Variable Lifetime Annuities:
Can You Live Long Enough
To Receive Fair Value?

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Abstract

This article presents an analysis of variable lifetime annuities and quantifies the advantages and disadvantages associated with this type of instrument. Given recent long-term rates of return and current low inflation rates, variable annuity contracts provide an effective means of compensating for inflation. An individual only needs to invest a small portion of retirement funds in variable annuities to protect the entire portfolio against the risk of long-term inflation without the risk of having one's entire retirement income based on variable annuities.

Introduction

This article presents an analysis of the characteristics of the variable form of lifetime annuity available through many insurance companies. The advantages and disadvantages of the variable lifetime annuity are discussed and the cash flow patterns are compared to those available from fixed rate annuities. Lifetime annuities provide a source of guaranteed income for the life of the purchaser. There are several varieties of lifetime annuities, but the majority will fall into the fixed or variable categories. Fixed annuities guarantee a specified rate of investment return and consequently the investor's future annuity income is known at the time the contract is purchased. Annuities based on variable investment returns do not provide this guarantee. Instead, variable annuities are intended to allow the purchaser the opportunity to earn greater rates of return. The

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price the purchaser pays for the advantages of the variable annuity is the risk of the unknown future investment returns plus a lower initial annual payment for a given investment amount. Although approximately 1,500 different variable annuity programs are in existence (Williamson, 1995, pp. 1) the oldest and one of the best known of the variable life annuities is the one created by the College Retirement Equities Fund (CREF) in 1952 (Johnson and Grubbs, 1971, pp. 15-16).

Lifetime Annuities

Lifetime annuities are different than fixed period annuities in that they incorporate the probability of each purchaser living to collect future payments. The calculations are based upon published mortality tables, actuarial adjustments for specific purchaser populations, and interest rate assumptions for discounting future cash flows. The goal of these calculations is to

insure that there is sufficient money in the annuity pool to pay every purchaser the amounts due to them and to have the pool exhaust its money when the last annuitant dies.

The combination of the purchaser's age and the assumed investment return result in an annuity factor, which is used to determine the initial payment the purchaser will receive. A representative table of lifetime annuity factors is presented in Table 1. These factors can be used to determine the initial payment received from a lifetime annuity assuming that the first payment is received on the date of the investment. To calculate the initial payment one need only find the factor at the intersection of the investor's age and the assumed interest rate, and then divide that factor into the amount invested in the annuity. For example, given a $100,000 investment at age 60 and a 4% interest rate, the table factor is 16.0585, so the annual payment at the beginning of the first year would be $6,227.23.

Variable Lifetime Annuities

Variable annuities are normally based upon an assumed investment return that is lower than that offered with fixed annuities, so that the payments from variable annuities will start lower than those from a fixed annuity and grow over time. The normal assumed investment return for variable annuities is 4 %. This rate of return is the basis for calculating the initial payment as well as future increases. Variable annuity payments are adjusted each year based on the prior year performance of the underlying investment portfolio. The change in the payment is calculated using the following formula: $(((1+i)/1.04)-1)$ x (Prior payment) = adjustment, where "i" is the investment return of the prior year. Given a first year payment of $6,227.23 and a 15 % investment return, the adjustment would be as prescribed: $(((1.15/1.04)-1)$ x ($6,227.23)) = $658.65. This would result in a payment of $6,885.88 at the beginning of the second year. If the same individual were to purchase a 7 % fixed annuity, the payments would be $100,000 divided by 12.0389 (table factor for 60 years of age and 7 %) or $8,306.41 at the beginning of every year for as long as the individual lived. In most cases payments are made on a monthly basis with changes made once each year. Annual payments are used here to simplify the illustrations.

Table 1
Lifetime Annuity Present Value Table Factors
Based on 1983 Table A (Merged Gender MOD 1) Actuarial Tables Set Back 2.0 Years

Age	4.0 %	4.5 %	5.0 %	5.5 %	6.0 %	6.5 %	7.0 %
55	17.4984	16.5032	15.6029	14.7861	14.0431	13.3656	12.7461
56	17.2246	16.2634	15.3922	14.6004	13.8791	13.2201	12.6168
57	16.9439	16.0167	15.1748	14.4083	13.7087	13.0687	12.4818
58	16.6562	15.7630	14.9504	14.2093	13.5318	12.9109	12.3407
59	16.3611	15.5019	14.7187	14.0032	13.3479	12.7464	12.1932
60	16.0585	15.2331	14.4794	13.7895	13.1567	12.5749	12.0389
61	15.7480	14.9565	14.2322	13.5681	12.9579	12.3959	11.8774
62	15.4299	14.6719	13.9771	13.3388	12.7513	12.2094	11.7086
63	15.1041	14.3795	13.7140	13.1016	12.5369	12.0152	11.5322
64	14.7711	14.0796	13.4434	12.8567	12.3149	11.8134	11.3485
65	14.4315	13.7728	13.1655	12.6045	12.0855	11.6044	11.1576
66	14.0860	13.4596	12.8809	12.3455	11.8492	11.3884	10.9599
67	13.7352	13.1405	12.5902	12.0801	11.6064	11.1659	10.7555
68	13.3796	12.8162	12.2938	11.8072	11.3575	10.9371	10.5448
69	13.0198	12.4870	11.9921	11.5316	11.1026	10.7022	10.3280
70	12.6561	12.1532	11.6852	11.2490	10.8419	10.4613	10.1051

Lifetime annuities are effectively a bet with an insurance company that the purchaser will live longer than average. If the average life expectancy of a 60 year old is 26 years, the formula used will provide the purchaser fair value only if the individual lives 26 more years. People who die earlier will not receive a fair return on their investments while people who live longer than 26 years will receive more than a fair return on their money.

The life expectancy bet with the insurance company is amplified with a variable annuity. Because variable annuities have lower payments in the early years and normally higher payments in the later years than do fixed annuities, the loss to those who purchase variable annuities and die before they reach their average life expectancy is normally greater than for those who purchase fixed annuities. Although the loss resulting from early death is greater with a variable annuity, the reward for living beyond the average life expectancy is also greater. A 60 year old investor who purchased a 7 % fixed annuity for $100,000 and invested $100,000 in a variable annuity that earned a 7 % annual return, would receive the initial payments calculated above ($8,306.41 and $6,227.23) at the beginning of the first year. If the investor experienced 3 % inflation during the investment period and died at age 70, he would have received a total of $79,162 (in constant age 60 dollars) from his fixed return annuity but only $68,115 from his 7 % variable annuity. It isn't until age 82 that the 7 % variable annuity exceeds the 7 % fixed annuity in cumulative constant dollar payout. If that person lives to the average life expectancy of 86 he will receive $165,703 from a variable annuity earning 7 % compared to $156,799 from a 7 % fixed annuity. Normally, the longer one lives, the greater the advantage of the variable

annuity, even given the same rate of return. The formula for the variable annuity annual adjustments results in a 2.88% increase every year when the investment earns 7 % return. The 7 % fixed investment return annuity payment does not change. Therefore, the longer one lives the greater the advantage of the constantly increasing annual payment.

The potential of the variable annuity to earn more than the rate of return paid on a fixed annuity offers advantages that can more than compensate for the risk of the market. The breakeven point (where cumulative constant dollar returns are equal for the variable and fixed annuities) occurs earlier for higher rates of return on the variable annuity. Table 2 shows the breakeven age and gain from variable annuity performance at representative investment return rates. When both the variable and fixed annuities return 7 %, the breakeven point (for the 60 year old experiencing 3 % inflation) is age 82. The breakeven point drops to age 76 for 8 %, age 69 for 11 % and age 66 for 15 %. The higher the likely rate of return for the variable annuity the earlier it will become more advantageous than the fixed annuity. Moreover, for

Table 2
Variable Annuities Compared to a 7 % Fixed Annuity
Age to Breakeven and Gain at Age 86
in Constant Dollars 3 % Inflation Rate

Variable Annuity Rate of Return	Breakeven Age	Age 86 Cumulative Constant Dollar Gain From Variable Annuity
4 %	86	$ -0-
7 %	82	$8,904
8 %	76	$30,578
9 %	73	$55,941
10 %	71	$85,674
11 %	69	$120,581
12 %	68	$161,618
13 %	67	$209,918
14 %	67	$266,827
15 %	66	$333,938

those who live to the average life expectancy (age 86 in this case) the cumulative constant dollars received increases with the rate of return. The excess of variable annuity cumulative total constant dollar returns over those coming from the 7 % fixed return annuity are $8,904 for a 7 % variable return, $85,674 for a 10 % variable return, $209,918 for a 13 % variable return, and $333,938 for a 15 % variable return.

Inflation Protection

A principle objective of the variable annuity is to provide protection against an increasing cost of living during retirement years. This goal is clearly stated in *TIAA-CREF Choosing Income Options* (1996, pp.40) where they state

A primary purpose of a variable annuity is to provide an income that has a reasonable chance to rise in dollar amount over the retirement years. A 4 percent assumption was originally chosen for the CREF Stock annuity income because historically 4 percent had been enough lower than the average annual total return on common stocks to offer an opportunity for such an increase to occur.

The $8,306 annual payment from a 7 % fixed return lifetime annuity during a period of 3 % inflation has a constant dollar buying power of $6,181 at age 70, $5,332 at age 75, $4,599 at age 80, and $3,852 at age 86. Given that 86 is the average life expectancy, the average person who purchases a fixed 7 % lifetime annuity and experiences 3 % inflation, can expect to lose 54 % of their purchasing power during their retirement. The variable annuity offers an effective inflation hedge when its annual returns are sufficient to compensate for inflation. The formula for determining the rate of return necessary to compensate for inflation is as follows: $((1 + AIR) \times (1 + IR) - 1)$ = Rate of Return, where AIR is the assumed investment return of the variable annuity and IR is the inflation rate. In our example, the AIR is 4 % and the inflation rate is 3 %, so the formula would be $((1.04) \times$

$(1.03) - 1) = .0712$ or a rate of return of 7.12 %. A return of 7.12 % results in a constant dollar annual payment equal to $6,227 over the life of the annuity. Returns in excess of 7.12 % result in an increasing constant dollar annual payment. A return of 15 % will result in purchasing power that doubles by age 70, and a constant dollar payment of $39,426 at age 86, for a 533 % increase in purchasing power during retirement for the average purchaser.

For many retirees using variable annuities for their entire retirement income would be excessively volatile and risky. As a consequence, investors may elect to mix fixed and variable annuities to have the variable annuities provide protection against inflation and the fixed annuities provide more stability. Table 3 provides an example of the results of investing $300,000 in a fixed 7 % lifetime annuity and $100,000 in a variable lifetime annuity earning 12 %, during a period of 3 % inflation. The constant dollar annual returns are for representative years from age 60 to age 100, and indicate that this investment mix has provided an excellent shield against inflation without adding excessive amounts of risk. One added benefit of the variable annuity is the very high returns if

Table 3
Annual Constant Dollar Cash Flow
from Mixed Investment in Fixed and Variable
Annuities to Hedge Against 3 % Inflation

Age	7 % Fixed Annuity $300,000	12% Variable Annuity $100,000	Age 60 Constant Dollar Cash Flow
60	$24,918	$6,227	$31,145
65	20,580	7,442	28,022
70	18,543	9,722	28,265
75	15,996	12,148	28,144
80	13,209	15,178	28,387
86	11,061	19,830	30,891
90	9,828	23,698	33,526
95	8,478	29,610	38,088
100	7,314	36,998	44,312

one reaches the age of 100 and is, in all likelihood, in need of assistance for daily living. Predicting future returns for variable annuities is difficult, however, the advantage of predicting for retirement planning is that the predictions are long-range and tend to be less volatile than near-term predictions. The compounded average annual rate of return earned by the CREF Stock Account for the past 45 years (1953 to 1998) is 11.7 % (TIAA-CREF Internet site).

Withdrawal Options

Between age 60 and age 70 the federal tax code encourages people to make withdrawal decisions concerning their tax-sheltered retirement accounts. Prior to age 59 ½ withdrawals can be subject to a 10 % additional tax penalty. Failure to begin systematic withdrawals by age 70 can also result in substantial tax penalties. As a consequence, a person age 60 with a substantial tax-sheltered retirement investment portfolio is faced with important decisions concerning how to withdraw their retirement savings. There are three basic options. First, annuitize the investments at age 60. Second, allow the investments to accumulate and delay annuitizing until a later date. Third, withdraw earnings each year and annuitize at a later date. The analysis depicted

in Table 4 shows the results of four representative strategies for withdrawal of a $100,000 investment using variable annuities as described above, given an investment return environment of 15 % and an inflation rate of 3 %. The investment return is held constant for both the accumulation and annuity periods, and the constant dollar analysis is based on age 60 constant dollars adjusted to reflect the 3 % inflation rate. For conservative investors who estimate an investment return of only six or seven percent, the magnitudes of the analysis would differ, but the basic relationships should remain constant so long as the investment return is held constant for both the accumulation period and the annuity period.

The first strategy is to annuitize the $100,000 at age 60. The second option is to allow the $100,000 investment base to grow at 15 % per year and annuitize that larger investment at age 65. The third strategy is to allow the investment to grow until age 70 and then annuitize. The last option shown is to withdraw the $15,000 investment earnings each year and annuitize $100,000 at age 70. Investment withdrawals are at the end of each year, after the money has been earned. Annuity payments are received at the beginning of each year, including

Table 4
Withdrawal Options Cumulative Age 60 Constant Dollar Cash Flows
with A 15 % Investment Return and 3 % Inflation

Age	Option 1 Annuitize At Age 60	Option 2 Alternative 1 Accumulate And Annuitize At Age 65	Option 2 Alternative 2 Accumulate And Annuitize At Age 70	Option 3 Withdraw Annual Earnings And Annuitize At Age 70
65	$44,945	$12,023	$-0-	$68,696
70	100,160	86,777	23,785	133,832
75	178,899	193,380	171,677	170,387
80	291,185	345,402	382,579	222,517
86	490,737	615,573	757,390	315,161
90	679,659	871,352	1,112,234	402,869
95	1,005,297	1,312,227	1,723,865	554,048
100	1,469,675	1,940,940	2,596,086	769,639

the first year.

The table shows the cumulative constant dollar amounts received at eight points in life from each of the four alternatives. For evaluation purposes, after-death cash residuals, which would flow through to estates or second parties, are ignored. Age 86 is shown in lieu of age 85, because 86 is the average life expectancy shown in the set-back merged gender life expectancy tables used by CREF for a person age 60. The "average person" will receive the amounts shown on the age 86 line.

At age 65, the third option is 53 % ahead of the first option in cumulative constant dollar cash flow. At age 70 it is still ahead by 34 %. At age 75 all four options converge, with the "accumulate and annuitize at age 65" option moving ahead by only 8 %. At age 80 both of the accumulate and delay annuitization options are moving ahead of the first option by substantial amounts, and this trend will continue as the individual ages. The average person who lives to be age 86 will gain 25 % ($124,836) in cash flow by accumulating and annuitizing at age 65 rather than annuitizing at age 60, while the person who accumulates and annuitizes at age 70 will gain 54 % ($266,653). For the buyers lucky enough to live to be 100 years old, the decision to annuitize at 65 will result in a 32 % ($471,265) increase in cash flow, and the choice to annuitize at age 70 will give them a 77 % ($1,126,411) increase in cash flow. On the other hand, those who elect the third option to withdraw earnings every year and annuitize at age 70 will lose 36 % ($175,576) at age 86, 41 % ($276,790) at age 90, and 48 % ($700,036) at age 100 compared to the first alternative. For an environment with an 8 % investment return and 3 % inflation, the results are comparable although the percentage gains and dollar amounts are less dramatic.

Conclusions

Lifetime annuities are a bet with an insurance company that annuitants lose if they die prior to reaching their average life expectancy. Living beyond their average life expectancy is how one wins this bet. In any case, the buyers are assured of receiving income from the annuities for the rest of their lives and this is the primary goal of lifetime annuities. A primary goal of variable annuities is to provide protection against inflation and the greater the return on the variable investment the more annual income will increase during retirement years. Historical return rates on the CREF Stock account (TIAA-CREF *Perspectives of Performance*) indicate that it would compensate for an average inflation rate of slightly over 7 percent. Higher return rates combined with lower inflation rates allow a small portion of an investment portfolio invested in variable annuities to protect the entire portfolio against inflation. Even with the current low levels of inflation, earlier retirements combined with increasing life expectancies make some form of inflation protection an essential component of retirement planning. The added bonus from a variable annuity is that it provides the security of substantial funds if one lives past 90 that might be needed for the high cost of assisted living during the latter years of life.

Suggestions for Future Research

Variable annuities back-load annuity income to provide reasonable assurance of protection against inflation. During periods of low inflation and high returns to variable annuities a portion of retirement savings invested in a variable annuity can protect the entire portfolio against inflation. An interesting question for future research is how investors have actually used variable annuities in combination with other instruments and how successful they have been in protecting retirement income against inflation. 📖

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