	20.59	17.98	15.50	13.12	10.90	8.91	7.19	5.66	4.25	2.99	1.80

Table 3: Balance for different considered actions (billions of bellos).

5 Trade-offs

To foster informal care could have downsides on the patient's health. Indeed, the quality of care provided by relatives could not meet minimum required standards, which are guaranteed by professional staff. The consequences could be higher costs due to a certain number of people ending up in higher care levels.

To increase tax contribution rates can lead to financial pressure on the balance sheet of certain companies that may consider to relocate in countries with lower social contributions. Such decision would lead to an increase on unemployment rate having important consequences on the financial sustainability of the system.

The proposed solutions are planned to be execute in a twelve–month timeframe to keep the system sustainable in the next decade. However, on a larger horizon, more profound changes to the system have to be evaluated.

6 Conclusion

While the Social LTC Insurance Act was a certainly required step to tackle the imminent long-term care financial risk, the projected balance, based on the best estimates, shows that the *status quo* of system is not sustainable and will be insolvent after five years.

Thereafter, we recommend to take four actions within the twelve–month timeframe to allow the LTC Insurance program to run smoothly within the upcoming years. An increase in the standard and additional childless employee income tax. Encourage the informal

caregiver allowance program among all care levels. Reduction of administrative expenses by unifying facility providers payment processes. Even though in the German case this goal was deemed short–sighted (Costa-Font and Courbage, 2012) we strongly believe that a small reduction generates significant additional funds.

The execution of these measures afford the financial sustainability of the system without cutting LTC benefits or strengthening eligibility requirements. If something we cannot forget is that the main objective of the social protection is to provide direct or indirect income or income replacement to individuals in need.

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A Appendix

Total amount of funds available:

$$TF_t = 0.90\% \cdot TIH_t + 1.05\% \cdot TIC_t, \tag{1}$$

for $t = 2017, \ldots, 2028$, where

TF_t = total funds in year t,

TIH_t = total households with child taxable income in year t,

TIC_t = total childless households taxable income in year t.

Contributors participation force:

$$CPF_{x,g} = \frac{HPE_{2017,x,g}}{TP_{2017,x,g}}, \tag{2}$$

defining

$CPF_{x,g}$ = contributors participation force of gender s and age x,

$HPE_{2017,x,g}$ = healthy population with positive earnings of gender s and age x in year 2017,

$TP_{2017,x,g}$ = total population of gender s and age x in year 2017,

Average salary per household:

$$AI_{x,g} = \frac{1}{TP_{2017,x,g}} \sum_{i=1}^{TP_{2017,x,g}} IHP_{2017,x,g}^{i\text{-th}},$$

where

$AI_{x,g}$ = average annual income of gender s and age x,

$IHP^{i\text{-th}}_{2017,x,g}$ = taxable income of the i-th healthy household with positive earnings of gender s and age x in year 2017,

$TP_{2017,x,g}$ = total population of gender s and age x in year 2017.

Average income at year t:

$$AI_{t,x,g} = \begin{cases} AI_{x,g} \cdot (1+r)^t & \text{for } x < 65 \\ AI_{x,g} \cdot (1+i)^t & \text{for } x \geq 65, \end{cases} \tag{3}$$

$AI_{x,g}$ = average annual income of gender s and age x,

r = annual real wage increase,

i = inflation rate.

Total taxable income at year t:

$$TI_{t,x,g} = TP_{t,x,g} \cdot CPF_{x,g} \cdot AI_{t,x,g},$$

$TP_{t,x,g}$ = total population of gender s and age x in year t,

defining and other elements as per Equations (2) and (3) respectively.

Childless population proportion:

$$CP_{x,g} = \frac{HC_{2017,x,g}}{TP_{2017,x,g}}, \tag{4}$$

interpreting

$CP_{x,g}$ = childless population proportion of gender s and age x,

$HC_{2017,x,g}$ =households without dependents currently living in the household aged 18 or younger of gender s and age x in year 2017,

$TP_{2017,x,g}$ = total population of gender s and age x in year 2017,

Accordingly,

$$\begin{aligned} TIC_t &= CP_{x,g} \cdot TI_{t,x,g} \\ TIH_t &= TI_{t,x,g} - TIC_t. \end{aligned} \tag{5}$$

Thus, the total funds can be estimated as per Equation (1).

B Appendix

The equation used for modeling the expenses is as follows:

$$E_{jt} = \sum_j \sum_t (NH_{j,t} \cdot HC_j \cdot e \cdot (1+i)^t \cdot AH_j + NI_{i,t}(1 - HC_j) \cdot e \cdot (1+i)^t \cdot AI_j \tag{6}$$

where E is the total expense of the model, L is the number of care levels and $Proj$ is the number of projection years. Furthermore, $NH_{i,t}$ represents the number of dependent elderly cared for at home and $NI_{i,t}$ number of dependent elderly cared for in an institution by care level $j \in \{1, \ldots, 4\}$ through each projection $t \in \{1, \ldots, 11\}$. HC_j is the share of elderly cared at home by care level j, e represents the eligibility share and i is the mean inflation rate. Finally, AH_j and AI_j are the amounts of the allowances for elderly cared for at home and the ones cared for in an institution by care level j, respectively.

C Appendix

Parameter	Value
i	1.02%
r	1.36%
e	83.9%
HC_1	0.99
HC_2	0.97
HC_3	0.70
HC_4	0.12
AH_1	2662.44
AH_2	4963.44
AH_3	7292.52
AH_4	10 829.52
AI_1	12 073.80
AI_2	14 422.92
AI_3	16 784.64
AI_4	19 519.56
Birth rate	1.37
Fertility range	15-49
Standard inc. tax	0.90%
Additional childless inc. tax	0.15%

Table 4: Values for the different parameters on the best estimate scenario.