April/2018
Long Term Care Report

A nation's greatness is measured by how it treats its weakest members.

- Mahatma Gandhi -

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1 Executive summary

The demographic distribution of the Bellagos' nation poses a substantial risk to the sustainability of the LTC insurance programme. In particular the low fertility rates combined with a decreasing mortality trend and an ageing population give rise to the following discrepancy:

1. the number of LTC beneficiaries is increasing; resulting in an increase of care expenditures,

2. the workforce is decreasing; resulting in lower contributions,

3. the population is ageing; resulting in shortage of caregivers.

This combination implies that the LTC programme will face a deficit in 2020. Our recommendations to make the LTC system sustainable in the long term are an interplay of migration policies, tax adjustments, implementation of educational programmes, investment in research in artificial intelligence technologies for the care sector and campaigning to raise awareness in the general public.

2 Sustainability assessment

2.1 Bellagos' trends in demographics and health

Figure 1 displays the age distribution of the Bellagos' population in 2017. Noticeable is that a total of 32% of the population is aged between 30 – 45 years. The pyramid shape of Figure 1, typical for developed countries, results in multiple risks relating to long term care. In 25 – 30 years this substantial group who currently contribute to the LTC programme will be retirees, hence eligible for government LTC care and contributing to the LTC scheme at a lower rate due to their pension earnings. This, combined with a decrease in Bellagos' fertility and mortality rates yields a jeopardizing situation with an increasing number of LTC beneficiaries and decreasing workforce.
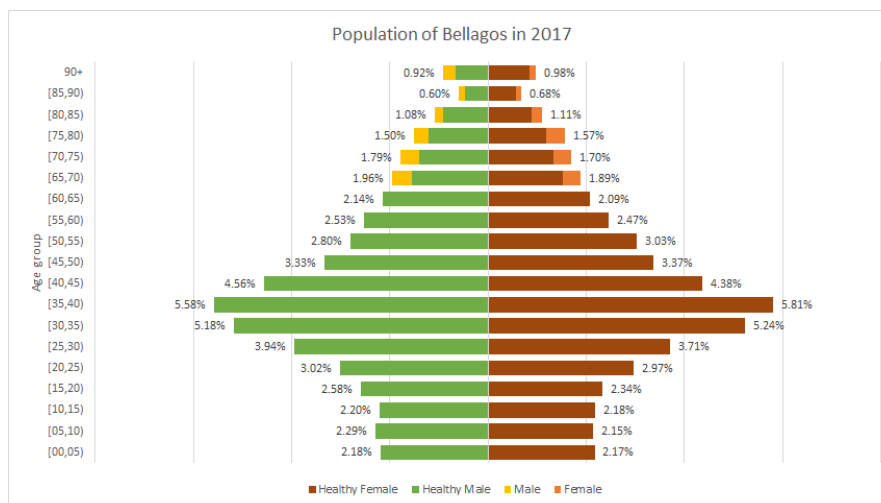

Figure 1: Demographic pyramid of the Bellagos' population in 2017 including the proportion of male respectively female in good health.

To assess this risk, we project the population of Bellagos for a timespan of 30
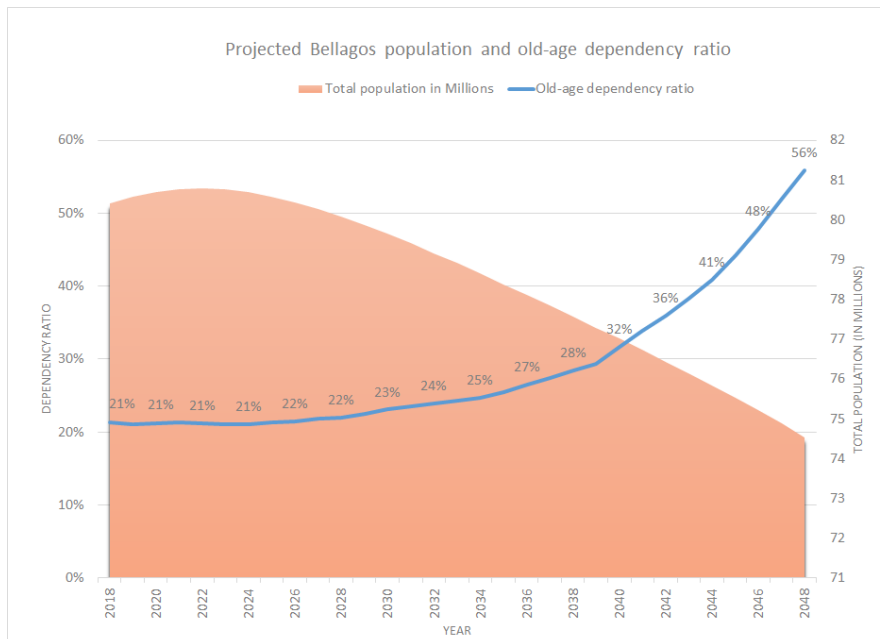
Figure 2: Projected old-age-dependency ratio (blue line) and total population of Bellagos in millions (pink area).

years. Even though the long term projection involves uncertainties, the trends are clearly outlined in Figure 2. While the percentage of people aged 65 and over to the population stays roughly at 15% for the next 10 years it increases to 20% in 2038 and further to 32% in 2048. We estimate that *life expectancy at birth* will increase from 78 in 2015 to 81 in 2028, and from 83 in 2015 to 85 in 2028, for males and females respectively. This combined effect of the ageing population with dropping mortality and fertility rates below the population preservation rate is displayed in Figure 2 through the steeply ascending *old-age-dependency ratio* (the percentage of people aged 65 and over relative to the population of the working-age group, 15 – 64 year). An old-age-dependency ratio of 21% corresponds to 4.8 working people supporting one retiree. Thus, an increase of the old-age-dependency ratio
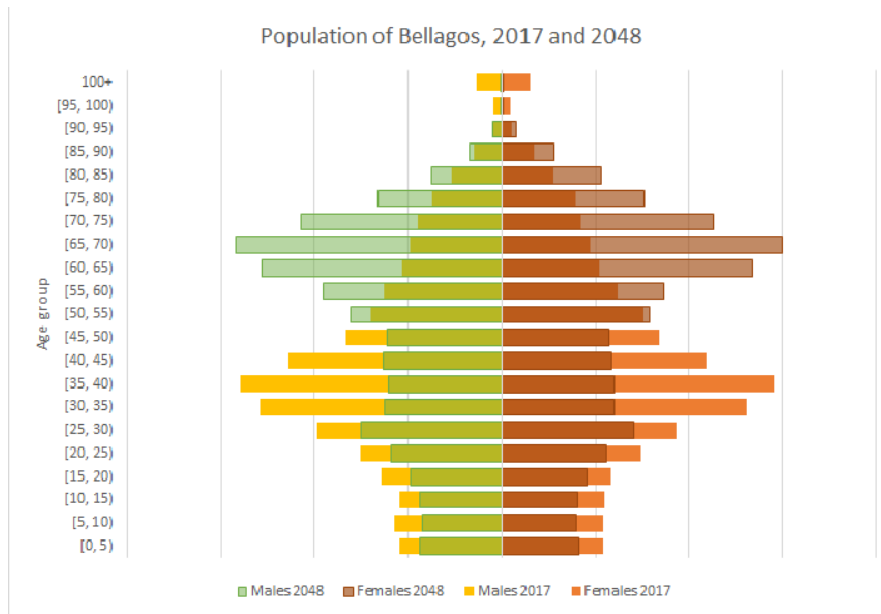
Figure 3: Comparison of Bellagos' population in 2017 and the projected population in 2048 in percentages.

to 28% implies that only 3.6 working people support one retiree in 2038. This is not a desirable trend for a LTC programme based on intergenerational funding.

Figure 3 displays in detail the change in population of Bellagos from 2017 to 2048. Particularly, the (projected) population in 2048 (light coloured pyramid) has proportionately more people eligible for the government LTC programme while the workforce is substantially reduced.

2.2 LTC care payments and contribution

According to our assessment, the total government LTC expenditures on care payments (including administration costs) will surpass the contribution in 2020, both reaching 38 billions, see Figure 4. This is in line with historical data which shows an increase of annual care costs from 8% to 23% through the years 2013 –

2017.
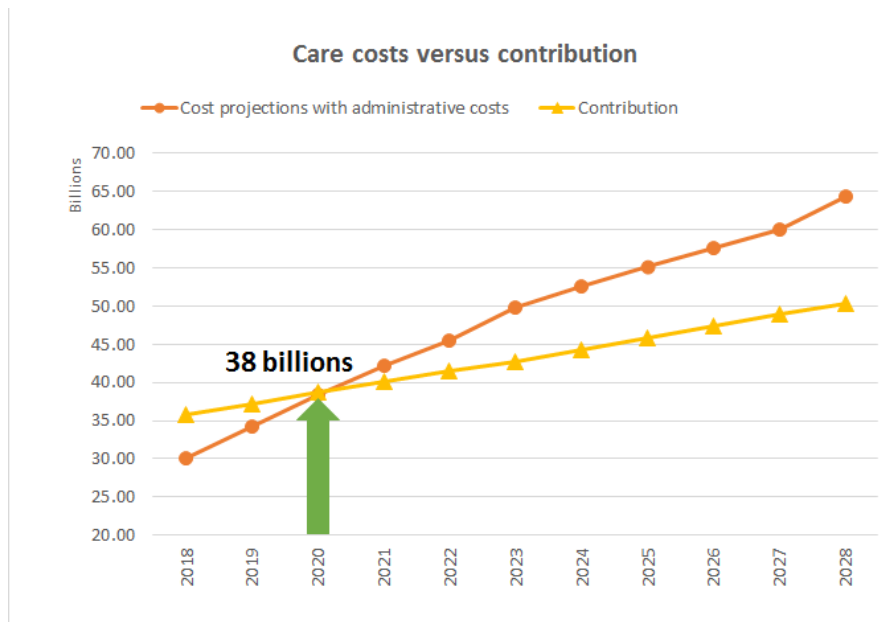
Figure 4: Total LTC care payments including government administrative expenses versus contribution to the LTC programme over the next 10 years.

2.3   Supply of caregivers

If the current trends continue to be observed in the future, we forecast that there will be a substantial shortage of informal and professional caregivers over the next decade. According to our projections, the total number of informal caregivers will slightly increase to 7 Million. However, it will not increase as fast as the old-age-dependency ratio, which results in a shortage of informal caregivers. Specifically, the number of informal caregivers per home care beneficiary will decrease from 3.9 in 2017 to 1.3 in 2028. Moreover, we estimate that the number of professional caregivers per 100,000 beneficiaries will decrease from 35.1 to 14.4 in the next decade.

3 Recommendations

The government LTC insurance system is a service from the government of Bellagos to protect its most vulnerable part of the population. Therefore our recommendations are based on the philosophy to not diminish any aids or benefits. We refrained from cutting care payouts - we suggest to adjust them with inflation - nor do we impose new eligibility criteria for the government LTC scheme such as, for instance, increasing minimum contribution years or retirement age.

3.1 Sustainability of the LTC programme

Our definition of sustainability of the LTC insurance programme is that, in 2028, the contributions to the LTC programme are at least equal to the sum of all LTC care expenditures, including administrative costs and a *risk margin*. We advise that the government should include a risk margin of 6% EIOPA (2009) of the total LTC care payments in 2028 (3.86 billions) to account for model uncertainty and unforeseeable risks.

3.2 Migration

Without any available data, we adopt the prudent view of zero net migration for our baseline model. However low net migration is not a far-fetched assumption. Japan for example had a net migration of 0.56 migrants per thousand population in 2015[1]. Incorporating (working) migration will result in a reduction of the old-age-dependency ratio thus alleviate the overall risk of the LTC system. Table 1

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[1] https://knoema.com/atlas/Japan/topics/Demographics/Population/netmigration-rate

Bellagos Actuarial Solutions

Table 1: Adjusted of income tax rates and childless contribution to obtain sustainability in 2028. Our proposed tax adjustment is marked in bold.

Net migration	Income tax		Childless tax
migrants per 1000 of population	< **B**75,000	≥ **B**75,000	
0	1.12 %	1.35 %	0.19 %
5	**1.07 %**	**1.28 %**	**0.18 %**
10	1.02 %	1.22 %	0.17 %
15	0.97 %	1.17 %	0.16 %
20	0.93 %	1.11 %	0.15 %
25	0.90 %	1.07 %	0.15 %
32	0.90 %	0.90 %	0.15 %

unrealistic (rows 15–32)

shows how our proposed adjustments of income tax depend on the net migration levels of Bellagos. The calculations of the tax rates are discussed in Section 3.3. The scenarios with net migrations above 15 migrants per 1000 of population which are highly unrealistic (termed unrealistic in Table 1) are only shown to provide the Bellagos' government with a justification of the increase in taxes. Specifically, the rapid increase of net migration to an extreme level of 32 per 1000 in which case the taxes can stay unchanged, would be a problematic demographic development for Bellagos. We believe that the government can adopt one of the scenarios up to the dotted line in the table depending on the political and economic situation in the country and adjust taxes depending on its net migration policy. It can be achieved by introducing skilled workers' migration program.

To keep the tax adjustment low and to reduce Bellagos' adverse demographic distribution

we recommend that the government incentivise an increases in

migration to 5 per 1000 over the next 12 months.

3.3 Tax rates adjustments

We aim to adjust income taxes as fair as possible and in a completely transparent way to ensure support and acceptance throughout Bellagos' population. An increase in LTC taxation is a necessity since the intergenerational support is the foundation pillar of the insurance programme. In order to minimize potential complaints from population, we based our suggestions on the statistics of the public opinion regarding the LTC programme.

According to the survey, a small proportion of Bellagos' citizens with earnings of **B**75,000 or above believe that their LTC insurance contribution is too high. Thus for people earning **B**75,000 or more, we increase the income tax 20% more than for people earning less than **B**75,000. The ratio of additional childless employee income tax to the new taxation rate of people earning less than **B**75,000 is modelled as constant. The choice that the additional childless tax rate is independent of people's earning is to incentivise childbirths - a long term view to rectify Bellagos' demographic distribution. Our tax adjustments are a trade-off between the net migration level, fairness among the working population and cutting of benefits.

We recommend that the government makes the following changes

from 01. January 2019:

1. *increase migration level to* **5**,

2. *increase tax for incomes less than* **B***75,000 to* **1.07%**,

3. *increase tax for incomes above or equal to* **B***75,000 to* **1.28%**,

4. *the costs for income tax is borne 45% by the employee and 55% by the employer,*

5. *increase additional childless employee income tax to* **0.18%**

To reduce the burden of the tax increase we suggest that the costs for income tax is split not equally but is borne 55% by the employer. Table 2 provides an example of the effective change for the suggested tax adjustments to the LTC programme for citizens earning **B**45,000 respective **B**100,000.

Table 2: Effective change in tax contributions to the government LTC programme for citizens with earnings of **B**45,000 respective **B**100,000.

		2017	After adjustment	% increase
B45,000	Income tax	**B**203	**B**217	7%
	add. childless tax	**B**68	**B**81	20%
B100,000	Income tax	**B**450	**B**576	28%
	add. childless tax	**B**150	**B**180	20%

% of informal care givers to meet the target of 3.9 informal care givers per home care beneficiary
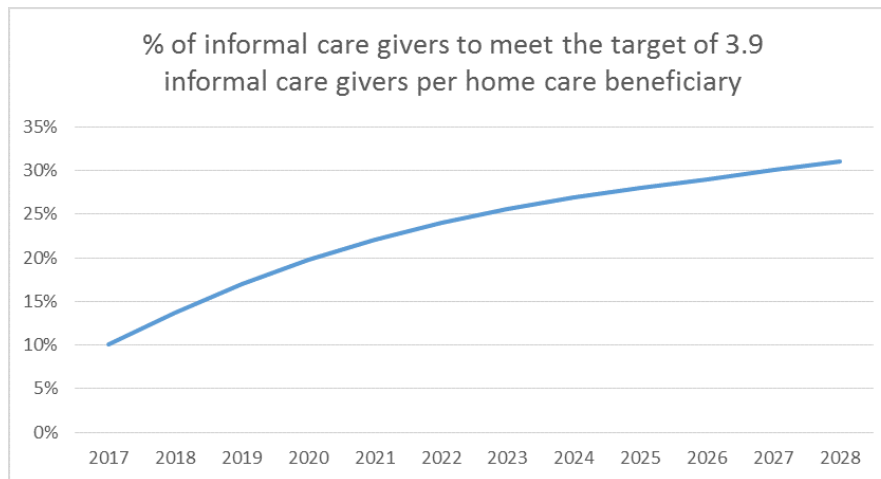
Figure 5: Target percentage of the adult population providing informal care such that the number of informal caregivers per home care beneficiary stays constant.

3.4   Shortage of caregivers

As exemplified in Section 2.3, there is a shortage in informal and professional caregivers. Figure 5 shows that to mitigate the shortage of informal caregivers, the percentage of adults providing informal care has to rise to 31% by 2028. We believe with adequate education programmes and rising awareness this target should be achievable. Especially, in the long term the number of retirees will increase and older people are more likely to provide informal care to their spouses or family.

We recommend that the government incentivise increase in informal caregivers though information campaigns and subsidised education programmes to guarantee quality.

To alleviate the shortage of professional workers in the care sector, the Bellagos' government should facilitate immigration of professional caregivers. However, as displayed in Figure 6, the shortage of professional caregiver is quite substantial,

192 in 2018 increasing to 1304 in 2028. We believe that the government should add formal caregiver profession in the shortage list for its skilled workers' migration program recommended above. Successful solutions to mitigate this deficit, together with creating more apprenticeship training position, is to create an educational exchange programmes with developing countries. An example is the "Triple Win" migration programme in Germany (Schulz, 2010) which alleviates the shortage of caregivers through foreign skilled workers. The sending country with high unemployment rate in the health sector, benefits from well-qualified workers returning home and enabling young professionals a job opportunity abroad. We suggest that the funding for such an educational programme to be provided through the surplus of the LTC programme. According to our calculations, the Bellagos' government will put aside 50% of the surplus as a reserve for care payment in future years. The other 50% of the surplus should be invested in campaigning to raise public awareness, to promote more informal caregivers and set up an educational exchange programme to mitigate the shortage of professional caregivers. Thus,

we recommend that the government develops an educational exchange programme over the next 12 months to mitigate the shortage of professional caregivers. Moreover, we recommend to add caregiver profession in the shortage list for its skilled workers' migration program recommended above.

3.5   Artificial intelligence and assistive technology

Limitations caused by the lack of human caregivers can be addressed by inclusion of assistive technology. According to Anderson and Wiener (2015) assistive
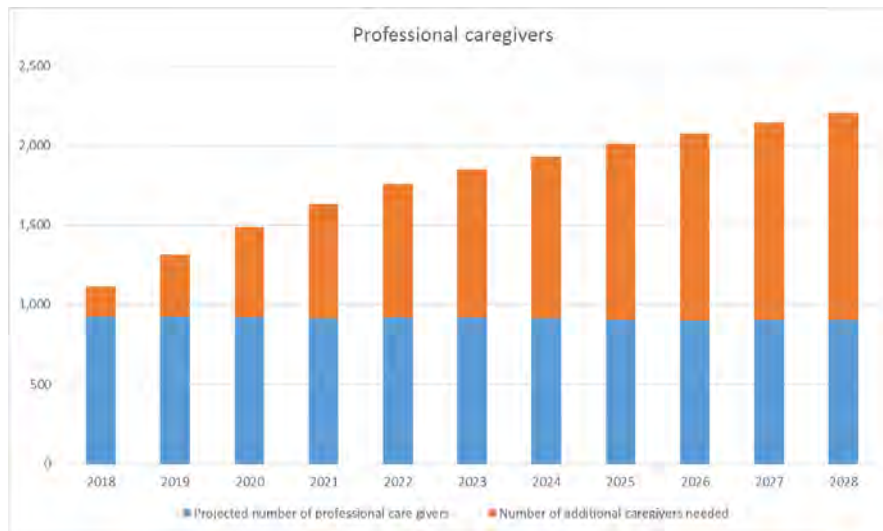
Figure 6: Shortage of professional caregivers over the next decade.

technology for indoor/outdoor mobility, bed transfer, and bathing was found to be total substitutes for human caregivers, whereas assistive technology for bed transfer and toileting was found to be complements for human caregivers' assistance. We believe that the rapidly developing artificial intelligence and robotics technologies have great potential and will play an important role in reducing care hours significantly, also responding to the needs of modern families and reshaping traditional models of care.

We recommend the government of Bellagos to invest some of the current and future surplus in research in robotics in the care sector to reduce care costs and abate the shortage of caregivers.

4 Long term sustainability of the LTC programme

Figure 7 displays the LTC care payout including the administrative costs of the Bellagos' government and the contribution including a reserve of 50% of the surplus of the preceding year. We defined the sustainability of the LTC programme such that the contribution is at least the sum of the total care costs, the administration costs and the risk margin of 6% of the total care costs. Thus adopting our recommendations, by 2028 the contributions will par the care costs (not including the risk margin). However, the Bellagos' government will likely be faced with another LTC social insurance reform, since the LTC programme will make deficit in 2033, see Figures 8. This inevitable problem is inherent in Bellagos' demographic distribution particularly due to decreasing mortality and fertility rates. Thus, we strongly advise the government to include our subsequent demographic policy recommendations and suggestions of a collaboration with private insurers.

4.1 Long term demographic policy

We recommend that Bellagos adjusts its demographic policies for the changing needs of the system, otherwise, the government will have to increase the taxes periodically. We recommend that the government raises awareness about the problem and announces significant increase in taxes years in advance as well as advises a substantial reduction in taxes for each child. This way, we believe Bellagos can achieve an increase in fertility rates to some extent. Also, the government should consider adjustments to migration rates depending on projected fertility rates in order to support sustainability of the system. Rapid increase in immigration levels
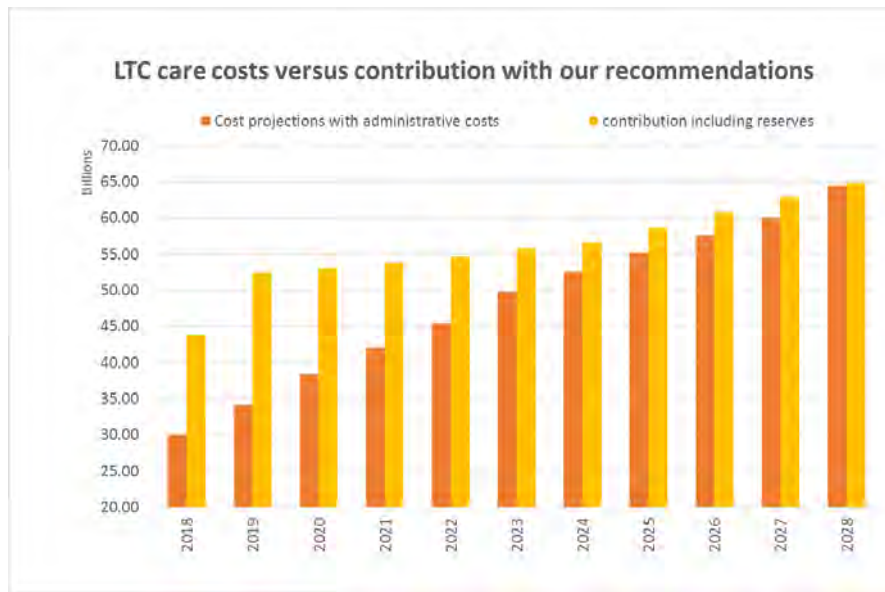
Figure 7: LTC care costs including administrative costs (orange pillars) and the contribution including reserves and the risk margin (yellow pillar).

can trigger an increase in unemployment rates, therefore the government should implement this policy gradually to sustain economic growth.

4.2   Partnership of private insurers and government

We recommend a partnership of private insurers and government body as it has been for example successfully implemented in Singapore. The highly successful ElderShield plan in Singapore is based on the separation of distribution of wealth (managed by the government) and the pricing and risk management (managed by the private insurers), for more details see Schreyögg and Kin (2004); Hoffman (2009). A collaboration with private insurers cannot be achieved within 12 months however, as seen with the ElderShield plan, is a successful solution to obtain sustainability in the long term.
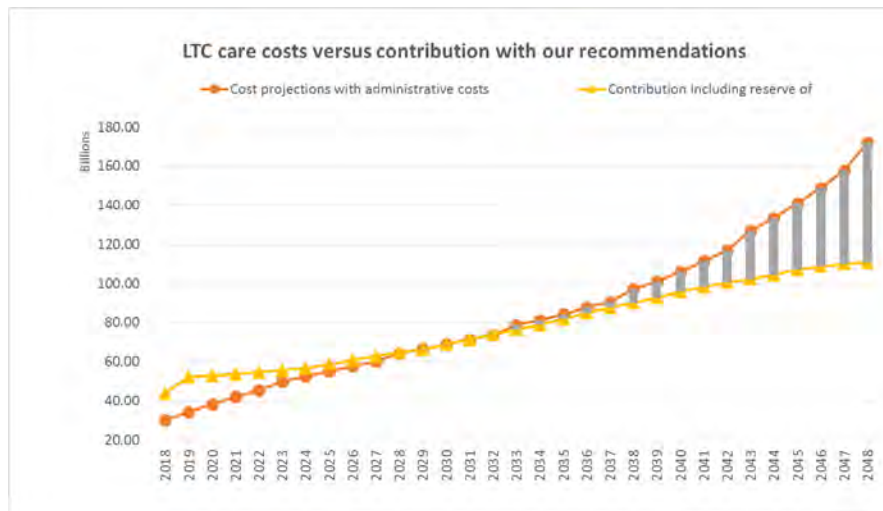
Figure 8: Care costs including government administrative expenses versus contribution to the LTC programme over the next 30 years under the implementation of our recommendations. The contribution includes a reserve of 50% from the surplus of the previous year.

5 Risks not addressed in this report

The subsequently listed risks threatening the sustainability of the government LTC programme would require additional data and exceed the scope of this report.

5.1 Decrease of informal care

An increasing proportion of facility care among beneficiaries is a trend in most developed countries (Karlsson et al., 2006). This is a substantial risk since payouts for facility care are on average 2.7 times the payouts of home care. However according to the survey, 93% of Bellagos' citizen prefer to stay autonomous in their home. Thus the Bellagos' government has to address the developing shortage of supply of informal caregivers, see also Section 3.4.

5.2   Increase of LTC costs faster than inflation

Common in all developed countries is that LTC costs increase faster than inflation, an effect called the Baumol's disease (Karlsson et al., 2006). Bellagos' data indicates that inflation was on average (over the last 5 years) 0.6% while the increase of the LTC care payouts was annually 5% in every care level (for both home and facility care). In our calculations, we incorporated this increase of LTC care payouts combined with an inflation adjustment of the maximal monthly care payout every 5 years. However, a manifestation of the Baumol's disease would result in a substantial increase of the LTC costs compared to the Bellagos' economy. In particular the government would face mounting pressure from the public to further increase the maximum monthly care payout.

5.3   Economic risk

From the sparse historical data of Bellagos available to us, it is unfeasible to build a credible model of Bellagos' economic behaviour. However, due to rising inflation, increasing unemployment and decreasing GDP growth, Bellagos is prone to entering into a recession. We recommend that the government collects data to reliable estimate the potential impact of an economic recession onto the LTC insurance system.

Appendices

The appendices contain the detailed explanations of the projection model as well as any model assumptions and limitations. The enclosed excel files contain the numerical calculations and should be self-explanatory.

Throughout the enclosed excel files containing the numerical calculations, we use *disabled people* and beneficiaries (persons receiving government LTC benefits) interchangeably. *Healthy people* are Bellagos' citizen not receiving government LTC benefits.

A   Data limitations

The data sample is relatively small since our projection is extensively based on beneficiaries of the government LTC programme, that is people aged 65 and above representing 16% of the population respective the data sample. Specifically, for projecting the number of future beneficiaries, beneficiaries are split by gender, by home or facility care and by care levels 1 to 4. Furthermore, every age is projected separately using the transition rates. This methodology though accurate, results in very few observations for old ages. Thus, to minimise uncertainty, we choose prudent assumptions which are addressed though sensitivity and scenario analysis.

The data is collected though a survey per household which implies a few restrictions. Particularly, there is only limited information for household members 3 – 6, for example earnings are only collected for two people per household.

B   Projection Model

This section provides a detailed explanation and assumptions of the projection model for the Bellagos' population for the next 30 years. As discussed in Section 2.1 and especially in Figure 3, a substantial burden on the LTC programme arises in 25 – 30 years.

B.1   Fertility rates

The fertility rate of Bellagos as at 2017 is 1.37 child per woman in the childbearing years, that is between 15 and 49. The assumption of a constant fertility for all ages is unrealistic. Thus using the world bank data[2], Canada emerged as the best fit for the population statistics of Bellagos (see the excel worksheets for details on the comparison). To model the fertility rate distribution, we adopted the distribution of the fertility rates of Canada adjusted to the overall Bellagos' fertility rate of 1.37 in 2017. Since the Canadian fertility data is given in 5 year age groups, we use a linear interpolation to obtain fertility rates for single years. The fertility rates and the proportion of newborn boys and girls is assumed to be constant over the projected time horizon.

B.2   Prevalence rates

The prevalence rate is commonly defined as the number of beneficiaries (split by gender) aged x divided by the number of people (with the same gender) aged x. The prevalence rate is used to calculate the number of people aged x becoming
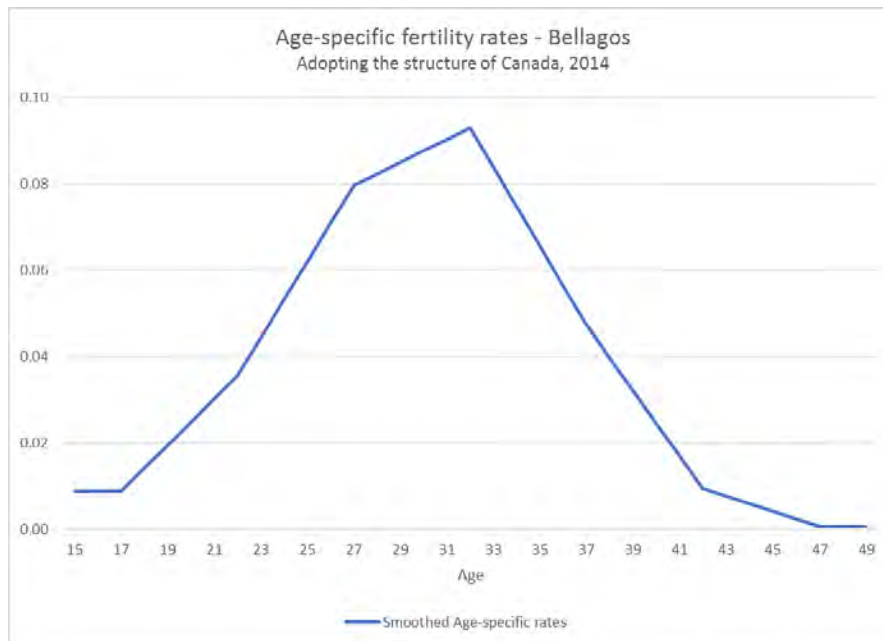
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[2]https://data.worldbank.org/

Figure 9: Smoothed fertility rates adopting the fertility structure distribution of Canada in 2014.

beneficiaries in future years. However, due to limited and missing data for ages above 87 and the extreme variability in the prevalence ratios for different ages (ranging from 0%, no data points, to 50%), we assume a constant prevalence rate for all ages above 65. In particular, 19.8% (female) and 21.2% (male).

Due to the uncertainty involved and the limited data, we assume that the prevalence rates and thus the proportion of people becoming beneficiaries to be constant over the projection period.

B.3   Migration

We are not provided with migration data for Bellagos. Thus for the baseline model we make the prudent assumption of 0% net migration. However, we address

different scenarios of net migration in Section 3.2. For these calculation, we assume that migrants move because of work prospects and government's migration policy, hence are aged between 18 − 45 and that net migration stays constant over time.

B.4   Mortality of the Bellagos' population

We use the stochastic Lee-Carter (LC) mortality model using StMoMo package in R (Millossovich et al., 2017) to project the mortality for the male Bellagos' population, see Figure 10. The mortality for females was projected using the Cairns-Blake-Dowd (CBD) model (Cairns et al., 2006), due to a better fit. For reliable estimates, the LC and CBD models require 15 − 20 years of historical mortality data (Millossovich et al., 2017). However, we are only provided with 3 years (2005, 2010, 2015) of Bellagos' mortality rates. Thus, we augmented Bellagos' mortality data with Canadian mortality rates[3]. Specifically we used yearly Canadian mortality rates from 1995 to 2015 adjusted to the Bellagos' mortality rates. Thus the resulting projected mortality tables adopt the time-trend in Canadian mortality rates adjusted to the Bellagos' mortality data.

Due to irregularities in the Bellagos' data we obtain a (unjustifiable) trend of increasing mortality for people aged 99 and above. To mitigate this anomaly, we adopted the time-trend of age 98 to ages above 99 and capped the mortality of people aged 110.

B.4.1   Mortality for people in good health and beneficiaries

The projection of the mortality of the Bellagos' population, Section B.4, includes both, people in good health and beneficiaries of the government LTC programme.

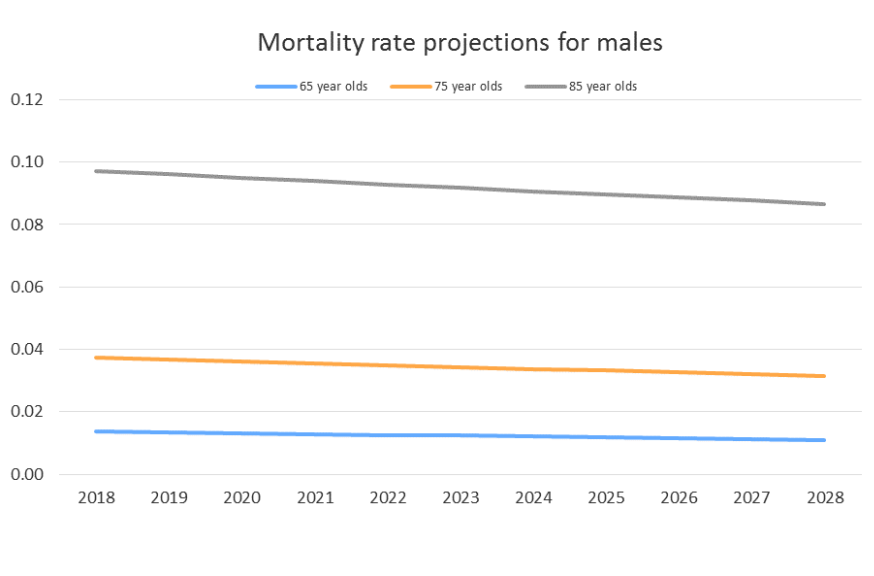[3]http://www.statcan.gc.ca/pub/84-537-x/84-537-x2018001-eng.htm

Figure 10: Projected male mortality rates for the next 10 years for using the CDB model.

For ages 65 and above the projected mortality rates are split between people in good health and beneficiaries. Specifically, we use the formula

$$q_{pop,x}^g = q_{h,x}^g \, \text{prev}^g + q_{b,x}^g (1 - \text{prev}^g),$$

where $q_{s,x}^g$ denotes the mortality of an $x \geq 65$ year old person with gender $g \in \{\text{female}, \text{male}\}$ in state $s \in \{\text{population, healthy, beneficiaries}\}$ and prev^g denotes the prevalence rate. Bellagos' government provided the assumption that the mortality of beneficiaries is 3 times the mortality of the population. Firstly, this assumption is very unrealistic and the mortality adjustment for beneficiaries should depend on the care level. Secondly, the decreasing time trend in mortality is considerably different for people in good health and people in need for care Manton (1987); Gruenberg (2005). Therefore, we assume that the multiplier, 3,
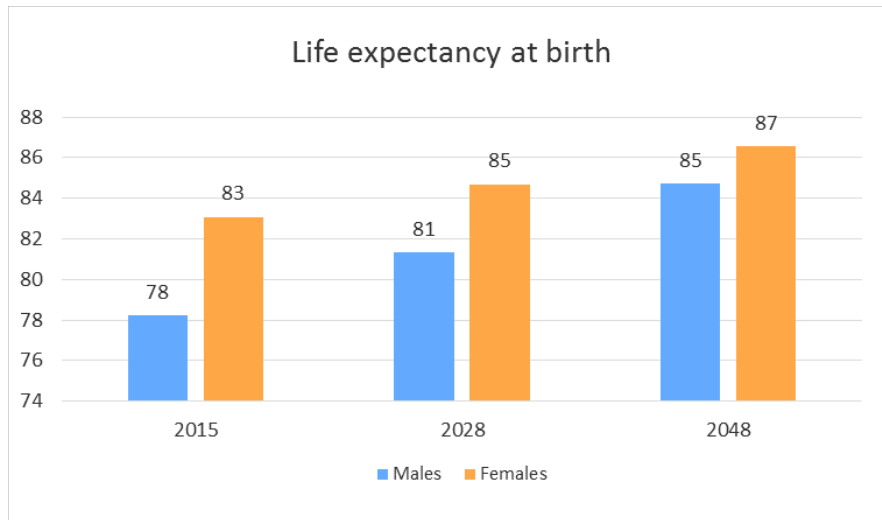
Figure 11: Change in life expectancy.

decreases linearly to 2 over the next 30 years.

B.4.2   Lee-Carter and Cairns-Blake-Dowd mortality model – R-code

This section provides the R-Code of the LC, respective CBD, mortality model used for projecting the mortality of the male, respective female, population.

```
install.packages("StMoMo")
install.packages("demogdata")
library(StMoMo)
library(demogdata)
years    <- c(1995:2015)
ages     <- c(0:110)
MaleBellData            <- demogdata(MaleRates,MaleExt,ages,years,"mortality",
                                     "BellagosMale",0)
MaleBellagosStMoMo       <- StMoMoData(MaleBellData, series = "0")


constLC <- function(ax, bx, kt, b0x, gc, wxt, ages){
                c1 <- mean(kt[1, ], na.rm = TRUE)
                c2 <- sum(bx[, 1], na.rm = TRUE)
```

```
                     list(ax=ax+c1*bx, bx=bx/c2, kt= c2*(kt−c1))  }


LC <− StMoMo(link = "logit", staticAgeFun = TRUE, periodAgeFun = "NP",
             constFun = constLC)
MaleBellagosIniStMoMo <− central2initial(MaleBellagosStMoMo)
ages.fit <− 0:110
wxt       <− genWeightMat(ages = ages.fit, years = MaleBellagosIniStMoMo$years,
                   clip = 3)
LCfit    <− fit(LC, data = MaleBellagosIniStMoMo, ages.fit = ages.fit, wxt = wxt)
LCfor    <− forecast(LCfit, h = 33)
LCforArima <− forecast(LCfit, h = 33, kt.method = "iarima",
                   kt.order = c(1, 1, 2))
LCfor$rates




FemaleBellData  <− demogdata(FemaleRates, FemaleExt, ages, years,
                   "mortality","BellagosFemale",0)
FemaleBellagosStMoMo <− StMoMoData(FemaleBellData, series = "0")
f2       <− function(x, ages) x − mean(ages)
CBD      <− StMoMo(link = "logit", staticAgeFun = FALSE, periodAgeFun = c("1", f2))
FemaleBellagosIniStMoMo <− central2initial(FemaleBellagosStMoMo)
ages.fit <− 0:110
wxt       <− genWeightMat(ages = ages.fit, years = FemaleBellagosIniStMoMo$years,
                   clip = 3)
CBDfit   <− fit(CBD, data = FemaleBellagosIniStMoMo, ages.fit = ages.fit, wxt = wxt)
CBDfor   <− forecast(CBDfit, h = 33)
CBDfor$rates
```

B.5   Transition rates between care levels

Table 3 displays the transition rates provided by the Bellagos' government. Due to no data and the uncertainties involved we assume that the transition rates do not change over the projected time horizon and are constant for all ages of beneficiaries independent of their gender. However, this is an unrealistic assumption as they

are likely to improve over time.

Table 3: Bellagos' care level transition matrix for people aged 65 and above.

to/from	**Healthy**	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Healthy	90%	1%	0%	0%	0%
Level 1	5%	80%	1%	0%	0%
Level 2	3%	15%	90%	0%	0%
Level 3	2%	4%	7%	75%	0%
Level 4	0%	0%	2%	25%	100%
	100%	100%	100%	100%	100%

B.6   Projection of LTC care payments

From the historical data we observe that the monthly average payout for each care level for both, home and facility care, increased by 5% per annum from 2013 to 2017. We adopt this annual increase for the monthly average payout of care costs until the average payout reaches the policy maximum (in 2019). Moreover, the maximal payout is adjust to the average historical inflation of 0.6% per annum every 5 years. We only adjust every 5 years since this is a government decision which will very likely not be made on a yearly basis. Figure 12 displays the care costs split by care levels.

Fraud was treated as negligible since the number of fraud cases was constant from 2013 to 2017 and is accountable for less than 0.005% of beneficiaries. Additionally, due to no data we assume that all people aged 65 and over with need for care are considered eligible for government LTC. The prediction of total care costs includes government administrative expenses of 12% per annum of the total
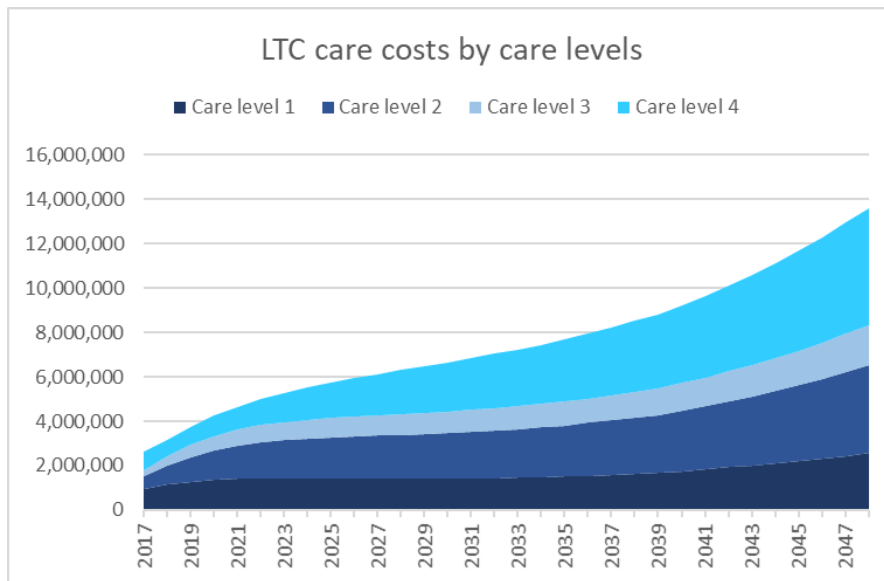
Figure 12: Government LTC care cost projection (without administrative expenditures for the next 30 years split by care levels.

government expenditures on care payments. The administrative expenses are assumed to be constant and taken as an average of the historical data from 2013 to 2017.

B.7   Projection of contribution

It is assumed that all people with earnings contribute to the LCT government programme and that all people aged 65 and over who do not have additional earnings receive a pension, thus contribute to the LTC scheme. The earnings of people aged 88 and above is floored due to a lack of data stemming from the data collection process according to households where a maximum of two people's earnings per household is recorded. However, this is not a restrictive assumption since Bellagos is a politically and economically stable government of a developed

nation and thus is very likely to have a governmental social insurance and pension programme.

We split the population into *low-earnings*, below 75'000 and *high-earners*, above 75'000. This assumption however is only later used to make separate tax adjustments.

The *childless* benefit is derived through the ratio of people aged 18 and above receiving earnings and not living with children (below 18 years) to the total number of adults with earnings, applied to the fraction of the population contributing to the government LTC scheme. The proportion of Bellagos' population not eligible for childless benefits is assumed to be constant. This is a limiting assumption since fertility rates are abating in developed countries resulting in a reduced proportion eligible for reduced LTC taxation.

Unemployment is accounted for by incorporating the percentage of workers per age multiplied with the average earnings of the working group with that age. Even though the unemployment rate according to the historical data of Bellagos is increasing, we assume the proportion of the workforce to stay constant. This simplifying assumption is due to a lack of economic data of Bellagos which makes a reliable prediction of the economy of Bellagos impossible. The earnings are adjusted through a nominal wage growth rate of 2.66% per annum over the projected time period (using the average inflation and average real wage growth rate from Bellagos over the years 2013 to 2017).

B.8   Sustainability

In case the government LTC insurance programme makes a surplus (for 0% net migration this is till 2020), the government will puts 50% of the surplus aside as a reserve for future years. This is a reasonable assumption since the government is well aware that the LTC system is facing sustainability problems.

The sustainability condition for the government LTC insurance system is that the projected contributions to the LTC programme in 2028 are at least the sum of all LTC care expenditures, including administrative costs and a *risk margin*. The risk margin is defined as 6% to the total governmental expenditures in 2028 and necessary to address model risk and uncertainty in the estimates not accounted for in our model and functions as a buffers against unforeseeable risks. The choice of 6% is in line with that of the risk margin for solvency capital requirements (SCR) according to Solvency II, EIOPA (2009).

B.9   Supply of caregivers

B.9.1   Informal caregivers

Informal caregivers are not qualified to work in care institutions, hence are only eligible to provide care for beneficiaries living in their own home. From the historical data of Bellagos we observe that the percentage of the Bellagos' adults providing informal care is fairly constant. Thus we assume the historical average (10.6%) for our projection to be constant over time. This assumption together with an increasing old-age-dependency ratio results in a shortage of informal caregivers. Specifically, the number of informal caregivers per home care beneficiaries drops

from 3.9 in 2017 to 1.3 in 2028.

B.9.2 Professional caregivers

The proportion of professional caregivers to the workforce in 2013 – 2017 stayed constant and we assumed this trend to continue over the next decade. The number of professional caregivers per 100,000 beneficiary drops from 35.1 in 2017 to 14.4 in 2028, which is a reduction of 41%.

C Enclosed Excel files

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MortProjLC.xlsx
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```
Projections.xlsx
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MainCaseStudy.xlsx
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Care cost projections_sp.xlsx
```

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AdjustedHistoricalMortalityRates.xlsx
```

```
Fertility rates.xlsx
```

```
supply of care givers.xlsx
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