Bellagos Social Long-Term Care Insurance Program Evaluation

Team UTstar

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1   Executive Summary

Bellagos' Long-term care(LTC) is a significant part of its public insurance program that covers majority of its citizens' demands in LTC. To better meet different stakeholders' needs from this program and maintain the functionality, re-evaluation of the sustainability of Bellagos' LTC program is necessary. After evaluating Bellagos' demographic change and the change of usage patterns of the LTC program, three recommendations are proposed. First, adjust the contribution of the program from each individual based on annual income, classification of family status and age. Secondly introduce new policies to encourage child birth. Finally, to lower the limit of each care level in order to meet the increasing demands. Besides, based on the trend that Bellagos' citizens are raising their investment level on technologies that they believe will be helpful while they are in need of LTC.

2   Purpose and Background

The purpose of this study is to evaluate the sustainability of the Bellagos Social Long-Term Care Insurance Program by making projections of the expenditure, revenue of the program and some other factors such as fertility rates, lifespans, ratio of older to younger citizens in the next decade. The goal of the study is to identify which factors have the greatest impact on the sustainability of the program and which factors could cause it to be unsustainable in 2028.

The Social LTC Insurance Program has been covering Bellagos citizens' health care spending for years. However due to changes in economic trends and an aging population, this program has faced mounting pressure to be financially sustainable in the next decade. The revenue of the LTC Insurance program is funded using a tax-based contribution system reliant on state-levied taxes. For all households, the tax contribution is based on a tax rate (varies depending on households' fertility condition). The expense of the LTC Insurance program consists of payments on health care both at home and at facility from level one to level four, and administrative expense.

In order to maintain the sustainability of the LTC Insurance program, we need to either raise the tax rate to increase revenue or decrease the limit of health care payment at every level to reduce the expenditure. To provide an unbiased and evidence-based analysis and recommendation, we suggest a trade-off between increasing revenue and decreasing expenditure.

3   Data Limitation

Demographics:

The population structure of Bellagos is an important part of the expenditure and revenue projection. However, besides the limited quantity of data points provided, details of the population in each group is lacking, which may cause a bigger gap between the projected data and actual data points.

On the other hand, the life table mortality data was given every five years for the past 15 years. Ideally, the life table should be updated every year for data efficiency purposes. Additionally if ways to know or predict certain types of social change, such as an improved maternity leave policy, will also lead to a better understanding of Bellagos social factors.

Expenditure:

We assume the percentage of population with private LTC insurance stay the same after 2017 since we do not have any further information about people's willingness to stay with private LTC insurance plan or change to public LTC plan. With more information, the predictions of population for public LTC beneficiaries could be more accurate.

We assume that the percentage of people over 65 in private LTC insurance is the same as the percentage in public LTC insurance. Since we can only project the percentage of people over 65 in the whole nation, these projections are the only value we can use to infer the percentage of people over 65 in the public LTC insurance program.

The tendency of people's increasing willingness to stay at home to receive health care is not fully reflected in our projection due to limited data of how the ratio of population in home care to population in facility care will change.

Revenue:

Granted, the statistics used, and calculations of revenues have their shortcomings in this analysis. Due to the fact that only five years' data were provided, actual approach is not accurate in our case since it depends heavily on historical reliable large database. Furthermore, given the fact that we have included several possible scenarios of each economic growth rates to reflect the uncertainties associated with the nature of any such projections, we had to ignore some possible cases that were not able to ensure the sustainability of the LTC program. Those cases not considered should not be enough to deter from the projections made.

In addition, we mainly focused on three factors that affect Bellagos' economic status. The other three economic factors that were not analyzed numerically individually may affect the accuracy of the estimation. However, the GDP growth rate, inflation rate and real wage growth rate are much more dominating in affecting future economic status than basic living expenses and real wage growth rate, which serves the methodology of the analysis well.
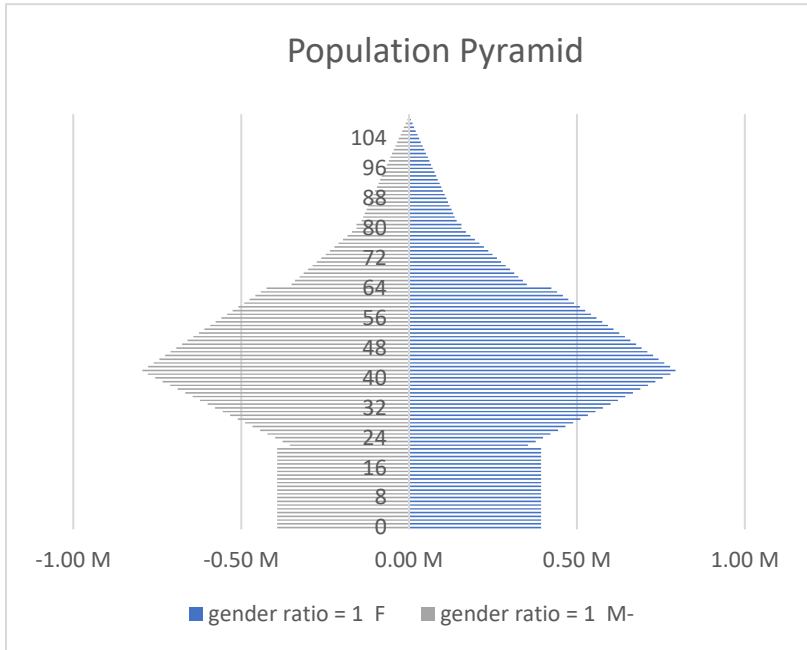
4   Method Analysis and Models

4.1   Demographics

Based on Bellagos' given five-year data features, including fertility rate and the percentage of each age group, it is highly likely that the country is at its later phase II and gradually transferring to phase III of population transformation stage[1], with the support of its total population and mortality growth trends. Therefore, it is reasonable to assume that the demographic structure is similar to some developed country with similar age group percentage. The population in Germany in 2005[2] has met such criteria. According to its demographic features, the population at age 81-110+ can be considered as a triangle-shaped structure with the tip being the population at age 110; the population pyramid at age 65-80 can be considered to be shaped as a trapezoid with top and bottom parallel sides representing population of 80-year-olds and 66-year-olds respectively; the population pyramid at age 20-64 is divided into two trapezoids with the median age of the country being the common parallel side; and lastly, the population of the youngest age group 0-19 decreases. The decrease of people in the base group in turn leads to a decreasing population size for the 20-64 age group. Although the 20-64 age group is the largest group here with regards to its ratio to the total population and the length of its cohort year, there will be less people entering the group and the mortality rate raises as the age getting closer to 64. Furthermore, unlike the previous group, people in this group with

[1] Probabilistic Projections of the Total Fertility Rate for All Countries, Leontine Alkema, Adrian E. Raftery, Patrick Gerland, Samuel J. Clark, François Pelletier, Thomas Buettner, and Gerhard K. Heilig, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3367999/
[2] https://www.populationpyramid.net/germany/2005/

Population Pyramid

-1.00 M -0.50 M 0.00 M 0.50 M 1.00 M	

■ gender ratio = 1 F   ■ gender ratio = 1 M-

higher age is more likely to die, which means the population older age is decreasing itself at the same time. On the other hand, the populations of group 81-64 and 65-110[+] are both growing bigger due to the large number of people entering the group, and the mortality rate is getting smaller due to technology development, medical breakthrough and other social factors.

Moreover, the assumption of the change of ratio of each age group to the population is also made to support the process of population projection, as the expected trend of population growth of each age group is shown as blow:

Age Group	Expected Trends	
0-19	Decrease	⬇
20-64	Decrease	⬇
65-80	Increase	⬆
80-110+	Increase	⬆

Since the mode median age of developed countries is around 41[3] and combined with the assumptions of the population pyramid shape above, 40.4 is a great fit in Bellagos given all other information.

After estimate the trends of the population, the numerical projection of each group starts with the most important three factors— fertility, mortality and migration[4].

Fertility rate can be affected by both economic and social factors[5], some of which was not mentioned by the given information. Hence using curve-fitting to past empirical data on fertility rate projection is one of the most reasonable method[6], with a high relevant rate (R^2 close to one) between the empirical data point and chosen model. (model function)

As for mortality, a life table of three five-year mortality rate was provided, which can not be directly applied to the given age groups since the given mortality rate is overly detailed. In this case, it is needed to transform life table mortality rate into a more general applicable rate: age specific death rate(ASDR).

Migrations were not mentioned in the package; therefore, the initial population projection will not consider migration and will make recommendations on migrations in recommendation session.

[3]https://www.gapminder.org/tools/#_state_marker_axis/_x_which=median/_age/_years&domainMin:null&domainMax:null&zoomedMin:null&zoomedMax:null&scaleType=linear;;;&data_/_lastModified:1523039135923;&chart-type=bubbles; row = "More developed regions", column = "2015", https://docs.google.com/spreadsheets/d/1aYvBICRlEsG0VGjJ8SPD2Ot5O2gBPdfeL0hJYQ1Na90/pub
[4] https://www.prb.org/united-nations-population-projections/
[5] Some Causes of Fertility Rates Movements, Claire Norville Rocio Gomez Robert L. Brown, https://uwaterloo.ca/waterloo-research-institute-in-insurance-securities-and-quantitative-finance/sites/ca.waterloo-research-institute-in-insurance-securities-and-quantitative-finance/files/uploads/files/03-02.pdf
[6] Coale and Trussell, 1996

4.2 Expenditure

The expenditure of the program consists of two parts. The first part is the Social LTC Program expense. It is calculated by using the projections of populations of beneficiaries and the average monthly payment at each level.
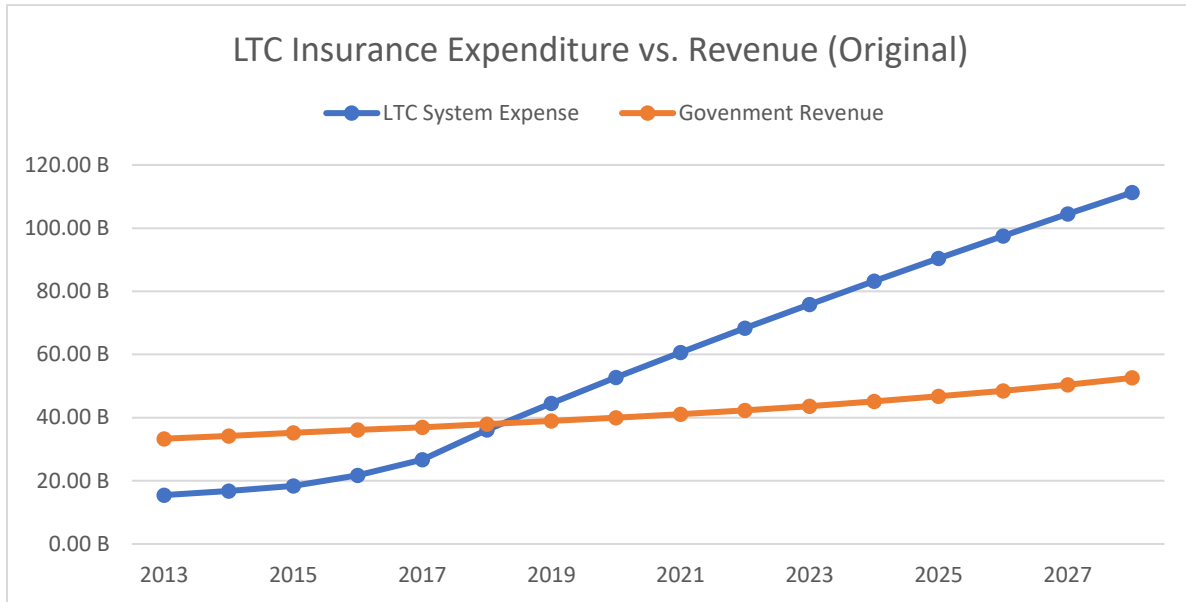
$$\text{Total Annual LTC Expense} = \sum_{\text{Level I}}^{\text{IV}} \text{Monthly Average Payment} \times \text{Population of Beneficiaries} \times 12$$

The average monthly payment is projected using linear regression model fit by the data from 2013 to 2017. If the predicted average monthly payment is greater than the maximum monthly payout at each level, we use the maximum payout to replace the predicted value.
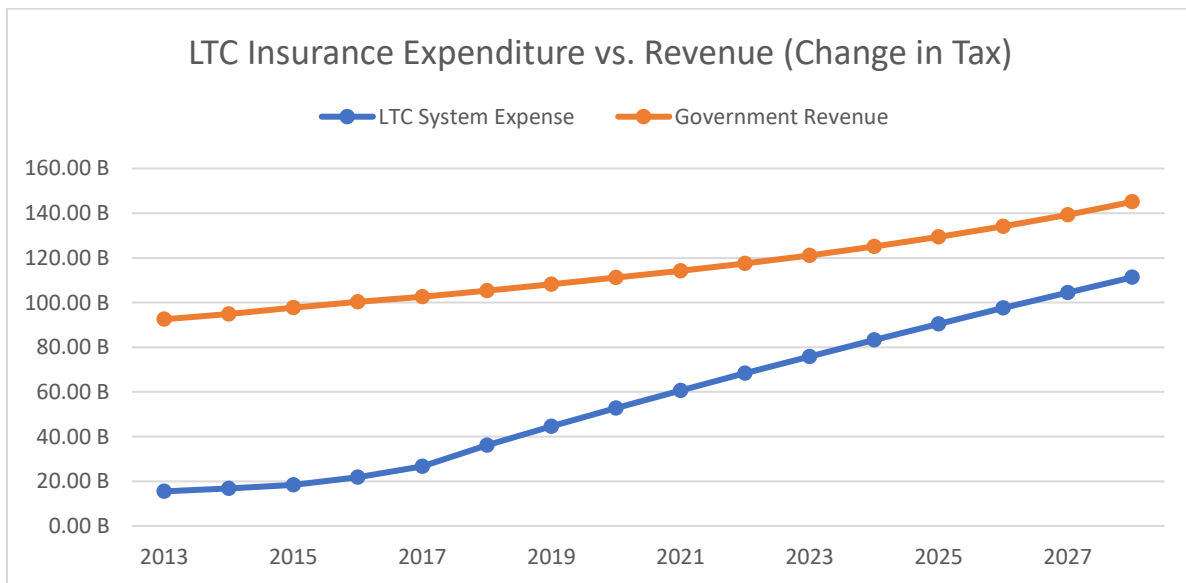
The population over 65 can be divided into two big groups—the beneficiary and the insured. The insured are over 65 but still healthy. And the beneficiary are over 65 and paid by the LTC Insurance program. The insured and beneficiaries at each level is calculated using the transition matrix. The population is presented below:
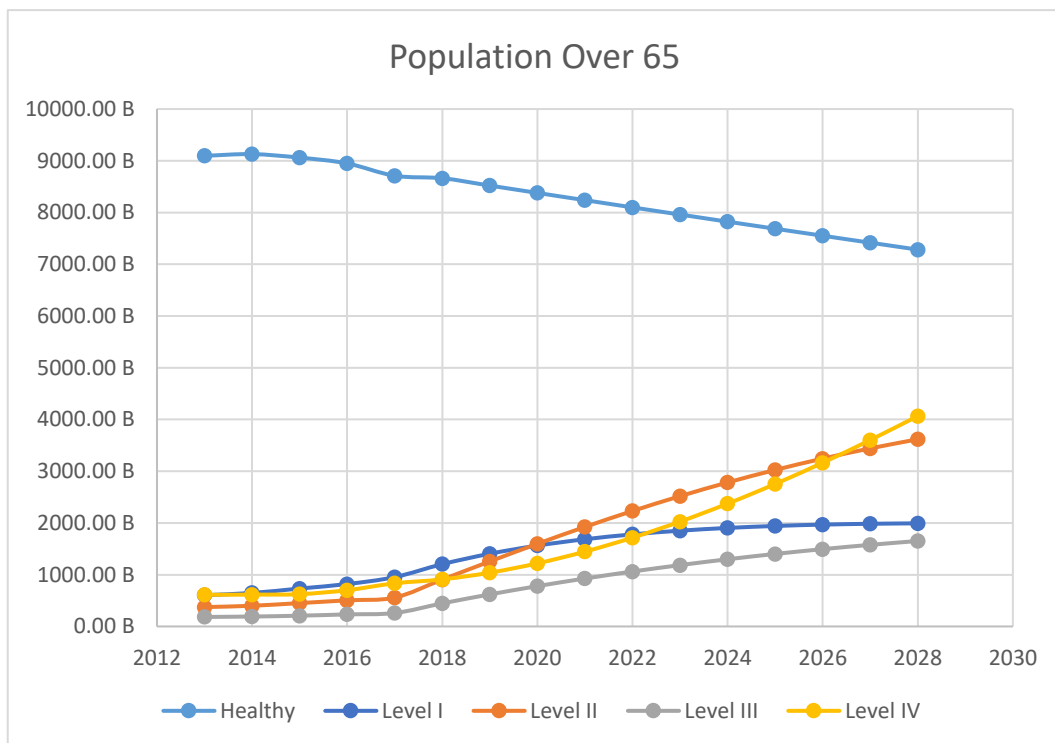
Under current policy, the revenue can only cover the annual expenditure of the LTC Insurance program in the first few years. As shown in the figure below, after 2018, the government revenue is no longer able to cover the expense, which means the program is no longer sustainable.

LTC Insurance Expenditure vs. Revenue (Original)

— LTC System Expense — Govenment Revenue

Year	2013	2015	2017	2019	2021	2023	2025	2027

(Y-axis: 0.00 B to 120.00 B)

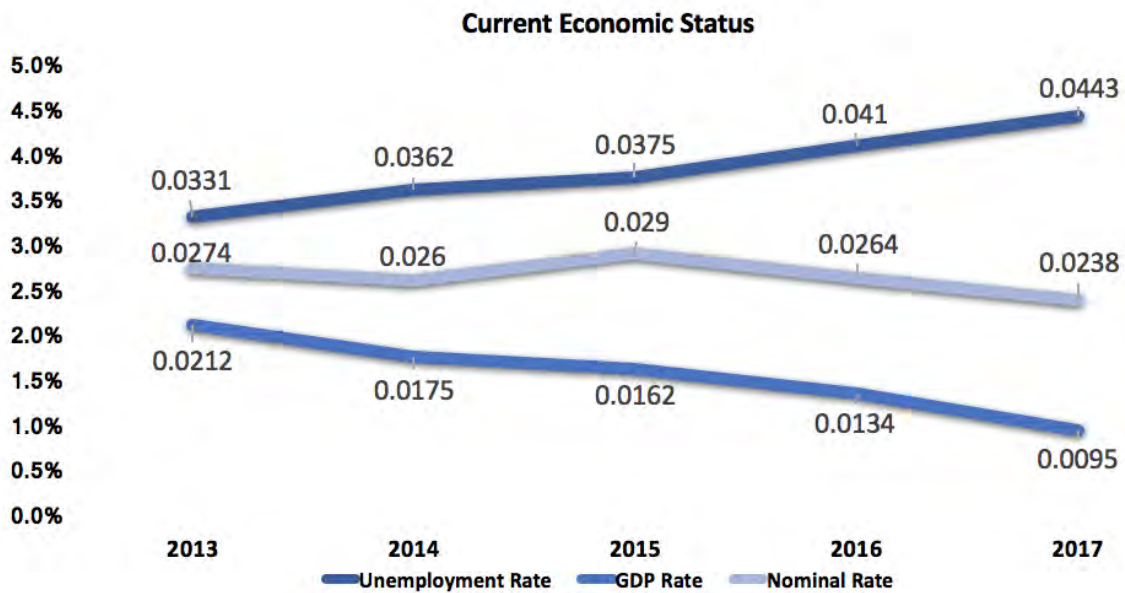In order to maintain the sustainability of the program, we plan to change the tax policy. After changing the tax policy, the revenue is able to cover the expenditure.

LTC Insurance Expenditure vs. Revenue (Change in Tax)

— LTC System Expense — Government Revenue

Year	2013	2015	2017	2019	2021	2023	2025	2027

(Y-axis: 0.00 B to 160.00 B)

4.3 Revenue

From the data of general Bellagos economic trends from 2013 to 2017, we can see a relatively big picture of Bellagos demographical and economical status. The fertility rates over the five years are below 2 and have been decreasing generally. The GDP growth rate has decreased to 1%. The short-term interest rate and real wage growth rate both have fallen significantly. Meanwhile, the unemployment rate has risen steadily through the past five years. The inflation rate has been continuously increasing as well.

Current Economic Status

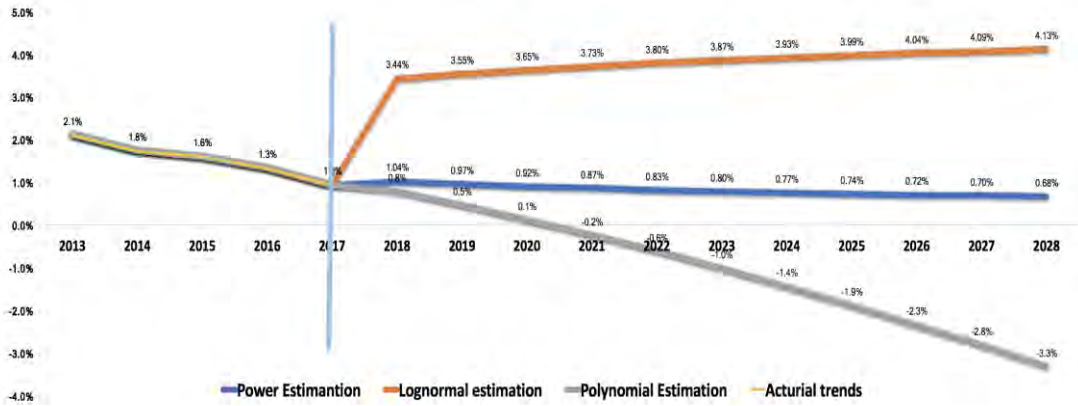|	2013	2014	2015	2016	2017
Unemployment Rate	0.0331	0.0362	0.0375	0.041	0.0443
Nominal Rate	0.0274	0.026	0.029	0.0264	0.0238
GDP Rate	0.0212	0.0175	0.0162	0.0134	0.0095

Overall, the economics of Bellagos is in recession. After comparing Bellagos' statistics to those of other countries in the world, we have found out that Great Britain is similar situation, both quantitatively and qualitatively speaking. Under this assumption, we treat Great Britain as the
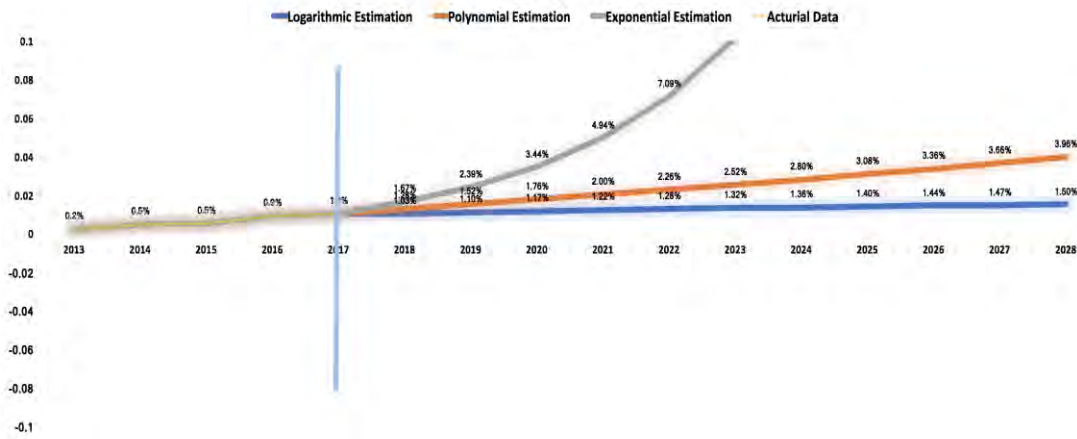
real-world model country. The projections of United Kingdom's economics will be used to compare with our prediction for Bellagos to test its reliability.

To indicate the economic tendencies in the next ten years, we implement fitted curve approach to smooth out the empirical data and predict the potential trends from 2018 to 2028. Due to the fact that only five years' data were provided, actual approach is not accurate in our case since it depends heavily on historical reliable large database. We only focus on three dominated factors that may affect Bellagos' economic status – the GDP growth rate, inflation rate and real wage growth rate. To include as many possibilities as possible, polynomial, power, logarithm and exponential distributions are all considered to fit historical data and to find the most representative distribution. Although we have considered many possible scenarios to reflect the uncertainties associated with any such projections, in order to ensure the sustainability of the LTC program while staying as neutral as possible, only projections of second-strongest growth will be considered in this case. Granted, this is relatively more optimistic than the present scenario and the worst case of three projections, which assumes that there are some positive economical and demographical trends in the global economy. The projection includes numbers in the next ten years.
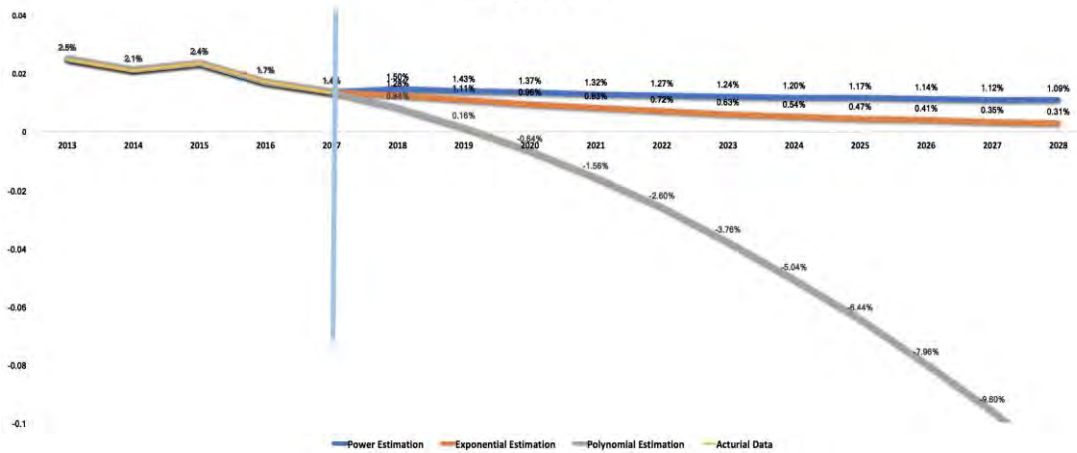
GDP Trends Prediction

Power Estimantion — Lognormal estimation — Polynomial Estimation — Acturial trends

2.1% 1.8% 1.6% 1.3% 1.0%
3.44% 3.55% 3.65% 3.73% 3.80% 3.87% 3.93% 3.99% 4.04% 4.09% 4.13%
1.04% 0.97% 0.92% 0.87% 0.83% 0.80% 0.77% 0.74% 0.72% 0.70% 0.68%
0.8%
0.5% 0.1% -0.2% -0.6% -1.0% -1.4% -1.9% -2.3% -2.8% -3.3%

Inflation Rate Prediction

Logarithmic Estimation — Polynomial Estimation — Exponential Estimation — Acturial Data

0.2% 0.5% 0.5% 0.0% 1.0%
7.09%
4.94%
3.44%
2.39%
1.67% 1.52% 1.76% 2.00% 2.26% 2.52% 2.80% 3.08% 3.36% 3.56% 3.96%
1.10% 1.17% 1.22% 1.28% 1.32% 1.36% 1.40% 1.44% 1.47% 1.50%

Real Wage Rate Prediction

Power Estimation — Exponential Estimation — Polynomial Estimation — Acturial Data

2.5% 2.1% 2.4% 1.7% 1.4%
1.50% 1.43% 1.37% 1.32% 1.27% 1.24% 1.20% 1.17% 1.14% 1.12% 1.09%
1.11% 0.96% 0.83% 0.72% 0.63% 0.54% 0.47% 0.41% 0.35% 0.31%
0.16% -0.64% -1.56% -2.60% -3.76% -5.04% -6.44% -7.96% -9.80%

The power equation of projected GDP growth rate model is $Y = 0.0228 * x^{-0.438}$.

The model of inflation rate is $Z = 0.00004x^2 + 0.0018x + 0.0006$.

As for real wage growth rate, the neutral projected model is $W = 0.0302e^{-.143x}$.

Y, Z, W represent the respective rate of a specific year from 2018 to 2028 and x is the number of years from 2012 to that year. The GDP growth rate of 2019 of Bellagos is 0.97%, and GDP growth rate of United Kingdom is 1.06%[7]. Therefore, the second-strongest projections of Bellagos are acceptable.

Taking the sum of real wage growth rate and inflation rate, we can get the desired nominal rate which we will use in the calculation of tax revenue in ten years.

Projected Tax Revenue of n year $= (1 + nominal\ rate) * tax\ rev\ of\ (n-1)year$

By 2028, around $46.14 billion Bellos tax is expected to be received.

After comparing Bellagos' statistics to those of other countries in the world, we have found out that Great Britain is similar situation, both quantitatively and qualitatively speaking. Under this assumption, we treat Great Britain as the real-world model country.

Requiring the sustainability of the LTC means that the LTC insurance fund needs to have enough money to be used for covering LTC and program administration costs. Since the LTC program is funded using a tax-based contribution system, introducing immigration to Bellagos will have a positive effect on increasing taxes collected by state. In addition to increasing the money collected for the fund, introducing immigration also has benefits for Bellagos' economy in other

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[7] https://data.oecd.org/gdp/real-gdp-forecast.htm

perspective. Research shows that immigration has effect on improving wages and employment rates. In developed countries, comprehensive immigration reform could support and create a large amount of new jobs. Immigrants accounted for 70% of the increase in the workforce in Europe over the past ten years.

5 Conclusion & Recommendation

5.1 Recommendation

5.2.1 Immigration

Requiring the sustainability of the LTC means that the LTC insurance fund needs to have enough money to be used for covering LTC and program administration costs. Since the LTC program is funded using a tax-based contribution system, introducing immigration to Bellagos will have a positive effect on increasing taxes collected by state. In addition to increasing the money collected for the fund, introducing immigration also has benefits for Bellagos' economy in other perspective. Research shows that immigration has effect on improving wages and employment rates[8]. In developed countries, comprehensive immigration reform could support and create a large amount of new jobs[9]. Immigrants accounted for 70% of the increase in the workforce in Europe over the past ten years[10].

5.2.2 Tax Rate Structure

In order to ensure the sustainability of the LTC insurance program, the objectives of the government should be prioritized at changing the tax rate structure besides introducing immigration. Since it is already obvious that the government's tax revenue was not able to cover the expenditure of insurance from historical data, to maximize the likelihood that the revenue can catch up with expenditure, we suggest six different tax rates for six groups of households.

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[8] http://policyoptions.irpp.org/magazines/november-2016/how-does-increasing-immigration-affect-economy/
[9] https://obamawhitehouse.archives.gov/blog/2012/07/12/ten-ways-immigrants-help-build-and-strengthen-our-economy
[10] https://www.oecd.org/migration/OECD%20Migration%20Policy%20Debates%20Numero%202.pdf

Tax Rate Indication			
With Children		Income group	
Without Children		<75,000	>=75,000
Age Group	Under 65	1.00%	1.50%
		1.50%	2.00%
	Above 65	0.00%	0.00%
		0.50%	1.00%

If the government chooses to implement our recommendations within twelve months, in 2028, the LTC insurance program can expect a tax revenue over 400 billion Bellos under this improvement, which are more than enough to cover the expenditure.

5.2 Trade-offs

Granted, manipulating the tax rate structure can significantly change the whole picture. However, there do exist some noticeable trade-offs that the government should consider before deciding whether to implement the recommendations. Most importantly, the government needs to put the public opinions into consideration. The 2017 representative survey of Bellagos citizens has shown that there are already 84% of citizens under age 65 with a household income of less than 75,000 believe that their contributions are too high. Hence, only raising tax income may lead to a potential unintended consequence: citizens become increasingly unsatisfactory about the LTC program. While ensuring citizens' LTC needs can be adequately met, the government can also consider cutting off some expenses. This policy will result in not only the desired decrease of payment, but also improvement of the public's impression on the reformed LTC insurance. Furthermore, since the survey also shows that 93% of citizens wish to stay autonomous in their home for as long as possible, changing the

structure of facility care and home care will also have a positive effect on decreasing expenses. Through our data manipulation, the ratio of people receiving home care versus those receiving facility care is steadily around 2:1 till 2028. If the government can let more people get home care, which is much less costly than facility care, and fewer get facility care, the deduction of care expenses is relatively optimistic.

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