INFLATION AND THE CALCULATION OF LIFE INSURANCE NEEDS

Michael L. Walden, North Carolina State University [1]

The element of inflation, or more precisely, the element of unpredictable inflation, can wreak havoc with life insurance requirements. It is obvious that an unpredicted jump in the inflation rate can reduce the "real" protection provided by a life insurance face value amount. But this paper will also show that even a predicted inflation rate will reduce the effective protection of a life insurance policy. Remedies and procedures for handling inflation in life insurance need calculations are offered.

Calculating the Life Insurance Face Value Amount

The major purpose of life insurance is to pay future expenses of financial beneficiaries in the event of death of the insured. For simplicity, assume the annual expenses (EXPENSES) are constant and that the financial dependents require coverage for Y years. The required face value amount is then:

$$(1)\quad \text{FACE VALUE} = \sum_{j=0}^{j=y-1} \frac{1}{(1+r)^j} \times \text{EXPENSES}.$$

The factor r is the discount rate. Discounting begins with the second year, assuming that this year's expenses would be needed immediately if the insured were to die now. Use of a discount rate implicitly assumes that when the insured dies the life insurance face value amount will be invested and earn interest at an annual rate of r. The face value amount and its interest earnings will be gradually drawn down to meet the expenses of the financial dependents (beneficiaries).

How does the inflation rate enter the calculations of equation (1)? The answer is that the inflation rate can be explicitly incorporated or it can be ignored, and it doesn't matter which tactic is taken. If future inflation rates are ignored, then equation (1) is calculated in "real" terms. Future expenses are real (adjusted for inflation) dollars, and the discount rate is a "real" rate, typically 2 or 3 percent.

On the other hand, if the future annual inflation rate, i, is incorporated in the calculations in equation (1), then notice what happens:

$$(2)\quad \text{FACE VALUE} = \sum_{j=0}^{j=y-1} \frac{1}{(1+r)^j \times (1+i)^j} \times \text{EXPENSES} \times (1+i)^j.$$

Annual expenses are inflated by the compound inflation rate, as is the real discount rate [note that the nominal annual discount rate is (1+r) x (1+i), not (1+r+i)]. As is easily seen, equation (2) reduces to equation (1), so the face value amount is the same. Table 1 demonstrates this with an example.

Table 1. Alternative calculations of face value amount.

A. "Real" Amounts; equation (1)

YEAR:	1	2	3
EXPENSE:	$1000	$1000	$1000
DISCOUNT FACTOR:	$\frac{1}{1.03^0}$	$\frac{1}{1.03^1}$	$\frac{1}{1.03^2}$
DISCOUNTED AMOUNT:	$1000	$970.87	$942.60

YEAR:	4	5
EXPENSE:	$1000	$1000
DISCOUNT FACTOR:	$\frac{1}{1.03^3}$	$\frac{1}{1.03^4}$
DISCOUNTED AMOUNT:	$915.14	$888.49

FACE VALUE: $4,717.10

B. "Nominal" Amounts; equation (2)

YEAR:	1	2	3
EXPENSE:	$1000	$1050	$1102.50
DISCOUNT FACTOR:	$\frac{1}{(1.03^0)\times(1.05^0)}$	$\frac{1}{(1.03^1)\times(1.05^1)}$	$\frac{1}{(1.03^2)\times(1.05^2)}$
DISCOUNTED AMOUNT:	$1000	$970.87	$942.60

YEAR:	4	5
EXPENSE:	$1157.63	$1215.51
DISCOUNT FACTOR:	$\frac{1}{(1.02^3)\times(1.05^3)}$	$\frac{1}{((1.03^4)\times(1.05^4)}$
DISCOUNTED AMOUNT:	$915.14	$888.49

FACE VALUE: $4,717.10

[1] Professor of Economics and Business.

The Problem Created by Inflation

What's the problem, then, created by inflation? It is this: As the insured lives an additional year, inflation has occurred during that year. This increases all future projected expenses. The face value amount would have kept up with the year's inflation if the face value had been invested, but it wasn't since the insured lived. The face value amount is now inadequate to cover the higher expenses. Call this the "inflation effect."

Counterbalancing the inflation effect, however, is the fact that as the insured lives a year longer, there is one less year of insurance coverage needed, assuming that the insured wanted coverage for an initial y years. This reduces the needed life insurance face value amount. Call this the "term effect."

How the combined inflation effect and term effect influence the life insurance face value amount as the insured ages depends critically on the size of the past inflation rate and the original number of years of insurance coverage (Y). The higher the past inflation rate, the more likely that the inflation effect dominates the term effect, especially in the early years of the life insurance term. As the life insurance term nears its end, the term effect will become dominant. Likewise, the greater the original number of years of insurance coverage, the more likely that the inflation effect dominates the term effect for a longer period of the life insurance term.

Some Examples

Suppose an insured wants to provide protection for 22 years (e.g., until a child completes four years of college). Assume real (inflation-adjusted) expenses to be covered by life insurance are $1000 annually. Assume the real discount rate is 3 percent.

Figure 1 shows how the required face value amount changes over the term of the life insurance policy assuming different past inflation rates. The dotted line shows the original face value amount. The graph clearly shows that the higher the past inflation rate, the greater the increase in the required face value amount. Also, the increase in the face value amount occurs for a longer period of time the higher the past inflation rate. For example, with a past inflation rate of 6 percent, the face value amount peaks at year 9, whereas with a past inflation rate of 10 percent, the face value amount peaks at year 14.

Table 2 shows the annual required percentage rates of change in the face value amount based on the same assumptions as in Figure 1. The rates of change are negative for inflation rates of 0 to 3 percent. For each inflation rate above 3 percent, the required rate of change begins as positive and then gradually declines. However, in all cases the required rate of change is less than the

Figure 1. Life insurance requirements, initial $1000 annual need, 3% discount rate, 22-year term.

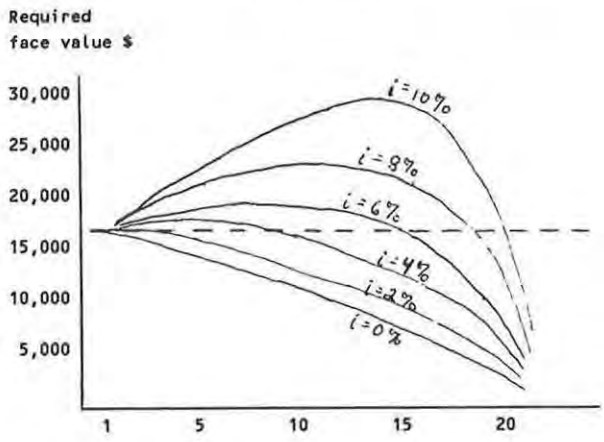


Table 2. Annual required rates of change in face value amount, 3% discount rate, 22 year term.

Change between years	- - Annual Inflation Rate - - 0%	1%	2%	3%
1- 2	---	---	---	---
2- 3	---	---	---	---
3- 4	---	---	---	---
4- 5	---	---	---	---
5- 6	---	---	---	---
6- 7	---	---	---	---
7- 8	---	---	---	---
8- 9	---	---	---	---
9-10	---	---	---	---
10-11	---	---	---	---
11-12	---	---	---	---
12-13	---	---	---	---

Change between years	- - Annual Inflation Rate - - 4%	6%	8%	10%
1- 2	0.6%	2.5%	4.5%	6.4%
2- 3	0.4%	2.3%	4.2%	6.2%
3- 4	0.1%	2.1%	4.0%	5.9%
4- 5	---	1.8%	3.7%	5.6%
5- 6	---	1.5%	3.4%	5.3%
6- 7	---	1.1%	3.0%	4.9%
7- 8	---	0.7%	2.6%	4.5%
8- 9	---	0.3%	2.2%	4.1%
9-10	---	---	1.7%	3.6%
10-11	---	---	1.1%	3.0%
11-12	---	---	0.4%	2.2%
12-13	---	---	---	1.4%
13-14	---	---	---	0.4%

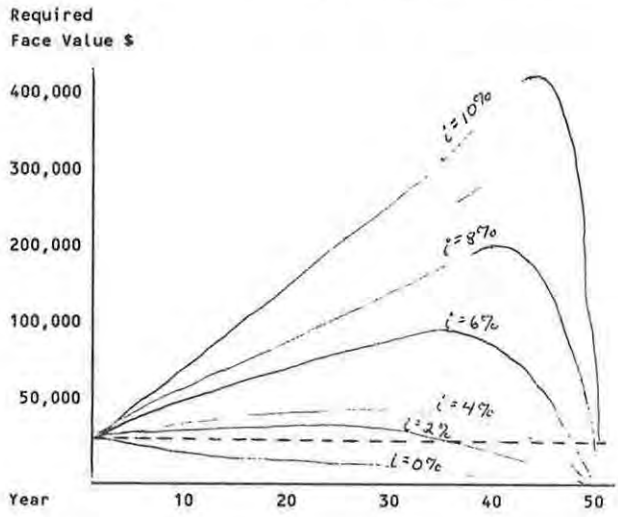
"---" = change is negative.

All changes for years 14-22 are less than zero.

assumed annual inflation rate. Mirroring Figure 1, the number of years required before the rate of change turns negative increases as the assumed inflation rate increases.

What happens when the insured wants protection for a considerably longer time period, say 50 years? Figure 2 and Table 3 show the required face value amounts when the original term of protection is 50 years. Now the required face value amount increases under all inflation rates.[1] Again, the rates of increase are greater the greater the inflation rate, and the peak in the required face value occurs later the higher the inflation rate. For example, in the case of an annual inflation rate of 4 percent, the peak in the face value amount occurs at year 32 at $49,766, 1.898 times the original face value amount ($26,502). With an annual inflation rate of 10 percent, the peak in the face value amount occurs at year 42 at $399,262, over 15 times higher than the original amount! However, in all cases the annual required rate of change is less than the assumed annual inflation rate.

Figure 2. Life insurance requirements, initial $1000 annual need, 3% discount rate, 50-year term.



Implications

The annual inflation rate, as measured by the change in the Consumer Price Index, has averaged 5.7 percent during the past 25 years. If this average continues in the future, then the analysis presented here suggests that insureds who don't adjust their face value amount as the insured ages will find their coverage to be inadequate.

In the case of an original insurance coverage term of 22 years, the insured can ignore inflation as the insured ages if the annual inflation rate is 4 percent or less (and annual real protection amounts are constant). In this situation, the declining income needs resulting from a reduction in the insurance term as the insured ages will counteract the increase in costs from inflation. However, at inflation rates above 4 percent there will be significant increases in the required face value amount as the insured ages.

For longer original insurance coverage terms, such as 50 years, as the insured ages the insured will have to adjust the face value amount whatever the inflation rate in order to maintain the amount of "real" protection.

These findings imply that it is important for life insurance consumers to consider how their face value amount can be altered over time to account for past inflation. Only in certain cases will the declining term of insurance protection, resulting from the aging of the insured, counteract the increasing costs from inflation.

One way to increase coverage over time is to simply buy more protection. If this is the tactic used, then it is probably wise for the insured to purchase a "guaranteed insurability" option.

Another way to increase coverage with participating policies is to use dividends to purchase paid-up coverage. Presumably, the higher the inflation rate, the greater will be dividends and the more paid up coverage which can be purchased. However, there is no assurance that the amount of paid up coverage which can be purchased will be an adequate amount.

A third option is to purchase a life insurance policy with a cost-of-living rider, thereby allowing the policyholder to increase the coverage by the previous year's rate of inflation. However, as both Tables 2 and 3 show, this method will result in too big of an increase in face value amount, and the size of the over-purchase increases as the insured ages.

A problem with all of the above options is how to reduce coverage in the later years of the policy term. This makes universal life insurance appealing. The face value component of universal life insurance can perhaps be most easily manipulated to follow the required pattern of life insurance needs.

Conclusions

Inflation causes a particular problem for the calculation of the life insurance face value amount. The problem is <u>not</u> in accounting for the future inflation rate when calculating a face value amount. As demonstrated in this

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[1] Although not shown, the required face value amount increases through year 4 when the assumed annual inflation rate is 1 percent.

Table 3. Annual required rates of change in face value amount, 3%, discount rate, 50 year term.

Change between years	- - - Annual Inflation Rate - - -					
	0%	2%	4%	6%	8%	10%
1- 2	--	1.1%	3.1%	5.1%	7.0%	9.0%
2- 3	--	1.1%	3.0%	5.0%	7.0%	9.0%
3- 4	--	1.0%	3.0%	5.0%	7.0%	8.9%
4- 5	--	1.0%	3.0%	4.9%	6.9%	8.9%
5- 6	--	0.9%	2.9%	4.9%	6.9%	8.9%
6- 7	--	0.9%	2.9%	4.9%	6.8%	8.8%
7- 8	--	0.9%	2.8%	4.8%	6.8%	8.8%
8- 9	--	0.8%	2.8%	4.8%	6.7%	8.7%
9-10	--	0.8%	2.7%	4.7%	6.7%	8.7%
10-11	--	0.7%	2.7%	4.7%	6.6%	8.6%
11-12	--	0.6%	2.6%	4.6%	6.6%	8.5%
12-13	--	0.6%	2.6%	4.5%	6.5%	8.5%
13-14	--	0.5%	2.5%	4.5%	6.4%	8.4%
14-15	--	0.5%	2.4%	4.4%	6.4%	8.3%
15-16	--	0.4%	2.4%	4.3%	6.3%	8.3%
16-17	--	0.3%	2.3%	4.2%	6.2%	8.2%
17-18	--	0.3%	2.3%	4.2%	6.2%	8.2%
18-19	--	0.2%	2.1%	4.1%	6.1%	8.0%
19-20	--	0.1%	2.0%	4.0%	5.9%	7.9%
20-21	--	--	1.9%	4.0%	5.8%	7.8%
21-22	--	--	1.8%	3.9%	5.7%	7.7%
22-23	--	--	1.7%	3.8%	5.6%	7.6%
23-24	--	--	1.6%	3.7%	5.5%	7.4%
24-25	--	--	1.4%	3.4%	5.3%	7.3%
25-26	--	--	1.3%	3.4%	5.3%	7.1%
26-27	--	--	1.1%	3.2%	5.2%	7.0%
27-28	--	--	1.0%	3.1%	5.0%	6.8%
28-29	--	--	0.8%	2.7%	4.9%	6.6%
29-30	--	--	0.6%	2.5%	4.5%	6.4%
30-31	--	--	0.4%	2.3%	4.2%	6.2%
31-32	--	--	0.1%	2.1%	4.0%	5.9%
32-33	--	--	--	1.8%	3.7%	5.6%
33-34	--	--	--	1.5%	3.4%	5.3%
34-35	--	--	--	1.1%	3.0%	4.9%
35-36	--	--	--	0.7%	2.6%	4.5%
36-37	--	--	--	0.3%	2.2%	4.1%
37-38	--	--	--	--	1.7%	3.6%
38-39	--	--	--	--	1.1%	3.0%
39-40	--	--	--	--	0.4%	2.2%
40-41	--	--	--	--	--	1.4%
41-42	--	--	--	--	--	0.4%
42-43	--	--	--	--	--	--

"--" = change is negative.
All changes for years 44-50 are less than zero.

paper, the future inflation rate can be easily incorporated into the face value calculations. The problem arises with the post inflation rate which has occurred as the insured lives another year. When the insured lives another year and the inflation rate which occurred during that year is incorporated into the face value calculations, the new required life insurance face value amount can be higher than the initial amount. This potential problem is more troublesome the higher the past inflation rate and the longer the original insurance term.

There are two important implications for life insurance consumers and insurance agents. First, required life insurance face value amounts should be recalculated periodically, probably at least every five years, to take account both of the past inflation and changes in the insured's remaining term. At each recalculation, prices and costs should be updated based on the inflation which has occurred since the last calculation. Second, in light of these findings, policies which allow the insured to easily change the face value amount, such as universal life, have a particular advantage. Changing the life insurance face value amount over the insured's life cycle to match the insured's needs and to reflect current costs will provide the correct amount of protection at the lowest cost.