# Wharton Financial Institutions Center

# Policy Brief: Personal Finance

# Measuring the Tax Benefit of a Tax-Deferred Annuity

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# Measuring the Tax Benefit of a Tax-Deferred Annuity

ABSTRACT

In this study, we show how to measure the size of tax benefit arising from the purchase of fixed annuities – both deferred and immediate. We demonstrate how the size of tax benefit available from tax deferral depends on five factors: (1) the length of time the annuity is held during the accumulation and decumulation phases of ownership; (2) whether a deferred annuity is annuitized (either by conversion or by a 1035 exchange) at the end of the surrender period, or taken as a lump sum distribution; (3) the level of yields; (4) tax rates on ordinary income; and (5) the differential between tax rates on ordinary income and tax-preferred treatment of dividends and capital gains. We provide a set of formulae that can be used to estimate the size of tax benefit arising from tax deferral under varied scenarios.

## *1. Introduction*

Is there a tax benefit for individuals who place their funds in tax-deferred vehicles such as annuities as opposed to taxable accounts such as mutual funds? If there is a benefit, how large is it, what factors influence its size, and how does one measure it?

Hogan (1994) provides one such measure – *cross over years* – which represents the number of years it takes for a tax benefit in tax-deferred accounts to overcome the higher investment yield in taxable accounts. The analysis is limited primarily to variable annuities, where the yield differential that exists between variable annuities and their taxable counterparts accounts for insurance expense. Moreover, the returns in both types of accounts are treated as ordinary income and not capital gains.

Wood and Attaran (1997) compare four different account types – taxable, tax-free, tax-deferred (e.g., annuity), and tax-deductible and deferred (e.g., 401(k) plans). They show that taxable accounts are the least efficient of the four with respect to taxes. Their analysis is also based on the assumption that all returns are taxed as ordinary income and not preferentially as capital gains or dividends.

Hogan (1994) and Neimeyer (1999) mention that an individual can attain an additional tax benefit by opting for a payout in the form of an immediate annuity; however, neither author attempts to quantify this added benefit.

In this study we provide a general framework to assess the tax benefit of tax-deferred accounts relative to taxable accounts. This is done by distinguishing the returns in the taxable accounts to be of three kinds: (1) ordinary income taxed immediately at the investor's marginal tax rate, (2) capital gains taxed at the end of the investment time horizon at a preferred tax rate, and (3) dividends taxed immediately at a preferred tax rate. We consider the tax benefit over both the accumulation and decumulation periods. Our concern here is with living benefits available through both taxable and tax-deferred accounts. We do not consider stepped-up basis for inheritances in the case of death of the owner of a taxable account.

In Section 2, we discuss the major factors that influence the size of any tax benefit of a tax-deferred account over a taxable account.

Next, in Section 3, we present methodology and formulae to compute the after-tax payouts for both account types (tax-deferred and taxable) and both payout options (lump sum or immediate annuity). The after-tax payout for an individual electing the immediate annuity payout option is computed after determining her exclusion ratio, which dictates the percentage of annuity income that is excluded from taxable income.

Finally, in Section 4 we present the results using these formulae. The tax benefit of a tax-deferred account is expressed in terms of a *yield spread*. The yield spread is defined as the additional yield that an alternative, taxable account must earn in order to match the after-tax performance of a tax-deferred account. We show that in some situations, this yield spread can exceed 200 basis points per year under today's yield and tax environment.

Over the past several years, the benefit of tax deferral has been lower than historically, and probably lower than what will unfold in the future. This can be traced primarily to two factors, as will be shown later. First, tax rates – particularly dividend and capital gains tax rates – are at historic lows. Second, interest rates are flirting with low levels not seen since the 1950s. Our study is written at a time when tax schedules are likely to change. Coupled with the unprecedented borrowing requirements of our federal government, interest rates are unlikely to remain where they are currently. If tax rates and interest rates both rise, the tax benefit of annuities will increase beyond its current levels. The analysis that follows will provide charts and formulae that will enable the reader to estimate the tax benefit as these changes unfold.

## *2. Factors*

Several factors influence the 'yield spread' that measures the tax benefit of tax-deferred annuities over taxable accounts, including:

1. Investment yield
2. Investment time horizon (accumulation phase)
3. Portfolio allocation
4. Payout option – lump sum or conversion to an immediate annuity
5. Tax regime – capital gains tax, dividends tax, and ordinary income tax

Setting these factors equal across the two accounts can isolate the tax benefit. Most of these factors are easily set to be equal across both accounts for comparability purposes. They include investment time horizon, portfolio allocation, payout options, and tax regime. The investment yield is stochastic in nature and could vary depending on investment performance and expenses, but in order to focus solely on the tax-benefit, it is best to hold yields constant.

The portfolio in the taxable account is allocated between two types of assets: (1) assets that generate interest income, and (2) assets that generate tax-preferred income such as capital gains and dividends. We will examine various combinations of ordinary and tax-preferred income in the taxable account. Insofar as tax-preferred income factors into the taxable portfolio, we will assume that one-fourth of the tax-preferred income stems from dividend payments, while three-fourths relate to capital gains.[1] Because of the capital gains component of these yields, over time the asset values in the tax-preferred portion of the taxable account will climb to the extent that tax-preferred income plays a role. This will require a small amount of rebalancing in order to maintain constant proportions between ordinary income and tax-preferred income in

[1] Annual returns on the S&P 500 securities over the past several years have included an approximately 1.5% dividend yield as well as capital gains and losses. Because we will be assuming a 6% constant portfolio yield, the 1.5% historical dividend yield corresponds to one-fourth of the assumed total portfolio yield.

the taxable account. In this study we will ignore the tax consequences of rebalancing, which would otherwise favor tax-deferred annuities by a small amount (5 to 7 basis points per year).

We found that the tax benefit depends mainly on two factors: (1) the share of assets that generate returns with a preferred tax rate, and (2) the method of payout – lump sum or immediate annuity. Other factors, such as investment yield, investment time horizon (also referred to as accumulation period), and tax regime also influence the extent of the benefit and in a few cases can reverse the tax benefit. Because of the considerable uncertainty that exists regarding our current tax regime, we will ignore the traditional attraction of deferring income into a period when an individual is expected to face lower marginal tax rates.

## *3. Methodology*

The primary motivation of this study is to measure the tax benefit in terms of yield spread. We assume equal initial investments in the taxable account and the tax-deferred annuity. As the tax benefit depends on several factors mentioned above, we studied the effect of each factor independently while others are held constant. The following is a list of constant values assumed in our base case:

1. Investment yield of 6%
2. Accumulation period horizon of 14 years
3. Portfolio allocation of 50% or 100%
4. Tax regime
    a. Capital gains tax of 20% (5% state tax included)
    b. Dividends tax of 20% (5% state tax included)
    c. Ordinary Income Tax of 40% (5% state tax included)
5. Age at end of accumulation period is 65 years.

Later, each of these factors will be changed so that we can examine its effect on the value of tax deferral.

The formulae used in this study are presented in Appendix A. There are four formulae for two payout options and two account types – tax-deferred and taxable accounts. The yield for the taxable account is changed until the payout equals the tax-deferred annuity payout. The yield spread is calculated as the difference between the two yields.

Both payouts are calculated on an after-tax basis. In the case of an immediate annuity payout election, the after-tax income is calculated by factoring in the exclusion ratio that determines the taxable portion of the income.

### 3.1. Exclusion Ratio Calculation

For non-qualified accounts under the annuity payout election, both taxable accounts and tax-deferred accounts provide the benefit of some income being excluded from taxes. The amount of annuity income excluded is determined by an exclusion ratio, and is aimed at returning principal (i.e., tax basis) over time without incurring double taxation.

In the case when a tax-deferred account is converted into an immediate annuity through a 1035 exchange, the tax on the gains is further deferred until the gains are received as income. The equivalent of a 1035 exchange does not exist when converting a taxable account to an immediate annuity. Therefore taxes are paid when the taxable account is liquidated at the end of the accumulation period to enable the purchase of the immediate annuity. The exclusion ratio is defined by the following formula:

$$\text{Exclusion Ratio} = \frac{\text{Net Cost}}{\text{Expected Return Multiple} \times \text{Annual Income}}$$

Net cost is the original principal of the deferred annuity (for tax-deferred accounts) or the total accumulated value less taxes (for taxable accounts). The expected return multiple ($\beta$) is determined by Table V of IRS Publication 939 and is the same regardless of the source of the funds (taxable or tax-deferred accounts). Annual income can be derived by multiplying the accumulated value (less tax) by the annuity factor ($\bar{a}$).[2]

For example, a 65-year-old male who purchases a $100,000 immediate annuity will receive income of $8,704 annually. This individual has an expected return multiple of 16 according to IRS publication 939,[3] which implies that the individual has an expected lifespan of 81 years (16 years beyond age 65). Using the formula above, we obtain an exclusion ratio of 0.72, implying that 72 percent of the income generated through the immediate annuity is excluded from taxes for all payments until the individual reaches life expectancy. An 80-year-old male purchasing the same $100,000 immediate annuity would receive $12,287 of income annually. This individual's expected return multiple is 9.5. Using the formula above, we can determine that 86 percent of that individual's annuity income will be excluded from taxes. The exclusion ratio allows for the return of already-taxed principal (basis) over the remaining expected lifetime of the individual. The exclusion ratio is higher for the 80-year-old individual than for the 65-year-old because the expected remaining lifetime is shorter for the 80-year-old (9.5 years) than for the 65-year-old (16 years).[4]

## 3.2. Effect of Exclusion Ratio

The tax-deferred account can be annuitized, or swapped into an immediate annuity through a 1035 exchange. Neither of these is a taxable event. Therefore, the annual income for the tax-deferred account is derived using the entire accumulated account value, whereas the annual income for the taxable account is derived using the accumulated account value, less taxes paid. The result is a higher gross monthly income for the tax-deferred account compared to the taxable account.

Conversely, the exclusion ratio is greater for immediate annuities purchased through taxable accounts than for those purchased through tax-deferred accounts. This is due to two factors. For immediate annuities purchased through taxable accounts, the 'net cost' (numerator) is defined as the accumulated balance less taxes; for immediate annuities purchased through tax-deferred accounts, it is defined as the original principal used to purchase the tax-deferred annuity. Therefore, unless all of the portfolio gains on the taxable account were lost to taxes, the net cost for taxable accounts is larger than that for tax-deferred accounts, assuming positive returns on investment. Additionally, the 'annual income' (denominator) is smaller when one liquidates a taxable account to purchase an immediate annuity than when one liquidates a tax-deferred account to do so. This is because liquidating the tax-deferred account does not trigger a tax event, but liquidating a taxable account will result in ordinary income tax as well as capital gains tax. This leaves a smaller amount in the taxable account with which to purchase the annuity.

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[2] For this analysis the source of the annuity factor is www.vanguard.com, February 2008.

[3] The IRS Table V is based on population mortality data, rather than mortality rates that reflect those of the people who actually purchase annuities. The life spans of those who annuitize are 14-18% longer, on average, than those of the population at large. Accordingly, purchasers of annuities benefit from the IRS use of population mortality tables, because in effect they receive accelerated tax benefits through the exclusion ratio, sooner than their life expectancy.

[4] The mortality table used by the Internal Revenue Service does not reflect the longer life expectancies of individuals who normally purchase annuities. This confers an additional tax benefit to annuity owners, who receive a faster return of their principal than would be the case were the Service to use mortality tables applicable to annuity purchasers.

In the example above, a 65-year-old male uses taxable funds to purchase a $100,000 immediate annuity and has an exclusion ratio of 72 percent. If the same individual used an existing tax-deferred annuity to purchase the same $100,000 immediate annuity, then his net cost would be less than $100,000. It would be the cost to purchase the original tax-deferred annuity. Suppose he spent $50,000 to purchase a tax-deferred annuity that is now worth $100,000 (i.e., the annuity earned $50,000 in investment gains), then the exclusion ratio for the individual would be 35 percent. In order to demonstrate how the exclusion ratios differ for the taxable and tax-deferred, it is assumed that the individual will purchase a $100,000 immediate annuity in both cases. However, a taxable asset worth $100,000 will have less purchasing power than a tax-deferred asset worth the same amount.

The following section presents the results of our analysis using the formulae and assumptions stated in this section.

## *4. Results*

We first outline the results of adjusting the factors affecting the tax benefit of a tax-deferred annuity. Our analysis looks at a taxable portfolio with 50% to 100% of ordinary income. We do not analyze a taxable portfolio that has no ordinary income, because we are comparing the tax implications of fixed annuities (traditional or indexed) to taxable portfolios. A taxable portfolio with no ordinary income would be all equities, or municipal bonds. Equity returns are vastly different from the returns and guarantees associated with deferred annuities. Also, municipal bonds do not provide the same pre-tax yields as taxable bonds of similar tenor and credit quality.

### 4.1. After-Tax Annual Income

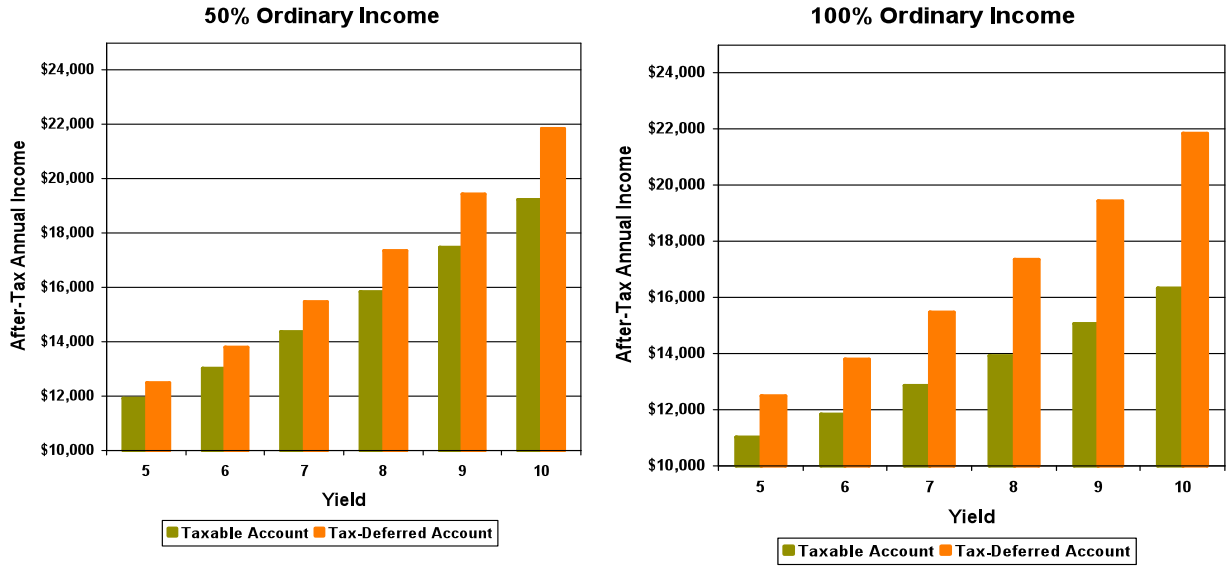
We compare the after-tax annual income of both the tax-deferred annuity and the taxable account after they are converted to an immediate annuity. In later sections we present the results for both payout options – immediate annuity and lump sum payout. Though both payout options exist, converting to an immediate annuity is a logical choice for an individual whose goal is to maintain his current income level during retirement.

Because the exclusion ratio is different for the two accounts, using before-tax income to assess the tax advantage could yield inaccurate results. Therefore, we use after-tax income to compare the tax advantage between the two accounts. We assume that the individual who is converting is a 65-year-old male. Our conclusions are similar for females. In Section 4.5 we adjust the age of the individual and present our results.

Figure 1 shows the after-tax annual income for both account types for $100,000 invested at the beginning of a 14-year accumulation phase. Regardless of the yield, the after-tax annual income is greater for the tax-deferred account compared to the taxable account.[5] For example: a taxable account with 100 percent ordinary income and a yield of seven percent will produce $2,500 less in annual after-tax income than a tax-deferred account with the same yield. This difference increases as the yield rises.

[5] Here we compare the after-tax annuity payments only through life expectancy. Beyond life expectancy, the exclusion ratios no longer apply and both accounts are taxed identically. More will be said about this later.

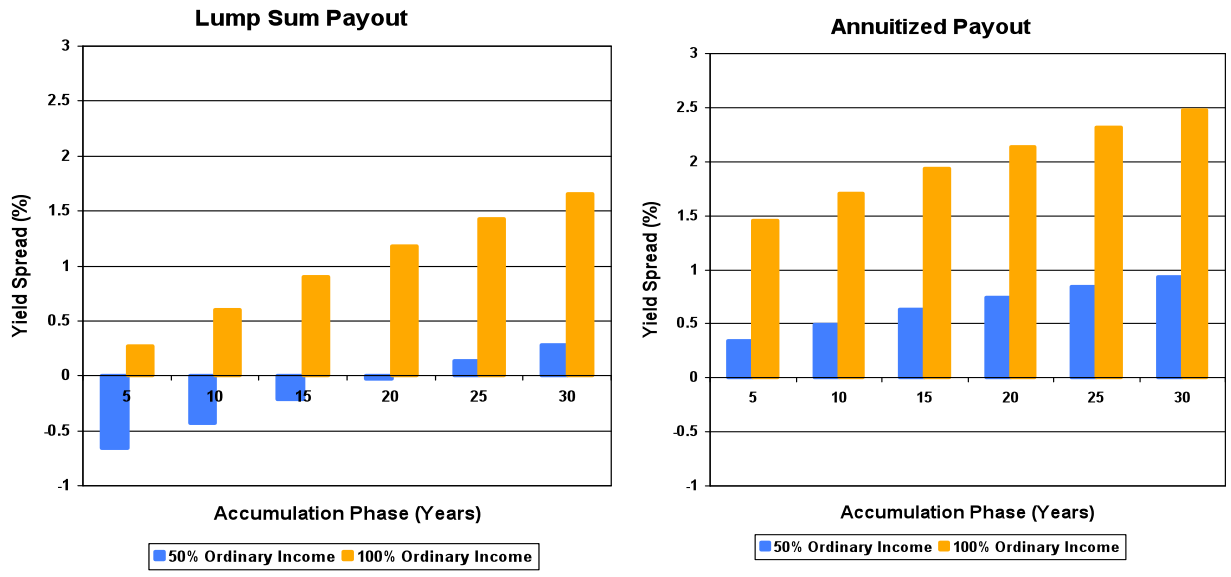
**Figure 1: After-Tax Annual Income per $100,000 Invested**




## 4.2. Investment Time Horizon

Here we measure the tax benefit in terms of the "yield spread" as the accumulation horizon is adjusted from five to thirty years, while assuming the base case where both accounts earn 6% annually. A positive yield spread means the taxable account must out-perform the tax-deferred account in terms of pre-tax yield. Figure 2 shows results for both payout options – lump sum and immediate annuity.

**Figure 2: Effect of Time Horizon on Yield Spread**




If the payout is taken as an immediate annuity (right panel), then the yield spread is positive for all time horizons and for any portfolio that has 50 percent or more returns as ordinary income. If the payout is taken as a lump sum (left panel), the yield spread is positive provided that the time horizon is greater than 20

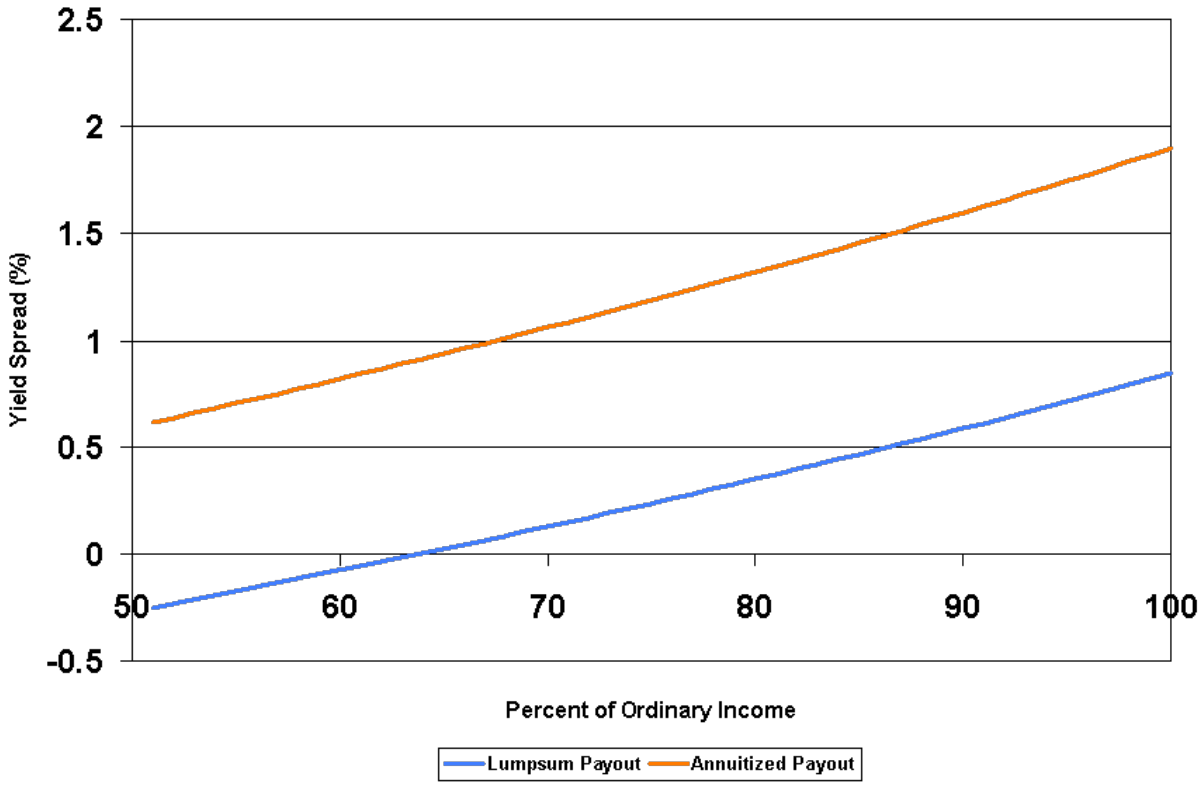
years or if 100 percent of the assets produce ordinary income, but the yield spread is negative for durations less than 20 years and where only 50 percent of the assets produce ordinary income.

For example, under a 15-year accumulation period, if an individual purchased a taxable investment comprised entirely of assets that generate ordinary income and she decided to annuitize the payout at age 65, then she would need to earn an additional yield (yield spread) of around to two percent annually. The yield spread is close to one percent if the individual opts for a lump sum payout regardless of the age the payout is received. This figure shows that in most cases, assets invested in tax-deferred accounts will achieve greater yields than assets invested in taxable accounts. Only by purchasing assets that generate capital gains and/or dividends (generally these types of assets are considered to be riskier) and electing for a lump-sum payout can an investor who purchases taxable assets expect to match or exceed the yield she would achieve by purchasing tax-deferred assets.

### 4.3. Percentage of Ordinary Income

The percentage of ordinary income specifies the portion of the portfolio generating returns that are taxed at ordinary income tax rates (which are higher than the capital gains tax rate). The remainder of the portfolio generates returns that have a preferred tax rate.

**Figure 3: Effect of Ordinary Income on Yield Spread**




The dotted line in

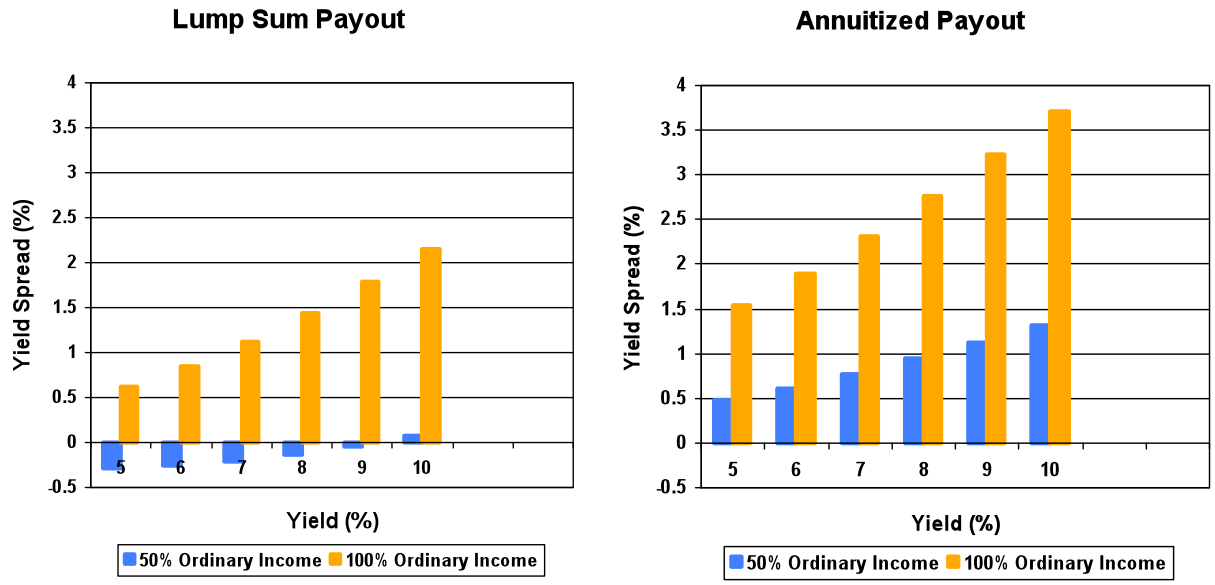
Figure **3** shows that for an annuitized payout option, the yield spread is positive and increasing as the portion of returns in taxable accounts attributed to ordinary income increases from 50 percent to 100 percent.

The solid line shows that the yield spread is positive for lump-sum payouts when at least 65 percent of the returns in the taxable accounts are attributable to ordinary income. A positive yield spread implies that in order to match the periodic payouts of a tax-deferred annuity an individual investing in a taxable account must either invest more initial principal or seek investments with greater yields than the tax-deferred investment.

## 4.4. Investment Yield

In this section, we adjust the investment's assumed yield on both accounts over a range from five percent to ten percent and measure the impact on yield spread. Figure 4 shows the results of our analysis.

**Figure 4: Effect of Investment Yield on Yield Spread**




If an individual elects an immediate annuity payout (right panel), then the yield spread is positive for all investment yields when the portfolio has 50 percent or more returns as ordinary income. If an investor elects a lump-sum payout (left panel), the yield spread is positive when 100 percent of the portfolio assets yield is ordinary income or when the investment yield is in excess of 9 percent.

This implies that the investor who purchases taxable investments will need to hold more of the assets that generate capital gains (which generally carry more risk) and opt for the lump-sum payout in order to match or exceed the performance of a tax-deferred annuity. The yield spread for individuals who choose to convert to an immediate annuity is close to two percent even when the investment yield is about six percent. The yield spread is an increasing function of investment yield. This implies that the yield spread increases as investment yield increases regardless of the payout type or portfolio composition. In fact, there is a yield spread in excess of 3.5 percent in certain cases when the payout is taken in the form of an annuity (right panel).

## 4.5. Age at Conversion to an Immediate Annuity

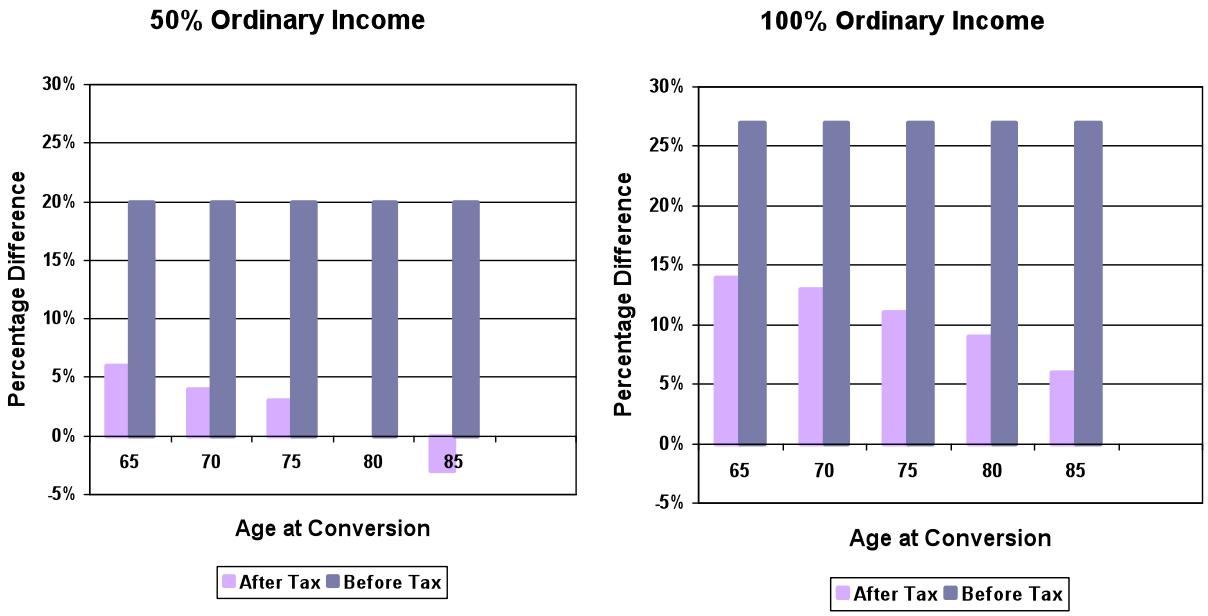
The age at conversion to an immediate annuity impacts the size of the tax benefit of the tax-deferred annuity. Federal law dictates that the principal used to purchase the annuity is returned to the annuity holder by

the time she reaches her expected conditional lifetime (which is the same increment to age as the 'expected return multiple' in the exclusion ratio). This return of principal is not taxed. This law is implemented in the exclusion ratio, which increases as one ages, all other variables remaining constant.

Exclusion ratios are larger for taxable accounts than for tax-deferred accounts because the net basis is greater for taxable accounts (see section 3.1). Note that a larger exclusion ratio does not necessarily mean that annuities purchased through taxable accounts have a tax advantage. This is because the gross income would be lower for taxable accounts when compared to tax-deferred accounts, assuming that both accounts started with the same initial investment and earned the same gross rate of return during the accumulation phase. Furthermore the difference between the exclusion ratios (spread) is greater at older ages of annuitization. Therefore by converting at a younger age, the taxable accounts will have a tax disadvantage.

The exclusion ratio does not impact taxes after one reaches his expected conditional lifetime. At this age and beyond, all income is taxed. Therefore, after one reaches his 'expected conditional lifetime', before-tax income is a good metric by which to compare the two account types; after-tax income is a good metric by which to compare the two account types before one reaches his 'expected conditional lifetime'. Figure 5 shows the percentage by which annual income from a tax-deferred account exceeds (or lags) annual income from a taxable account.

**Figure 5: Excess Income at Conversion to Immediate Annuity for Tax-Deferred Investments versus Taxable Investments**




In the left panel (50 percent ordinary income) at age 65, annual income from a tax-deferred annuity will exceed annual income from a taxable account by 20 percent on a before-tax basis and by 6 percent on an after-tax basis. We can infer from this figure that the only situation where an investor is better off purchasing a taxable investment, other things equal, is the case where 50 percent of the income generated is ordinary income and the investor converts to an immediate annuity at age 80 or older. In all other cases, our analysis shows the investor is better off purchasing a tax-deferred investment. This implies that in the only

case when the taxable account is more favorable, seniors are required to hold a high percentage of assets in risky investments over an extended period of time because they generate tax-preferred returns.

## 4.6. Tax Rate Sensitivity

Until now the tax rate used was 40% for the ordinary income tax and 20% for capital gains and dividends. Both these tax rates include a 5% state tax. To measure the sensitivity to tax, the tax rate is lowered and the results are compared to the results obtained in the previous sections. The lower tax rate is changed to 28% for the ordinary income tax and 18% for capital gains and with a 3% state tax. The state tax component is only 3% due to the assumption that the state marginal tax rate decreases gradually as the federal tax rate decreases.

The measure of the tax benefit is still expressed as "yield spread". In some cases the higher tax regime has a higher "yield spread" than the lower tax regime. A bigger "yield spread" does not imply a bigger payout, but instead implies that the benefit over a taxable account is bigger. Therefore, the "yield spread" of the lower tax regime may be lower but the payout could be larger than under the higher tax regime.

The tax sensitivity results are presented here for two cases: (1) Varied time horizon, and (2) varied yield. The other results follow a similar pattern that leads to similar conclusions.

### *4.6.1 Investment Time Horizon and Tax Rate Change*

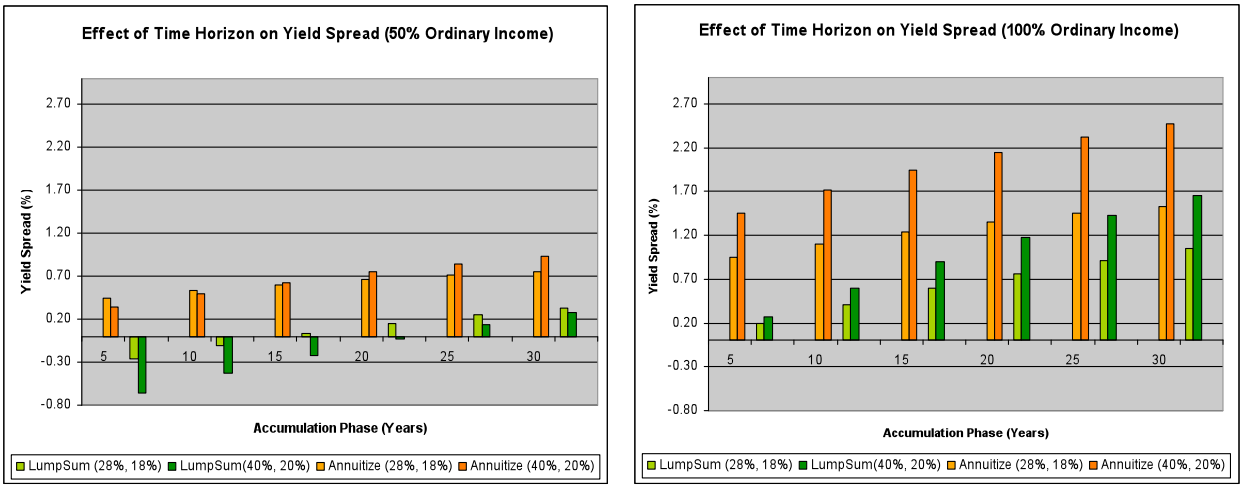
Under a 40 percent tax rate, the taxable account with 50 percent ordinary income and a lump sum payout has a tax benefit for cases where the investment time horizon is short. When the tax rate is 28 percent, the tax benefit of a taxable account is either reduced or entirely eliminated in some instances. This is because the spread between the ordinary income tax rate and the capital gains tax rate is diminished under the lower tax rate. For example: under the higher tax rate, some of the returns in the taxable account is taxed at a preferred capital gains rate of 20 percent, while the tax-deferred account is taxed at 40 percent. But, under the lower tax rate, some of the returns in the taxable account are taxed at 18 percent, while the returns in the tax-deferred account are taxed at 28 percent. Therefore, the size of the benefit to the taxable account is diminished under the lower tax rate when the taxable account generates 50 percent ordinary income. These results can be seen in the first panel in Figure 6.

When the portfolio is 100 percent ordinary income, the lower tax rate reduces (but does not eliminate) the yield spread for the tax-deferred accounts (even for time horizons as short as five years). This is because with 100 percent of the taxable portfolio generating ordinary income, there is only one tax rate applied to all the returns in the taxable and tax-deferred portfolio. All other factors being equal, an individual who falls within the higher tax bracket can reinvest a bigger portion of returns in the tax-deferred account as compared to a taxable account. This results in a bigger yield spread for the higher tax rate than for the lower tax rate. The second panel in Figure 6 shows these results.

When the portfolio is 50 percent ordinary income and an individual elects payout through an immediate annuity, the results are mixed when the tax rate is reduced. For longer time horizons, the higher tax rate offers a greater yield spread; while for shorter time horizons, the lower tax rate offers a greater yield spread. The reason is that a longer time horizon enables more returns to be reinvested (and taxes deferred) when the tax rate is higher. Therefore, for long time horizons, a higher tax rate results in a larger yield spread. Conversely, for short time horizons, the deferral period is too short for a higher tax rate to have significant impact on the yield spread. The factor that impacts the yield spread at shorter time horizons is the differ-

ence between the ordinary income tax rate and preferred tax rate. Under lower tax rates, this difference is only 10 percent, compared to 20 percent at higher tax rates.

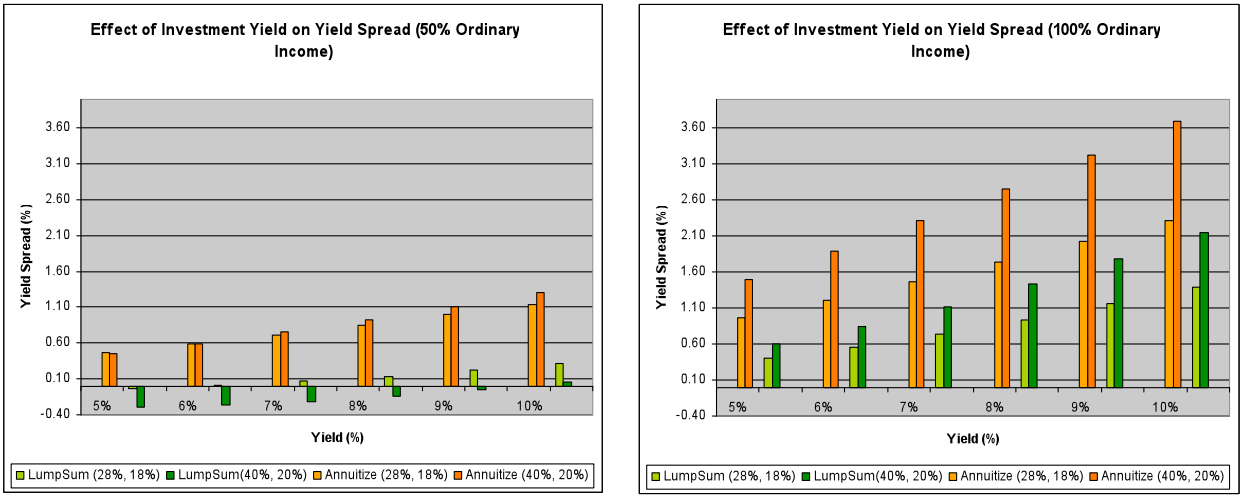
**Figure 6: Effect of Time Horizon on Yield Spread for both Tax Rates**




*4.6.2 Investment Yield and Tax Rate Change*

The effects of adjusting the investment yield are similar to the effects of adjusting the investment time horizon (Section 4.6.1) and are presented in Figure 7. Under a 40 percent tax rate, the taxable account with 50 percent ordinary income and a lump sum payout has a tax benefit in certain instances when the investment yield is small. But, when the tax rate is 28 percent, the tax benefit of a taxable account is reduced or entirely eliminated in some cases. Again, this is because the spread between the ordinary income tax rate and the capital gains tax rate is less under the lower tax rate.

**Figure 7: Effect of Investment Yield on Yield Spread for both Tax Rates**




When the portfolio is 100 percent ordinary income, the lower tax rate reduces (but does not eliminate) the yield spread for the tax deferred accounts (even for small investment yields of 5 percent). Again, this is because when 100 percent of the returns on the taxable portfolio are in the form of ordinary income, there is only one tax rate applied to all the returns in the taxable and tax-deferred portfolio.

When the portfolio is 50 percent ordinary income and an individual elects payout through an immediate annuity, the results are mixed when the tax rate changes. For larger investment yields, the higher tax rate offers a greater yield spread; but for smaller investment yields, the lower tax rate offers a greater yield spread. A larger yield enables more returns to be reinvested when the tax rate is higher; therefore, for larger yields a higher tax rate results in greater yield spread. For smaller yields, the amount of returns deferred is too small to have a significant impact on the yield spread. The factor of greater impact at lower yields is the difference between the ordinary income tax rate and preferred tax rate. At the lower tax rate, this difference is only 10 percent compared to 20 percent at higher tax rate. Once again, it is important to note that a greater yield spread does not mean a bigger payout; rather it is a measure of the benefit of a tax-deferred account over a taxable account.

The results above recreate results in two prior sections using different tax rates. All the conclusions from the prior sections still hold. But, the results expressed as a "yield spread" change in both directions (increases and decreases) depending on which factors are adjusted. In previous sections, the tax-deferred annuities had a negative yield spread in a certain instances. The occurrence of these instances falls when the tax rate is reduced. Where there is positive yield spread, the magnitude of this spread is reduced. Therefore, while the frequency of instances when tax-deferred annuities have an advantage is higher, the magnitude of this advantage is reduced to some extent.

## *5. Conclusions*

There are many situations when the tax benefit of a tax-deferred annuity outweighs those of a taxable account. This tax benefit can result in an annual yield spread of two percent or more, depending on how long the annuity is held, how high the yields are, and whether annuitization occurs as one reaches the end of his or her accumulation period. Our analysis shows two cases in which the tax-deferred annuity always has the tax advantage:

1. For individuals who are more risk averse and therefore prefer to invest in less risky assets, which generate ordinary income. Even for individuals who prefer to hold a portion of their assets in vehicles that produce tax-preferred income, the remaining assets that generate ordinary income provide better after-tax returns when they are in tax-deferred vehicles such as tax-deferred annuities.

2. For individuals seeking to convert their investments into immediate annuities to replace or add to retirement income. Payout through an immediate annuity extends the tax advantage since the conversion to a tax-deferred annuity can be done through the exercise of a contractual option within the deferred annuity, or through a 1035 exchange that does not result in an immediate tax event. Therefore, the taxes are deferred until the income is actually received.

In both cases, independently or together, the tax-deferred annuity provides the investor with a tax advantage. Additionally, by converting the investment into an immediate annuity instead of opting for a lump-sum payout, the individual also is protected from longevity risk.

# Formulae

## *I. Variables Used:*

The following are variables used in the formulas:

P = Principal (Premium)

r = Rate of return

t = Time horizon

PercentOfOrdinaryIncome = Percent of return attributed to income

PercentOfDividends = Percent of other return attributed to dividends

IncomeTax = Income tax rate

CapitalGains = Capital gains tax rate

$\bar{a}$ = Annuity factor (source vanguard.com February 2008)

$\beta$ = Expected return multiple (IRS publication 939)

## *II. Formula for the value of tax-deferred annuity through lump sum payout*

The value of a tax deferred annuity with a lump sum payout option:

$$TaxDeferredLumpSum = P * (1+r)^t - \left((P * (1+r)^t - P) * IncomeTax\right)$$

## *III. Formula for the value of taxable account through lump sum pay-out*

The value of taxable account with a lump sum payout option:

```
TaxableAccountLumpSum = P;
TotalCapitalGains = 0;
for i = 1: t
    OrdinaryIncome = TaxableAccountLumpSum * PercentOfOrdinaryIncome * r * (1 - IncomeTax);
    Dividends = TaxableAccountLumpSum * (1 - PercentOfOrdinaryIncome) * PercentOfDividends * r * (1 - CapitalGainsTax);
    CapitalGains = TaxableAccountLumpSum * (1 - PercentOfOrdinaryIncome) * (1 - PercentOfDividends) * r;
    TotalCapitalGains = TotalCapitalGains + CapitalGains;
    TaxableAccountLumpSum = TaxableAccountLumpSum + Dividends + CapitalGains + OrdinaryIncome;
end
TaxableAccountLumpSum = TaxableAccountLumpSum - TotalCapitalGains * CapitalGainsTax;
```

## *IV. Formula for the value of tax-deferred annuity through annuitized payout*

The income generated by the purchase of an immediate annuity using funds in a tax-deferred annuity:

$$TaxDeferredIncome = GrossIncome - GrossIncome * (1 - ExclusionRatio) * IncomeTax$$

where

$$ExclusionRatio = \frac{P}{\beta * P * (1+r)^t * \bar{a}} = \frac{1}{\beta * (1+r)^t * \bar{a}}$$

$$GrossIncome = P * (1+r)^t * \bar{a}$$

## *V. Formula for the value of taxable account through annuitized pay-out*

The income generated by the purchase of an immediate annuity using funds in a taxable account:

$$\text{TaxDeferredIncome} = \text{GrossIncome} - \text{GrossIncome} * (1 - \text{ExclusionRatio}) * \text{IncomeTax}$$

where

$$\text{ExclusionRatio} = \frac{\text{TaxableAccountLumpSum}}{\beta * \text{TaxableAccountLumpSum} * \ddot{a}} = \frac{1}{\beta * \ddot{a}}$$

$$\text{GrossIncome} = \text{TaxableAccountLumpSum} * \ddot{a}$$

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