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Life Pandemic Model Updates to U.S. Life Insurance Industry Moderate Scenario

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Updates to U.S. Life Insurance Industry Moderate Scenario

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Updates to U.S. Life Insurance Industry Moderate Scenario

The COVID-19 pandemic has disrupted lives worldwide, but it was not totally unexpected. Much as environmental scanning allows risk managers to anticipate emerging risks, historical research looked at pandemics and their potential impact on life insurance companies. The Society of Actuaries sponsored a report in 2007, written by Jim Toole, that provides a mechanism for a U.S. individual life insurance company to consider their liability exposure. In this research report, the 2007 report will be referred to as the Toole Life Pandemic Model.[1] The original report looked at the U.S. life insurance industry in aggregate, applying best estimates and Delphi surveys for assumptions where aggregated data was not available. Each company is unique, and the idea was to provide a starting point for companies to review their own exposure. Assets were not considered in the earlier report since there was no consensus about the impact under either of the two CDC scenarios.

In 2005 the U.S. Department of Health and Human Services developed two scenarios designed to help plan for future pandemics. They are labeled Severe and Moderate, and the CDC has used them in their analysis.[2] Both scenarios assume a population of 300 million in the U.S. and that 30% contract the virus. The Moderate scenario is designed to reflect assumptions similar to the 1957 and 1968 pandemics and results in 209,000 deaths (0.07% of the population). The Severe scenario represents the 1918 pandemic (all waves combined), resulting in 1,903,000 deaths (0.63% of the population).

Since then, the U.S. population has grown larger and aged. This report provides some takeaways from reviewing the assumptions from the Toole Life Pandemic Model against the CDC Moderate Scenario, considering current aggregated exposures and what is known so far about the current COVID-19 pandemic. The Severe Scenario, thank goodness, has so far not been representative of COVID-19. The Moderate Scenario, with 0.7 deaths per thousand population (approximately 225,000 U.S. deaths in total using current population levels) is a better benchmark for COVID-19 at this time. Note that this report uses this as a benchmark and not a projection or best estimate of deaths. Data for ongoing deaths by age used CDC data that had been updated to September 2, 2020.[3]

While maintaining the basic structure of the Toole Pandemic Life Model, this report updates several assumptions at a high level and shows the impact, using 2005 industry aggregates as a base and updating them to 2018. Many of the conclusions are similar, but the analysis provided surprising results that can be used as inputs to risk managers as they manage in-force blocks of business into the future. Each company is unique so an insurer should not rely on these approximations absent additional specific analysis. Consistent with the original 2007 report, this report does not analyze variables such as the impact of comorbidities, race, sex, air quality, economic hardship or length of lockdowns. It provides a first step for the risk manager assessing the potential impact on a block of business.

The Toole Life Pandemic Model combined a 38 page paper, including exhibits, with a standalone spreadsheet to help a company look at their own situation. Sources are documented and the methodology

[1] Toole, Jim. Potential Impact of Pandemic Influenza on the U.S. Life Insurance Industry. May 2007. https://www.soa.org/resources/research-reports/2007/research-impact-pan-influ-life-ins/

[2] https://www.cdc.gov/flu/pdf/professionals/hhspandemicinfluenzaplan.pdf HHS Pandemic Influenza Plan November 2005

[3] This paper was submitted September 20, 2020 and does not reflect information that became available after that date.

employed is described. This paper shows the impact of demographics representing an older and larger U.S. population across various excess mortality curves on current aggregate statutory surplus and Risk-Based Capital (RBC). A process to determine the impact of asset classes allows an analyst to measure sensitivities against surplus. While the methodology is designed to review a pandemic's impact on the U.S. life insurance industry, it is likely that readers will also find the process useful for other purposes. A mortality curve approximating the impact of excess deaths by age group due to COVID-19 was analyzed to compare the impact of coronavirus relative to prior pandemics. There are a number of caveats to consider with this research, and the reader should be careful of extending general results to a specific company.

Nothing in this analysis should be construed as investment advice. Companies must determine strategies after giving thought to their internal exposures and risks.

Key Takeaways

The top four takeaways from this review and update of the Toole Life Pandemic Model are

1. The U.S. population has increased by about 10%, from 2004 to 2019, and the mix is older. This increases the CDC Moderate scenario of 0.7 excess deaths (at all ages) per thousand from roughly 200,000 deaths to 225,000 deaths.

2. An excess mortality curve shaped like a "J", with excess deaths focused at older ages, reasonably approximates the COVID-19 experience so far.

3. The profitability of life insurance products is a small percentage of the life insurance industry in aggregate. Future reviews and stress tests of the life insurance industry should allocate more resources to fee based products as the combination of acquisition expense amortization catch-ups and lower fees on assets under management will drive results.

4. A lower tax rate has reduced the self-adjusting benefit when profits are stressed, increasing after tax profits but reducing resilience against negative tail events.

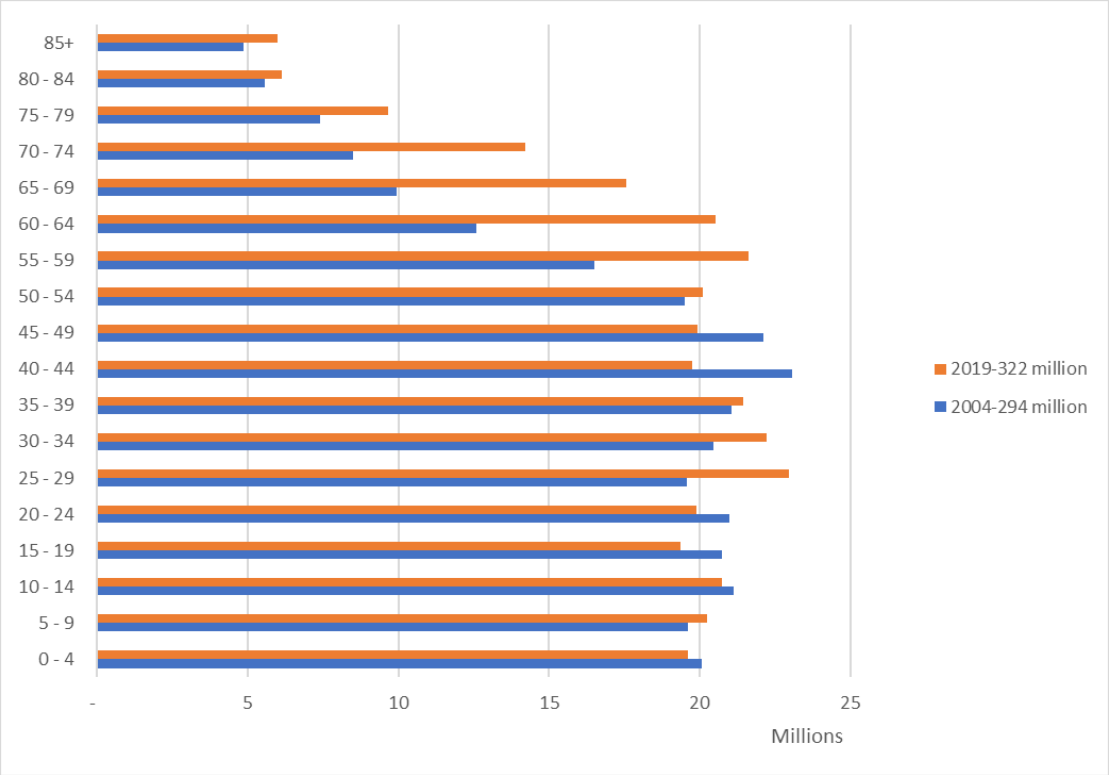
Section 1: Demographics

1.1 POPULATION UPDATE

One of the most important assumptions when analyzing a pandemic is excess mortality. In the Toole Life Pandemic Model the U.S. Census Population was projected to 2004 and presented in quinquennial age groups, with all ages 85 and above combined. The total population was estimated at that time to be 293,655,404. Since then the population has grown larger and aged. The total U.S. population was projected by the U.S. Census Bureau[4] at the end of 2019 to be 321,981,862 for an increase of nearly 10%. The report does not evaluate male/female splits or any other breakdowns, and all ages above 85 were again combined. These may be additional assumptions to consider when reviewing specific company business, along with splits based on factors like race and co-morbidities.

Figure 1

U.S. POPULATION CHANGES FROM 2004 TO 2019 BY AGE



COVID-19 CONSIDERATIONS: To date, the initial wave of mortality has focused on the elderly, with comorbidities often residing in nursing homes, along with younger workers at confined locations like meat packing plants. The current population trends older so it is more susceptible.

[4] www2.census.gov/programs-surveys/popest/tables/2010-2018/national/totals/na-est2018-01.xlsx

An aging population has a number of ramifications for the life insurance industry as the industry's sales force is aging along with the general population. It is not known how the insured population compares to this aging vector, or the role of reduced immigration.

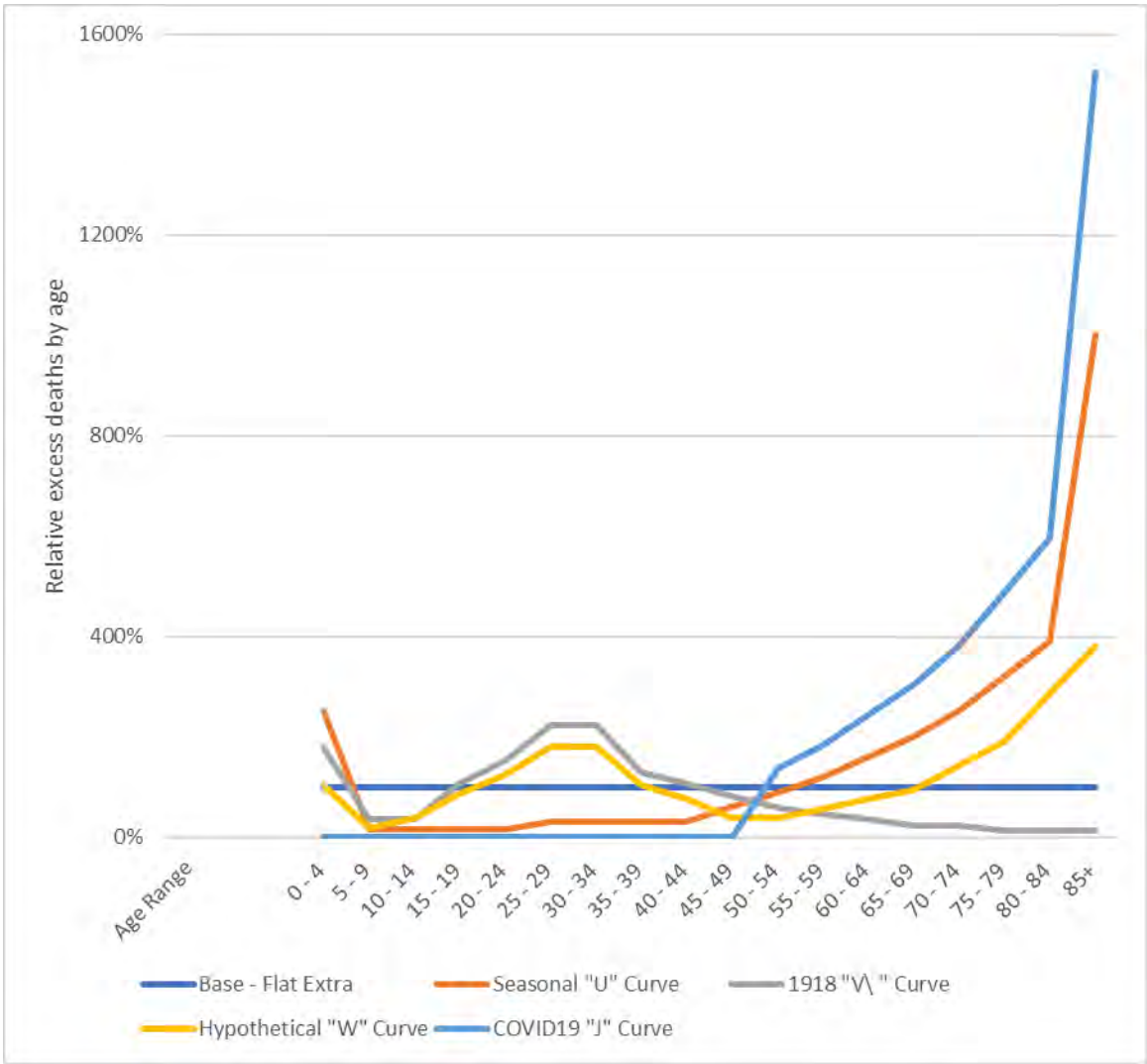
1.2 EXCESS MORTALITY CURVE

The Toole Life Pandemic Model considered four shapes for the excess mortality curve,[5] with each solving in total to 0.7 excess deaths per thousand. The first is a simple flat extra curve, applying the excess mortality rate equally to each age group. It can be used for expediency, and the results show that it can be a good first pass. The second curve is shaped like a "U", with both very young and very old impacted, with less impact on ages 5-54. This roughly estimates the 1957 and 1968 pandemics. The third curve, designated "V\", describes the 1918 pandemic (across all waves). It is known for its devastation of the young adult population. Deaths were not consistently reported by age groups at that time, but ages 15-35 were hit hard. The fourth curve is a "W", extending the "V\" curve with excess mortality for older ages.

For this report a fifth curve has been added, and based on a shape that will be referred to as the "J" curve. Excess deaths for the "U" curve have been zeroed out below age 50 and the remaining age groups increased so the total remains at 0.7 excess deaths per thousand using 2019 population levels.

[5] Excess mortality for pandemics has traditionally been considered additive, with additional deaths at each age grouping added to historical mortality assumptions. The excess mortality curve measures the additional mortality rate for each quinquennial age group. This rate corresponds with the population for that same age group to determine the number of excess deaths. The aggregate total is then divided by the total population to derive the population excess mortality rate.

Figure 2
CDC MODERATE SCENARIO – EXCESS MORTALITY CURVE SHAPE (0.7 EXCESS DEATHS PER 1,000)



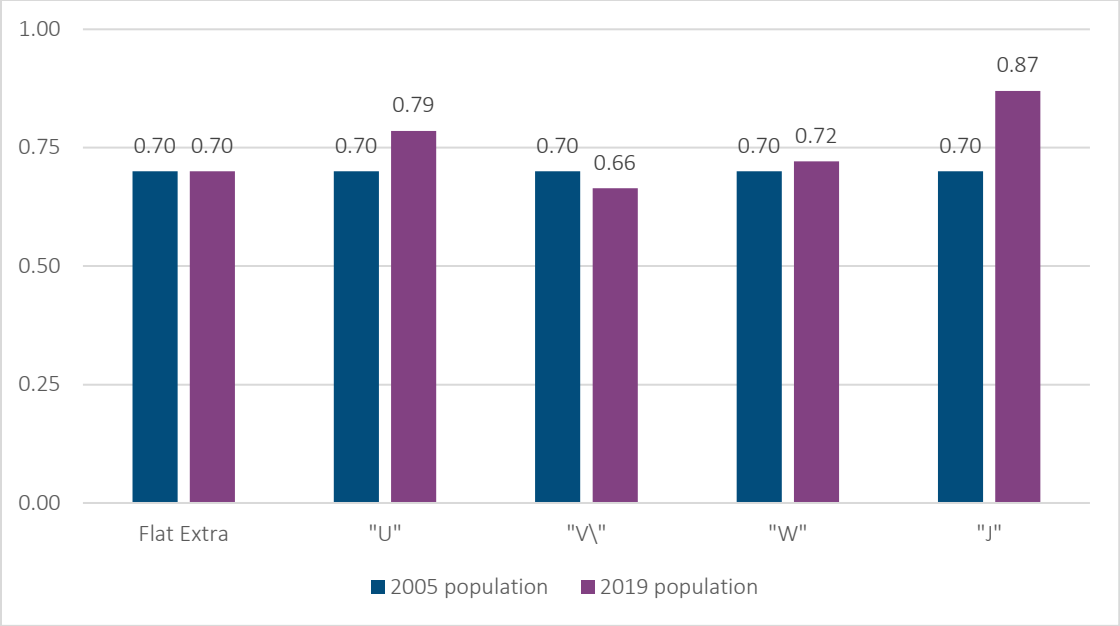
The shape of the curve matters for a life insurance company. Group insurance generally ceases at retirement, so excess mortality above that age is less important. Accumulation value products are more likely to be in force at older ages, with higher levels of reserves, so the "U" and "J" curves matter most for those writing those products. The "W" and "V\" curves will have excess deaths for life insurance products traditionally with the largest net amount at risk.

Only life insurance products have been considered here. Some annuities have a death benefit associated with them, but most would be expected to provide a countermeasure as annuitants die and reserve is released.

For purposes of this analysis, the "U" curve has been used as the base scenario as it approximates the shape of the underlying base mortality rates.

COVID-19 CONSIDERATIONS: The CDC Moderate scenario assumes 0.7 excess deaths per thousand population, and each curve was initially forced to this aggregate result despite the older population distribution found today. When the 0.7 excess deaths per thousand restriction is loosened to reflect the actual age distribution, the curves with greater exposure at higher ages show greater than 0.7 excess deaths per thousand aggregate results. Notable are increases for the "J" (.87) and "U" (.79) curves, and a decrease for the 1918 based "V\" (.66) curve. This provides an interesting demographic stress test to examine for analysis as demographic aging continues.

Figure 3
EXCESS MORTALITY COMPARISON

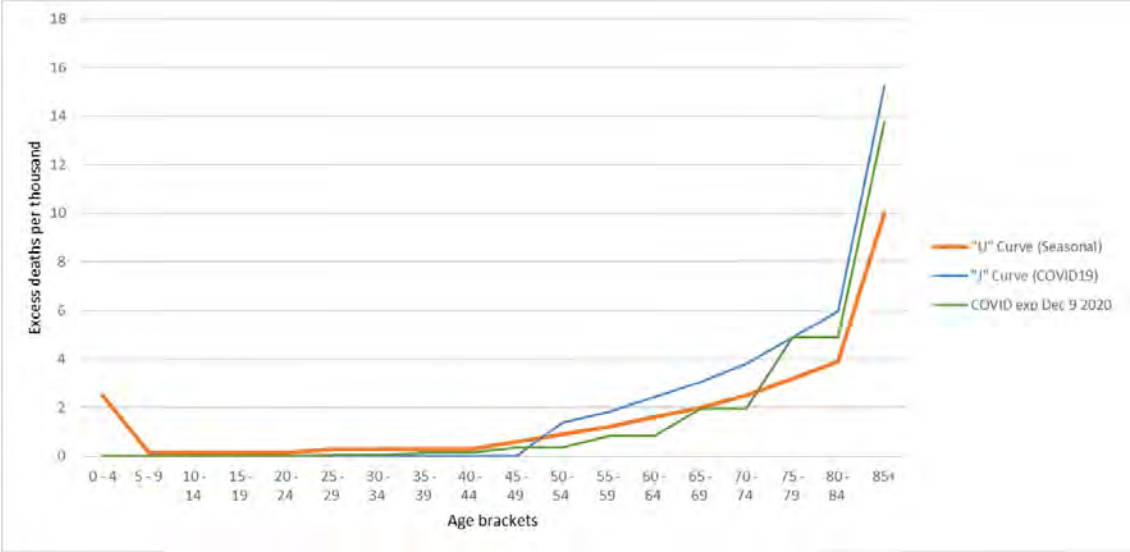


As a reasonableness check, the "J" and "U" curves were compared to actual U.S. reported experience as of September 2, 2020. [6] The current rate is .5196 excess deaths per thousand, and the curve was scaled up to be comparable with the "J" curve in total (.87 excess deaths per thousand). The shape is reasonable and when used in the aggregate, results are conservative for life insurers since the weighting is older than the smoothed "J" curve.

This could have ramifications to the life settlement and stranger owned life insurance industries, where investors end up owning a life insurance policy without insurable interest. The investor pays the premiums and collects the death benefit, benefitting from early death.

[6] https://data.cdc.gov/NCHS/Provisional-COVID-19-Death-Counts-by-Sex-Age-and-S/9bhg-hcku

Figure 4
MODERATE SCENARIO



Section 2: Insurance Assumption Changes and Results

The life insurance assumptions were left constant, with the exception of the corporate tax rate reduction from 35% to 21% to reflect the rate set by the Tax Cuts and Jobs Act. Readers should refer to the original paper for details regarding individual/group, direct/reinsurance and other assumptions as they model specific exposure levels. Industry aggregate assumptions were set by quinquennial age groups, estimating the percentage of the population owning a policy, along with average face amount for each age group. Assumptions were developed separately for individual and group policies.

The insured population was estimated in both iterations to have 57.1% of population mortality across all ages, with policy size and mortality adjusted by age grouping. An older mix, like that found using the "J" curve, increases the risk for individual blocks. No analysis was done with respect to race or co-morbidities.

Several publications have discussed aggregate excess deaths in percentage form rather than as additional deaths. According to the CDC FastStats Homepage (Deaths and Mortality), in 2017 there were 2,813,503 deaths for a death rate of 863.8 deaths per 100,000 population.[7] The number of deaths due to influenza and pneumonia was 55,672 (about 2% of the total deaths).[8] For both COVID-19 and influenza, it can be assumed that they also played a role in deaths due to other causes of death.

The CDC Moderate scenario that assumes 0.7 additional deaths per thousand corresponds to an 8.1% higher mortality rate. When the scenario was developed, the total additional deaths was about 200,000. Today, a larger population that is older would result in 225,387 additional expected deaths under this scenario. The final actual result of a pandemic will, of course, vary from this amount. This approach follows CDC assumptions, as well as the Toole Pandemic Life Model, that all deaths are concentrated in a single

[7] https://www.cdc.gov/nchs/fastats/deaths.htm
[8] https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_09-508.pdf National Vital Statistics Reports Vol 68 No 9 June 24, 2019

wave. Another approach, not considered here, would be to ratio up a typical mortality curve by the same amount at each age. As of September 2, 2020, the excess mortality attributed to COVID-19 was 51.96 per 100,000. If this grows to the .87 per 100,000 assuming higher impact at older ages the total deaths would exceed 270,000 in the U.S.

The Toole Life Pandemic Model considered, at a high level, offsets from other insurance products and these have not been updated. The offsets remain specific to company exposure and should be included in any detailed analysis.

Initially let's look at results from the original report using various shapes of the excess mortality curve

2.1 BASE SCENARIO – TOOLE LIFE PANDEMIC MODEL

The base scenario pulls information from the Toole Life Pandemic Model as shown in Table 1 of the original report, as shown below, focusing on the Moderate scenario. The key number is $2.8 billion extra net claims (after tax). It is a small percentage of 2005 statutory surplus in aggregate across the industry (1.1%). The Severe scenario data is included here but was not revisited.

Table 1
2007 LIFE REPORT - MODERATE SCENARIO U SHAPED, SEVERE SCENARIO V\

U.S Direct Life Insurance Industry Estimated Net Claims (Billions of Dollars)		
	Moderate Scenario	Severe Scenario
Individual	$1.3	$34.3
Group	$1.5	$30.0
Total	$2.8	$64.3
2005 Claims	$107.6	$107.6
% Claims	2.6%	59.8%
2005 Surplus	$255.7	$255.7
% Surplus	1.1%	25.1%
2005 RBC	$62.5	$62.5
% of RBC	4.5%	102.9%

If we use the "V\" scenario rather than the "U" scenario, the net after tax claims grow for the Moderate scenario to 5.0 billion, the flat scenario is 4.5 billion, the "W" scenario is 4.1 billion. The scenarios with more exposure to working ages have a higher total net claims amount.

2.2 UPDATES

Using data from the 2019 ACLI Life Insurers Fact Book,[9] the aggregate industry surplus for 2018 was updated to 418.688 billion, RBC to 98.7 billion and the tax rate was reduced to 21% (updated input is highlighted in the following charts). Face amounts, split between individual and group, and life claims were

[9] https://www.acli.com/posting/rp19-010

approximated using the ACLI aggregate numbers. The results for the Moderate scenario, paired with the "U" curve is shown in Table 2. While the impact is higher, surplus has grown to an extent where the event remains minor from a financial standpoint for the industry. The driver of this change is the lower tax rate, as additional claims are offset by a lower tax adjustment.

Table 2

MODERATE SCENARIO - U SHAPED EXCESS MORTALITY

U.S Direct Life Insurance Industry Estimated Net Claims (Billions of Dollars)	
	Moderate Scenario
Individual	$2.6
Group	$1.9
Total	$4.5
2018 Claims	$130.9
% Claims	3.4%
2018 Surplus	$418.7
% Surplus	1.1%
2018 RBC	$98.7
% of RBC	4.6%

Using the "Experience" curve, which ratios up current COVID-19 experience to .87 excess deaths per 100,000, the Moderate scenario has slightly lower after tax losses ($3.5 billion) due to excess mortality. Differences are minor and unlikely to lead to any tactical or strategic planning changes for the industry in aggregate. Results are shown in Table 3.

Table 3

MODERATE SCENARIO - EXPERIENCE (COVID-19) EXCESS MORTALITY

U.S Direct Life Insurance Industry Estimated Net Claims (Billions of Dollars)	
	Moderate Scenario
Individual	$2.0
Group	$1.5
Total	$3.5
2018 Claims	$130.9
% Claims	2.7%
2018 Surplus	$418.7
% Surplus	0.8%
2018 RBC	$98.7
% of RBC	3.5%

2.3 SIMPLE QUANTITATIVE ANALYSIS

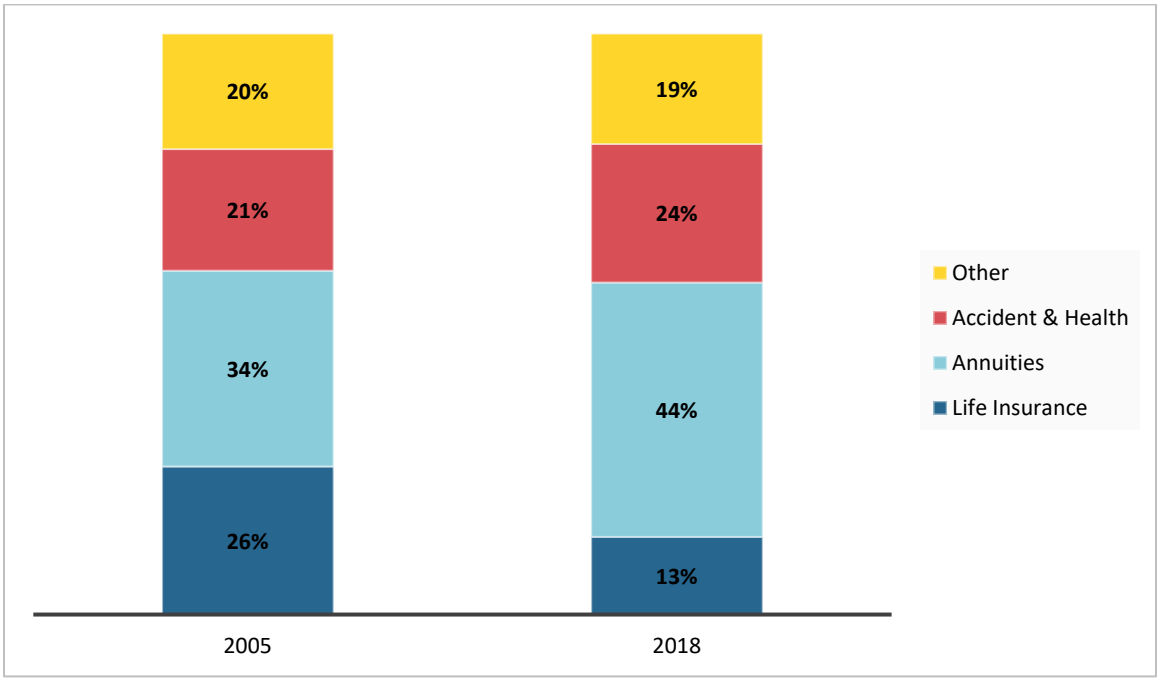
The flat extra deaths per thousand calculation allows the actuary to easily transition from qualitative analysis to starting to quantitatively assess the impact of a pandemic. A quick and dirty calculation takes an insurance company's net amount at risk (face amount net of statutory reserves) x excess deaths. This is a conservative calculation given that it assumes population excess mortality rather than (lower) insured excess mortality. This can be compared against statutory surplus, risk-based capital and other metrics to determine the expected impact.

Section 3: Life Insurance Mortality Materiality

One of the interesting takeaways from this analysis is the limited impact of mortality on industry aggregate life insurance company results. Per the 2019 ACLI Fact Book[10], the 2018 aggregate total net gain from operations after federal income taxes was $48.771 billion. Only 13% of that is attributable to life insurance. The comparable 2005 net income due to life insurance products was 26% (out of a total $37.551 billion) [11] Even a $5 billion hit to net income in one year is very manageable when industry aggregate income is this large, but when measured against the life insurance net income by itself, the hit would reduce industry income by 64%. Life insurance is not a dominant product line for life insurers in aggregate, although there are many insurers whose profitability is dominated by mortality risk products. Annuities, based on fee income and assets under management (although there is still longevity and mortality risk in some products and guarantees), represent 44% of total net income in 2018. This represents a move away from risk pooling, where the law of large numbers means that size is an advantage for the industry, to accepting systemic risk that is impossible to hedge over the life of the product (e.g., interest rate risk or equity risk). The risk to the annuity product line profits is driven by changes in asset market values, both as they apply to unrealized capital gains as well as expense amortization, but that impact is not considered in this analysis.

[10] https://www.acli.com/-/media/ACLI/Files/Fact-Books-Public/00FB19FFrontMatter.ashx?la=en
[11] Ibid from 2016 ACLI Fact Book

Figure 5
AGGREGATE LIFE INSURANCE NET INCOME



Section 4: Assets

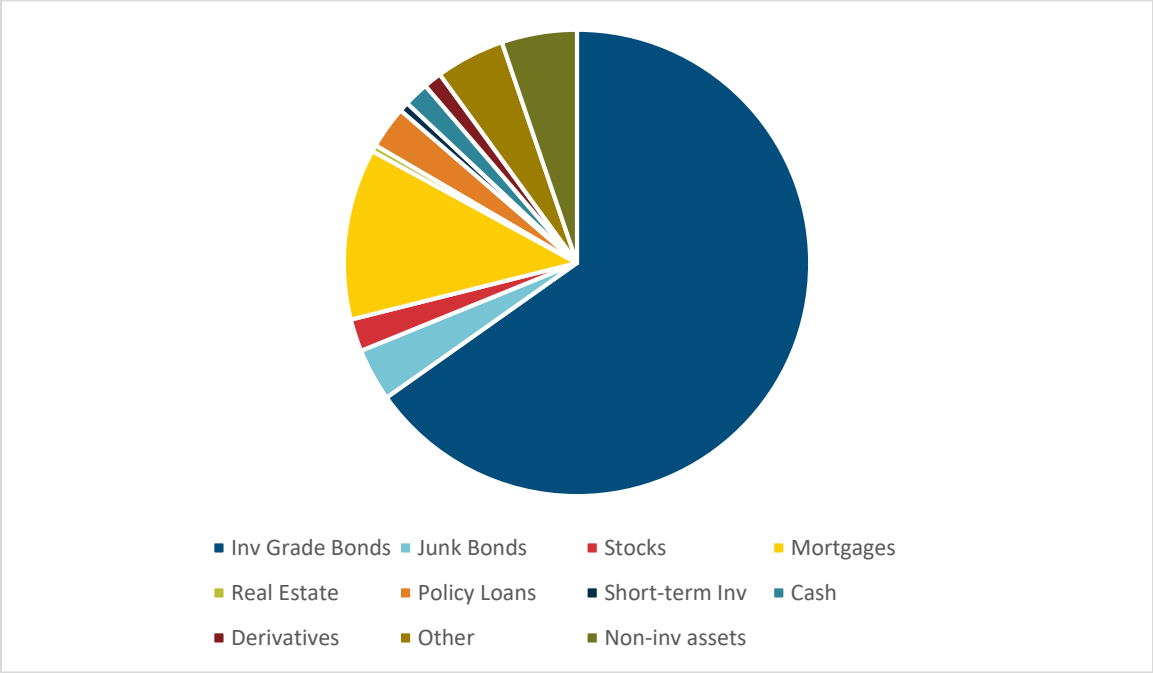
Focusing only on general account assets, aggregated industry analysis for assets is less useful since most companies diversify across fixed income asset classes but have one or two overweighted asset classes where they feel they have specific expertise to profitably accept additional risk. According to the ACLI Fact Book, in 2018 life insurers held $4.5 trillion of assets, backing all product lines, in the general account, and $2.5 trillion assets in separate accounts, for a total of $7.0 trillion. Statutory surplus is $0.4 trillion, so an isolated loss of about 9% of asset value would be enough to eliminate statutory surplus. If assets are matched to liabilities then the main impact would be from credit risk (defaults). A risk occurs when assets are marked-to-market while liabilities are not. Here you could have a matched block of general account business drive a statutory shortfall because assets were reduced while liabilities were not.

4.1 ASSET CLASSES

For general account assets held by life insurers, most are bonds and nearly 95% are investment grade. Further splits are available, so we know that the vast majority of mortgages are commercial (mortgage-backed securities are included with bonds). COVID-19, not surprisingly, initially created economic uncertainty that was reflected in asset prices. Fiscal and, especially, monetary stimulus has supported prices from a floor in March 2020 although, especially for small firms and stressed sectors it may not be enough to avoid defaults. Stagflation is also a risk. The modeler will need to decide if attempts at stimulus will be as effective in the future when another pandemic appears given the higher level of debt to GDP and the possible implementation of modern monetary theory (MMT). Building resilience is difficult without effective governmental support. Liquidity, and limits on leverage, become much more important without that safety net.

Scenarios could be generated that tell a story without being complicated. Some might be paired scenarios, such as whether stimulus was provided (today the result among life insurers would differ, for example, if fallen angels that started out as BBB were not backstopped by the Federal Reserve). Another scenario would be to look back historically to 1929 or another period of concern and estimate the impact on assets from that starting point. These are what-if scenarios that identify which product lines and events a company is susceptible to. The focus should be on a process. How do you stay proactive? Life insurance is an asset oriented industry with capital requirements. The Investment Policy Statement proved useful in the great financial crisis in 2008[12] and having that built-in stabilizer as a guideline is very helpful.

Figure 6
ASSET CLASSES 2018



4.2 REDUCTIONS IN ASSET VALUES

The impact on the income statement from asset defaults comes from general account assets since they generally are not passed through directly to the policy holder. Members of the investment department can help identify how much asset classes should be adjusted for market value to give the impact on a balance sheet. Those that need to be marked-to-market should be reduced immediately. What follows is an example of this type of analysis. The expected default level and stressed default levels are meant to be examples and not a safe harbor.

[12] https://www.soa.org/globalassets/assets/library/newsletters/risks-and-rewards/2013/march/rar-2013-iss61-rudolph.pdf March 2013 Risks & Rewards. Max Rudolph and Rick Beard. Why U.S. Insurers Fared Better than Banks: Did Key Differences give Insurers an Edge during the Financial Crisis?

Asset Class	Expected Default	Stressed Defaults/Losses
Investment Grade Bonds	0.3%	0.6%
Junk Bonds	2.0%	4.0%
Stocks	.	30%
Mortgages		15%
Real Estate		10%

Section 5: Potential Future Projects

The key takeaways from this research lead directly to some interesting projects that could be envisioned that relate to demographics. Clearly the population of the United States is aging, but is the insured population aging at the same rate? Can this analysis be done by race, and does the life insurance industry provide solutions equally across all races (and if not, how can it improve)? The actual excess mortality is more heavily weighted to the oldest ages than the "J" curve defined in this report.

Section 6: Acknowledgements

The researcher would like to thank Jim Toole, Dale Hall, Ronora Stryker and Jeff Czajkowski for comments made while this paper was being developed. All remaining errors remain the responsibility of the author.

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