

# The Impact of Rates of Return on Roth Conversion Decisions and Retiree Savings Wealth

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## Abstract

A tax-optimal retirement savings withdrawal model, implemented as a linear programming application, is used to compare savings wealth growth when Roth conversions are permitted (RC) and when they are not (NoRC). Evaluations are made for combinations of percentage rates of return (ROR) for taxable, tax-deferred, and tax-free savings.

PctDiff, the difference between tax-free and tax-deferred (TD) account RORs, is an important conversion consideration. When investment strategies target PctDiffs at two percent or greater, RC provides substantial benefits. As PctDiff increases, the percentage of initial TD savings that should be converted rises, the time to recover savings wealth lost to conversion-related taxes declines, and savings wealth growth surges. When PctDiff is less than two percent, savings wealth growth is small and savings wealth loss due to conversion-generated taxes persists for more than 13 years; retiree health and prospects of living long enough to realize savings wealth gains becomes a vital concern.

Conversions are best made relatively early in retirement and at varying annual amounts. Conversion of all initial tax-deferred savings in the first year of retirement rarely results in maximum savings wealth growth.

## Introduction

Generally, Roth IRAs are coveted for their tax-free earnings and withdrawals. They are funded by nondeductible contributions from earned income (for example, salary) or from taxable Roth conversions from traditional IRAs. Since 2010, there has been no limit on the amount of traditional IRA savings that can be converted to Roth IRAs, which has led financial advisors to encourage their clients to execute Roth conversions. Ed Slott, a Roth conversion proponent, opines: "The Roth IRA is the single best gift Congress has ever presented to the American taxpayer. It allows us to build retirement accounts that, over the long haul, will grow to incredible size – and remain free of income tax forever", Slott (2003). In 2010 "Slott...says he converted nearly all his six-figure IRA in January [of 2010]", Saunders (2010).

Because Roth conversions are taxable, they can cause immediate wealth reduction. However, the size and duration of this reduction is not well understood. Keebler (2010) states that

Roth conversion planning is complex and advisors and CPAs must work together to determine which clients should convert and which clients should maintain their Traditional IRA. The factors that support some level of conversion generally outweigh the factors that favor no conversion. In an overgeneralization, the wealthier a person is, the greater the need to carefully study the Roth conversion question.

## Literature Review

Recent publications compare Roth conversion (RC) strategies to No Roth conversion (NoRC) strategies and focus on the merits of each strategy under varying marginal tax rate assumptions at the time of conversion and withdrawal. Geissler and Hulce (2014) conclude that traditional IRAs are not always preferable when a lower income tax rate is expected during retirement. Washer (2011) examines four strategies that differ by Roth conversion amounts. He determines the levels of marginal tax rates at which each strategy is preferred relative to wealth growth and longevity. Clayton, Davis and Fielding (2012) evaluate when to convert based on marginal tax rates but they do not

include taxable savings nor adequately address complicating factors such as required minimum distributions (RMDs) and alternative rates of return (RORs) for Roth and tax-deferred savings. They conclude that the decision to convert to a Roth IRA remains an individual one and may be influenced by factors other than the time to break even. Krishnan and Cumbie (2016) also evaluate the Roth conversion decision based on marginal tax rates and consider taxable savings. Cellucci (2014) defines specific strategies to convert an entire traditional IRA to a Roth IRA and uses Monte Carlo simulation to determine when to convert based on the tax impact at that time.

All of these studies conclude that some amount of a Roth conversion provides greater benefits than no amount of Roth conversion when marginal tax rates are expected to be higher in retirement than at the time of conversion. However, the conversion amount is not easily forecasted and there is no assessment of the impact on total savings wealth.

Welch (2016) uses a tax-optimal linear programming model to evaluate whether to execute Roth conversions based on the metric of disposable income. He concludes that there is no significant economic benefit to conversions. He observes that the conversion option pays less total tax than no conversion option and the patterns of tax payments are totally different. While there are many similarities between Welch and this research, the differences in the model, methodology and research objectives are contrasted throughout this paper.

An early use of a tax-optimal withdrawal strategy is described in Ragsdale, Seila, and Little (1994). The linear programming formulation used in this study is based on the formulation described in Coopersmith and Sumutka (2011) and Coopersmith, Sumutka, and Arvesen (2009). Their formulation was enhanced to include Roth IRA accounts and IRA to Roth IRA conversions. Welch (2015) demonstrates the validity of the linear programming approach to tax minimization and the superiority of linear programming over a common practice simulator.

Our results and methodology contribute to the body of literature demonstrating how linear programming is a useful platform for evaluating alternate strategies in retirement financial planning.

## Research Design

This research extends previous Roth conversion studies in two respects:

(1) A tax-optimization model is used to determine withdrawals from three account types: taxable (TX), tax-deferred (TD), and tax-free Roth (TF) savings. The objective of the linear programming model used in this research is to maximize savings wealth at the end of the planning horizon, as measured by the final total savings of the three account types, referred to as Final Total Account Balance (FTAB). This is one of the essential differences between our methodology and Welch's. We justify using maximization of FTAB as our optimization objective based on both our study of personal finance and personal experience with wealth managers in their practice of retirement planning. We have observed that retirement financial planning generally starts with setting a budget that includes pre-tax itemized living expenses based on lifestyle expectations. This is followed by planning in order to satisfy this budget plus taxes from income sources and retirement savings. We also observed that effective management of retirement savings and investments not only reduces the chance that savings will be exhausted during the planning horizon but could actually result in savings growth. Additional justification for our choice of optimization direction is that it allows an appropriate comparison of savings wealth growth between RC and NoRC when the set of model input data that includes pre-tax living expenses is fixed. We believe our optimization objective of maximizing FTAB is most appropriate for evaluating this paper's key comparative measures of savings wealth reduction resulting from Roth conversion, as discussed below in how we extend Welch's work. The importance of growing savings wealth in retirement is reflected in the quotes in the Introduction. Furthermore, all authors other than Welch in the Literature Review note the importance of achieving high levels of final savings wealth in their evaluation of Roth conversion strategies.

(2) RC strategies are compared to NoRC strategies for various combinations of RORs by account type to analyze the impact of each strategy on retiree total savings wealth over a 30-year retirement planning horizon.

The tax-optimization model used in this research is tax-efficient according to the criteria stated in Sumutka, Sumutka, and Coopersmith (2012):

- "Consideration of more than one annual withdrawal strategy over a retirement horizon—each strategy differs by the sequence of withdrawals from different accounts, and each account has a different tax treatment
- A realistic calculation of taxes for each strategy
- Selection of the best strategy with respect to some performance measure (for example, final total account balance)"

A "tax-optimal" retirement savings withdrawal strategy results when the set of withdrawal strategies evaluated is *all possible* strategies. Tax optimization is achieved through the use of a mathematical programming model and its associated solution algorithm.

An important reason for the use of tax-optimization is that for any given set of initial data, the tax-optimal strategy results in the mathematically maximum FTAB. In comparing RC to NoRC, annual tax-optimal withdrawals are determined for each strategy for the same set of model input data. For RC, the model also determines the optimal amount of annual Roth conversions that maximize the FTAB. The resulting Roth conversion amounts can vary from zero to the entire balance of the previous year's TD savings. Thus, RC results could be:

- (a) the same as NoRC (the FTAB cannot be more than the NoRC strategy at any level of Roth conversion),
- (b) a partial Roth conversion (some Roth conversions in some years, but not in others), or
- (c) full Roth conversion (a one-time Roth conversion of all TD savings)

Therefore, the annual withdrawal and/or conversion decisions are more effective than those prescribed by a rule-based strategy, such as the common rule which uses a predetermined sequencing of withdrawals (for example, exhaust sequentially TX, TD, and finally TF).

We extend Welch's work in these ways:

- Instead of annual spending we measure the improvement in FTAB for RC over NoRC.

- Welch uses the same RORs for account type while this study varies the ROR by account.
- We evaluate the amount of savings wealth reduction: the greatest annual total savings wealth reduction of RC compared to NoRC early in the plan.
- We report the number of years it takes before the total savings wealth of RC exceeds that of NoRC (i.e., the savings wealth break-even point).
- We use a Monte Carlo Method to compute the difference in longevity risk between RC and NoRC. Longevity risk is defined as the chance of the plan failing before the end of the planning horizon.

The tax model incorporates the following for 2015:

- Federal tax brackets, specified itemized deductions (which always exceed standard deductions), and exemptions are increased annually by a 2 percent inflation rate.
- Qualified dividend income (QDI) and long-term capital gains (LTCG) are taxed at their favorable rates of zero percent, 15 percent, or 20 percent.
- All other income (for example, interest, non-qualified dividends, RMDs, etc.) is taxed at ordinary income tax rates, from 10 percent to 39.6 percent.

The study data assumes a 65-year-old retired couple with \$2,000,000 in 2014 year-end savings, which is allocated among three accounts: TD = \$1,400,000 (70%), TX = \$400,000 (20%), and TF = \$200,000 (10%).

The following assumptions are fixed for all analyses:

*Pre-tax living expenses:* Total 2014 pre-federal tax living expenses are \$115,000, comprised of \$34,500 in itemized deductions (as opposed to \$12,600 standard deduction), and \$80,500 in other living expenses, which are increased annually by a 2 percent inflation rate. Pre-federal tax living expenses are the same for the two strategies.

*Income sources:* 2014 Social Security is \$30,000 (\$15,000 for each spouse) and increases annually by a 2% inflation rate. To satisfy the remaining \$85,000 of cash needs (\$115,000 pre-federal tax living expenses minus \$30,000 of Social Security), the couple withdraws 4.25% from their 2014 year-end initial total savings of \$2,000,000.

*RORs for TX accounts:* For reasons described below, the ROR for taxable savings is 2 percent below the ROR for tax-free accounts.

*Taxation of TX RORs:* One-sixth of the taxable ROR is derived from fully taxable savings (for example, interest income), one-sixth is from favorably taxed QDI and LTCG, and two-thirds is from non-taxed capital appreciation.

*Taxation of TX account withdrawals:* Fifty percent of withdrawn taxable savings is LTCG; the remainder is a return of non-taxable basis.

## An Example to Illustrate Comparative Measures

In this example, the RORs for TD savings (ROR.TD) and TX savings (ROR.TX) are 6 percent and the ROR for TF savings (ROR.TF) is 8 percent. ROR.TD and ROR.TX are set lower than ROR.TF due to the prudent financial reasoning that TD savings (used for Roth conversions and RMDs) and TX savings (used for tax-free basis, favorable tax rates, and tax bracket management) are likely to be withdrawn before TF savings (used for tax bracket management and bequests). Thus, to minimize the sequence of returns risk, TX and TD should have higher allocations of lower risk, lower return investments. In this example and for other combinations of RORs, we assume that accounts are rebalanced as funds are withdrawn or added to maintain specified ROR levels by account type. Obviously as funds are transferred between account types, the percentage of funds in a given account type to total savings may change resulting in changes to the ROR for total savings. This is discussed further in the section *How Research Findings Can Be Used in Practice*.

By comparing a NoRC to RC strategy, Table 1 illustrates the first evaluation measure, “the amount of Roth conversion” which produces the greatest FTAB. Withdrawals for both strategies are displayed for only 15 years since key differences in withdrawals occur in these years.

For NoRC, the model withdraws only from TX and TD accounts in each of the years. Taxes are low in the first four years because of lower-taxed withdrawals from TX. When RMDs start at age 70.5, RMDs and taxes increase annually. Note that the tax-optimal specification of TD withdrawals before the entire depletion of TX is contrary to the common rule of withdrawing all TX before TD.

In contrast to NoRC, the tax-optimal RC strategy prescribes varying amounts of partial Roth conversions from ages 66–69 (which total \$714,000 or 51% of the initial

**Table 1: Comparison of Tax-optimal Withdrawal Strategies**

Assumptions: ROR.TF=8%, ROR.TD=6%, ROR.TX=6%

Age (on Jan 1)	No Roth Conversion (NoRC) (Entries in \$000)				Roth Conversion (RC) (Entries in \$000)					
	Withdrawals		RMD	Federal Taxes	Withdrawals			RMD	Federal Taxes	Roth Conversion
	Taxable (TX)	Tax-deferred (TD)			Taxable (TX)	Tax-deferred (TD)	Tax-free (TF)			
66	57	32		2	151				63	245
67	58	33		2	153				64	251
68	59	34		2	118	12			39	163
69	59	35		2		124			31	55
70	39	61	61	6		99	6	29	11	
71	38	64	64	6		101	6	28	11	
72	37	68	68	6		103	6	26	12	
73	36	72	72	7		106	7	24	12	
74	34	76	76	7		108	7	22	12	
75	32	81	80	8		110	7	19	12	
76	8	111	84	13		112	7	15	13	
77	8	114	87	14		44	67	11	2	
78	8	116	90	14		45	68	10	2	
79	9	118	92	14		46	69	8	2	
80	9	121	95	14		22	93	7	2	

\$1,400,000 TD savings) that increase taxes during those years, but favorably increase TF savings and reduce TD savings and future RMDs. When compared to NoRC, from ages 66–68, TX withdrawals increase and TD withdrawals are eliminated at ages 66 to 67. TX withdrawals from ages 66 to 68 exhaust initial TX savings (not shown) creating the need from ages 68 to 76 for TD and limited TF withdrawals;

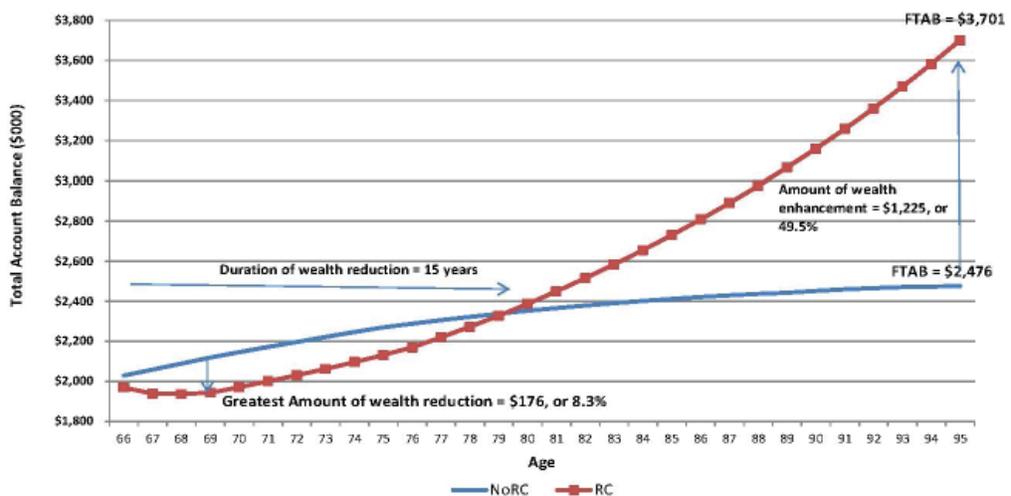
the TF withdrawals help reduce taxes. After age 76, RMDs and TD withdrawals are reduced, TF withdrawals increase, and taxes decrease significantly.

Figure 1 illustrates three additional evaluation measures. The RC strategy FTAB is \$3,701,000 and the NoRC strategy FTAB is only \$2,476,000, a difference of \$1,225,000.

**Figure 1**

**Comparison of Tax-optimal RC versus NoRC Results**

Assumptions: ROR.TF=8%, ROR.TD=6%, ROR.TX=6%



Expressed as an evaluation measure, the “amount (percent) of savings wealth enhancement” using RC is \$1,225,000 (49.5%). However, in early years RC generates higher taxes and lower annual total account balances (TABs).<sup>1</sup> Therefore, the “greatest amount of savings wealth reduction” evaluation measure for any year is \$176,000 or 8.3 percent less than NoRC and the “duration of savings wealth reduction” (or savings wealth breakeven point) evaluation measure is 15 years, to age 80.

## Variable ROR Analysis

Roth conversions cause a transfer of TD assets to the TF. Therefore, the RORs of each asset location impact the RC decision. For example, the conversion of TD assets with a 6 percent ROR to the TF with a 6 percent ROR may not be appropriate, since earning the same, albeit, tax-free ROR after a conversion may be insufficient to offset the tax cost of the conversion. However, if ROR.TF exceeds ROR.TD, the increased ROR.TF offsets some of the tax cost and the conversion becomes more viable. Therefore, the difference in percentages ROR.TF minus ROR.TD, referred to as “PctDiff,” influences the conversion decision.

As shown in Table 2, seven PctDiff amounts, varying between 0% and 6%, were evaluated by examining three different ROR.TF and ROR.TD pairs<sup>2</sup> for each PctDiff. In total, 21 pairs of ROR.TF (from 6 to 10 percent) and ROR.TD

(from 2 to 8 percent) were examined. For example, in the column labeled “4%,” a constant 4% PctDiff results if ROR.TF and ROR.TD are 8 and 4 percent, 9 and 5 percent, or 10 and 6 percent, respectively. For each iteration, ROR.TX was set at 2 percent below ROR.TF (for example, if ROR.TF = 8%, then ROR.TX = 6%). The average result for the three ROR combinations in a column is displayed in Figures 2, 4, and 5.

The bolded pairs in Table 2 were used to compare longevity risk of RC versus NoRC through the use of Monte Carlo simulation (adapted for use with the tax-optimal method, as described in Appendix A).

## Optimal Amount of Roth Conversion

Figure 2 represents the percentage of initial TD savings that is optimally converted to Roth accounts based on PctDiffs. For example, at PctDiff = 2%, the optimal Roth conversion rate is 52 percent of initial TD assets.

Results indicate that as the PctDiff increases from 0% to 6%, the optimal percentage of TD savings converted to TF savings increases. This is due to Roth conversion re-allocating assets from lower-yielding TD assets to higher-yielding TF assets while reducing future RMDs and any associated taxes. The trend shows Roth conversion percentages increase at a decelerating rate. When ROR.TF and ROR.TD are equal (PctDiff = 0%), only 15 percent of TD savings is converted. The conversion rates increase rapidly for PctDiffs of 1% and 2% and then level to under 70 percent when ROR.TF is significantly higher than ROR.TD (for example, at PctDiff = 5% or 6%). Figure 2 shows

1. Since there is a TAB for each age, age will be referenced when needed. For example, TAB(72) refers to the TAB at age 72.
2. Welch uses the same ROR for all account types which is equivalent to a PctDiff = 0%.

**Table 2: Variable ROR Analysis**

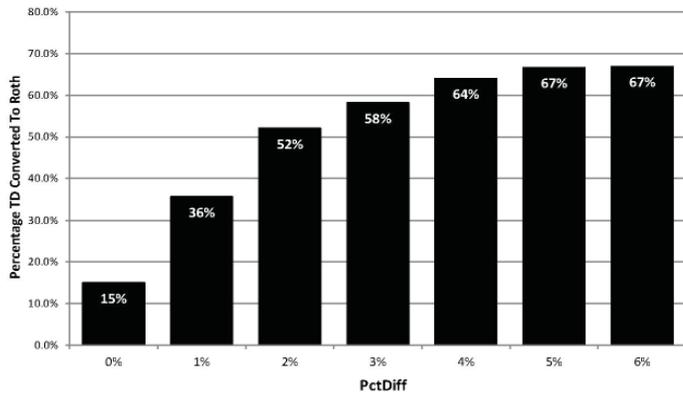
PctDiff <sup>1</sup>						
0%	1%	2%	3%	4%	5%	6%
ROR.TF, ROR.TD Pairs						
6%,6%	6%,5%					
<b>7%,7%<sup>2</sup></b>	<b>7%,6%</b>	7%,5%	7%,4%			
8%,8%	8%,7%	<b>8%,6%</b>	<b>8%,5%</b>	<b>8%,4%</b>	8%,3%	8%,2%
		9%,7%	9%,6%	9%,5%	<b>9%,4%</b>	<b>9%,3%</b>
				10%,6%	10%,5%	10%,4%

Note: ROR.TX percentage value is set at 2% below ROR.TF.

1. PctDiff: Percentage points ROR.TF is greater than ROR.TD.

2. Bold entries are used to analyze longevity risk.

**Figure 2**  
Percentage of Initial Tax-deferred Savings Converted to Roth



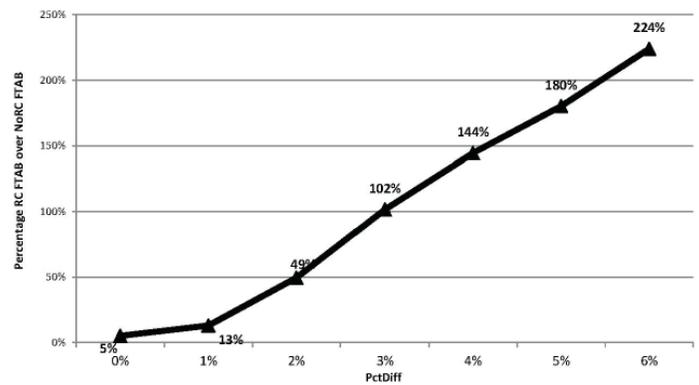
Bars are the average of the three results for same PctDiff (see Table 2 columns ); average values are shown in bars.

that the impact on the optimal level of Roth conversions diminishes as PctDiff increases above 2%. This implies that taxes generated by increased Roth conversions increasingly offset benefits of additional growth in the TF account. Interestingly, regardless of the PctDiff, some amount of Roth conversion maximizes the FTAB, but all conversion rates are below 100 percent, which implies only partial RCs are optimal.

**Amount of Final Savings Wealth (FTAB) Enhancement**

The effect of the Figure 2 Roth conversions on FTABs is illustrated in Figure 3, which shows the percentage improvement in the FTAB of RC over NoRC when ROR.TF equals 8 percent for each PctDiff (see Table 2, third row of pairs). The percentage improvement of FTAB increases as the PctDiff increases from 0% to 6% as assets are increasingly re-allocated from lower-yielding TD to higher-yielding TF (as illustrated in Figure 2). Figure 3 shows that for PctDiff = 0% (both ROR.TF and ROR.TD are 8 percent), there is only a 5 percent improvement in the RC over NoRC strategy. However, as the PctDiff increases, the RC FTAB improvement rises steadily to 224 percent over the NoRC FTAB at a PctDiff of 6% (ROR.TF and ROR.TD are 8 and 2 percent, respectively). While not displayed, results for other ROR.TF values (in other rows of Table 2) show similar increasing trends in percentage improvement in FTAB with increases in PctDiff, but the trends are less steep as ROR.TF increases.

**Figure 3**  
Percentage Improvement in FTAB: RC over NoRC  
For ROR.TF=8%



**Greatest Amount of Savings Wealth Reduction<sup>3</sup>**

Although Roth conversions increase final savings wealth, a potential deterrent to a conversion is that the conversion-caused increase in taxes reduces total savings immediately. Figure 4 illustrates the greatest annual percent TAB reduction over 30 years caused by RC<sup>4</sup> is only 1.8 percent when PctDiff = 0%. However, when the PctDiff = 1% or 2%, the greatest savings wealth reduction increases to 6.5 percent and 8.5 percent, respectively. This precipitous drop in savings wealth for RC is due to a combination of:

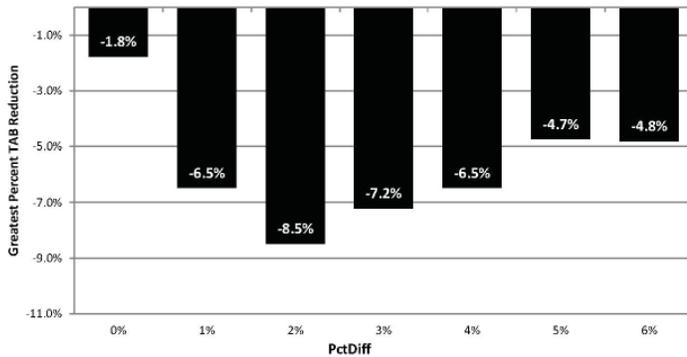
- (a) Increasing savings wealth in the early years for the NoRC strategy caused by some transfers from TD to TX accounts without a major tax impact.
- (b) An early decrease in savings wealth in RC caused by higher taxes on TD distributions, which are offset only partially by slightly higher RORs earned in the TF account at such low PctDiffs.

However, for PctDiff = 6%, RC transfers assets with lower ROR.TD to assets with a significantly higher ROR.TF so that the greatest savings wealth reduction is a more palatable 4.8 percent. Additionally, the moderation in savings wealth reduction is due to the fact that for PctDiffs greater than 2%, ROR.TX is greater than ROR.TD. For example, if ROR.TF = 7%, ROR.TD = 4% (PctDiff = 3%), then ROR.TX = 5% (since

3. "Savings Wealth Reductions" are computed for each age as [TAB(age) for RC] minus [TAB(age) for NoRC]. The greatest reduction occurs for the age when the Savings Wealth Reduction is most negative.  
4. There is very little variation among results for the three cases contributing to each shown average value, generally within 0.4% from the average.

**Figure 4**

**Greatest Savings Wealth Reduction Due to Roth Conversions**  
Most negative of annual percent TAB reductions over 30 years



Bars are the average of the three results for same PctDiff (see Table 2 columns); average values are shown in bars.

it is set 2 percent below ROR.TF). Thus, for NoRC, the model optimally transfers balances out of the lower-yielding ROR.TD into the higher-yielding ROR.TX, increasing downstream TABs.

**Duration of Savings Wealth Reduction**

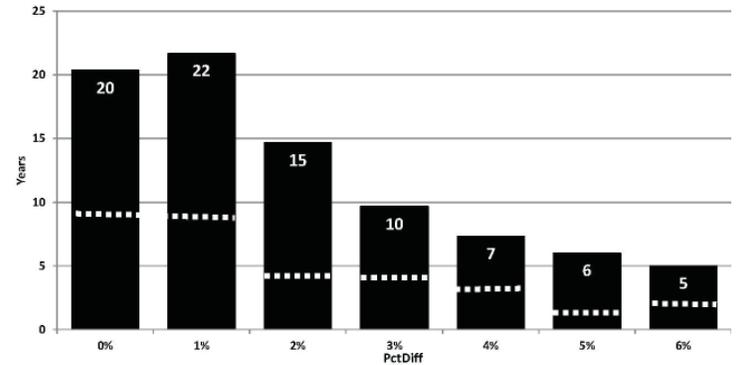
As illustrated in Table 1 and Figure 1, RC can cause increased taxes and reduced TABs for many years. The dashed lines in the bars of Figure 5 show the average number of years to reach the greatest savings wealth reduction caused by RC for various PctDiffs. The bars of Figure 5 show the average number of years to recoup the lost savings wealth caused by the conversion (bars)<sup>5</sup> (i.e., the savings wealth break-even period).

Figure 5 supports a strong inverse relationship between PctDiff and these savings wealth reduction evaluation measures. As the PctDiff increases, the measures decrease. For example, Figure 2 shows that when PctDiff = 0% or 1%, Roth conversions create little additional savings wealth. In Figure 5, the dashed lines in the bars show that it takes just under 10 years for the savings wealth reduction to decline to its lowest point. Twenty and 22 years, respectively, elapse before RC TABs exceed NoRC TABs. However as Pct-Diff increases from 2% to 6% the time to reach the greatest savings wealth reduction drops from 4.3 to 2.0 years. The

5. There is very little variation among results for the three cases contributing to each average value; with the exception of PctDiff = 0%, at most, one result was a year less than the average.

**Figure 5**

**Duration of Savings Wealth Reduction**  
Average Number of Years NoRC Total Account Balance Exceeds RC Total Account Balance



Dashed lines in bars show the average number of years until greatest wealth reduction.

Bars are the average of the three results for same PctDiff (see Table 2 columns); average values are shown in bars.

duration of time before the RC TAB exceeds the NoRC TAB (the savings wealth breakeven time) drops from 15 years to 5 years. For PctDiffs of 4% or more, the greatest savings wealth reduction is reached in only three years or less and the savings wealth breakeven time is relatively short at seven years or less.

For PctDiffs of 0% to 6%, savings wealth breakeven ages corresponding to the number of years in Figure 5 are 85, 87, 80, 75, 72, 71 and 70, respectively. These results imply that the more ROR.TF exceeds ROR.TD, the greater the chance that retirees will live to realize the increased savings wealth benefits of Roth conversions.

**Longevity Risk**

Roth conversion benefits are unrealistic if it is unlikely that they would be realized over the entire planning horizon. Traditionally Monte Carlo methods are used to assess longevity risk, defined as the chance of outliving savings during the planning horizon. A Monte Carlo method of risk analysis has been adapted for use with the tax-optimal retirement planning method used in this research; it is explained briefly in Appendix A.

Table 3 shows longevity risk differences between NoRC and RC. Except for PctDiff = 0%, longevity risk is smaller for RC than for NoRC. For the data used in this paper, the chance of outliving one's savings using RC is low, between 8 percent and 15 percent. While only two differences from

**Table 3: Longevity Risk<sup>1</sup> Comparison: NoRC Versus RC**

PctDiff	0%	1%	2%	3%	4%	5%	6%
NoRC	8%	19%	15%	19%	24%	13%	22%
RC	8%	15%	12%	12%	14%	9%	10%
Difference NoRC%–RC%	0%	4%	3%	7%	10% <sup>2</sup>	4%	12% <sup>2</sup>

1. Longevity risk is defined as the chance of outliving savings during the planning horizon.  
 2. Results for PctDiff = 4% and = 6% are statistically significant.

NoRC are statistically significant, the consistency of results implies RC is the less risky strategy. It appears that the higher total savings growth of RC most likely counteracts the greater risk that generally accompanies the potentially higher volatility associated with the higher ROR.TF of Roth savings.

### Additional Results

To determine the effect of altering assumptions other than PctDiff, NoRC results were compared to RC results for (a) higher initial savings wealth amounts, (b) higher initial expenses of \$118,450 (3% higher) and \$121,900 (6% higher), and (c) ROR.TX values that were above and below the 4 percent to 8 percent range used in this paper. Interested readers can obtain results from the corresponding author on request.

Patterns in evaluation measures for the additional results are almost identical to those in the figures, thus strengthening the implications related to PctDiff already discussed. Of note are the following additional implications:

- For higher initial total savings wealth of \$3,000,000, the equivalent Figure 2 pattern of conversion rates is similar but higher, as it jumps to slightly over 40 percent at PctDiff = 0% and levels off at about 75 percent for the highest PctDiffs.
- When initial expenses are higher than \$110,000, the percentage Improvement in RC FTABs over NoRC FTABs is higher than line graph in Figure 3 for PctDiffs greater than 1%. This is due to lower FTABs when expenses are increased for both NoRC and RC plus the result that the FTABs for RC become relatively larger than the FTABs of NoRC as PctDiff increases.
- In Figure 4, the ‘swoosh’ pattern is similar for other values of ROR.TX. However, the greatest TAB reduction of a RC strategy from a NoRC strategy occurs

when PctDiff equals ROR.TF minus ROR.TX. Reasons for this are given above in the section Greatest Amount of Savings Wealth Reduction where the greatest TAB reduction occurs at PctDiff = 2% and ROR.TF minus ROR.TX was also 2%.

### Conclusions

To better understand the impact of Roth conversions on retiree total savings wealth, tax-optimal retirement withdrawal plans over a 30-year horizon were compared for two strategies: no Roth conversions (NoRC) versus model-determined Roth conversions (RC). Annual withdrawals and Roth conversion levels were determined using a tax-optimization model. When the tax-free ROR (ROR.TF) is higher than both the tax-deferred ROR (ROR.TD) and the taxable ROR (ROR.TX), RC increases total savings growth over NoRC. Using Roth conversions does not increase longevity risk; to the contrary, under a wide range of ROR scenarios for the various account types, they lower longevity risk. However, not all combinations of RORs for these different accounts justify the use of Roth conversions, as discussed below in “How Research Findings Can Be Used in Practice.”

An important factor impacting the decision to convert is referred to as PctDiff, the difference between ROR.TF and ROR.TD. When PctDiff is below 2%, percentage gains in savings wealth growth for RC are small. When PctDiff is less than 3%, the savings asset balance reduction due to the need to pay federal taxes can persist for more than 13 years and retiree health and prospects of living long enough to realize savings wealth gains is a consideration in opting for Roth conversions.

As PctDiff increases above 2%, the RC strategy provides the following increasing benefits:

- The percentage savings wealth growth of RC over NoRC increases.
- The optimal percentage of initial TD savings converted to TF is greater.
- The time to recover savings wealth lost due to Roth conversion related taxes is shorter.

For example, a PctDiff of 3% (ROR.TF = 7%, ROR.TD = 4%) provides greater benefits than a PctDiff of 2%. The *relative* nature of PctDiff is of critical importance, not the value of ROR.TF. Thus, for PctDiff = 3%, the benefits of RC over NoRC are similar for savings targeting returns of ROR.TF = 8% and ROR.TD = 5% as one targeting ROR.TF = 7% and ROR.TD = 4%.

Roth conversion of all TD savings is never observed to be optimal; the highest optimal conversion rate equals about 75 percent of initial TD savings. Roth conversions should be made relatively early in retirement, with annual levels varying during the time interval from before, to not much later than, the age RMDs start.

## How Research Findings Can Be Used In Practice

Before opting for Roth conversions, financial planners should be confident that their use will create higher savings wealth for an acceptable number of retirement years. Based on this paper's findings, substantially higher savings wealth can be anticipated only if the ROR for tax-free Roth savings is at least 2 percent higher than the ROR for tax-deferred savings. However, as highlighted above in Conclusions, benefits resulting from Roth conversions taper off for PctDiffs higher than 2%. This suggests a PctDiff of 2% as a practically attainable planning objective. Since tax-free savings are generally not needed until later in retirement, a higher tax-free ROR (ROR.TF) at the time of Roth conversion can be generated by reducing or eliminating less volatile, lower return investments, such as cash or short-term bonds from the tax-free portfolio. To assure that a retirement plan stays on target, the balance of investments by account type should be reviewed at least annually.

Clients' tolerances for fluctuations in total savings wealth differ. Some retirees may be uncomfortable with large reductions in wealth early in retirement due to large Roth conversions that they feel may make them more

vulnerable to market volatility. This concern can be remedied to some extent by limiting the size of a Roth conversion in any year, for example, to not more than \$50,000. While this limitation is suboptimal, we have observed in practice that this type of restriction significantly moderates the levels of wealth reduction, slightly increases the time interval of reduced savings wealth after Roth conversions, and reduces final total savings wealth by a small percentage. A key intangible benefit of Roth conversions is that eventually a large percentage of savings is in tax-free Roth accounts. Even when higher than optimal levels of Roth conversions can potentially lower savings wealth growth, retirees may feel that greater proportions of final savings wealth in tax-free accounts may be desirable and important to estate planning.

The long-term benefits of Roth conversions can be significant, especially for taxpayers who do not need all of the cash flow generated by RMDs to satisfy living expenses. However, one must ensure that these benefits are not compromised by income-based surtaxes or tax phase-out provisions (such as the 3.8 percent surtax on investment income or itemized deduction and exemption phase outs), which can be triggered by the Roth conversion itself.

## Areas of Future Research

The tax-optimal method used in our research lends itself to comparing other strategies for differences in the impact on wealth growth. Of recent interest is the impact of Roth annuity plans on wealth growth and longevity risk. As referred to in "How Research Findings Can Be Used in Practice" it may be of interest to more thoroughly evaluate the impact of suboptimal use of Roth conversion strategies that take into account intangible factors such as retirees concern for market volatility. Other strategic questions besides those involving Roth savings could be evaluated. For example, tax-optimal methods can be used to evaluate the impact of alternative Social Security claiming strategies on total savings wealth growth, not just on total Social Security income.

## Appendix A: Monte Carlo Longevity Risk Assessment for Tax-optimal Retirement Planning

The main difference between the Monte Carlo (MC) method used in tax-optimal planning in this research and traditional MC methods is the use of a mathematical optimization model and solution algorithm to determine a withdrawal plan given a scenario of randomly selected annual RORs for each of the various types of savings accounts. The percentage of stocks, bonds, and cash are specified for each of the three savings types: taxable, tax-deferred, and tax-free. For each year of the planning horizon, a randomly selected ROR is determined separately for stocks and for bonds using statistical models that closely fit annual S&P 500 data for stocks and Shiller data on bond rates, both from 1951 to the present. A weighted average of these RORs is then used as the annual ROR for each savings type. Either an optimal withdrawal plan for the random scenario is determined or no plan is feasible. Results for a sample of size  $N$  ( $N=100$  in this paper) of retirements are run and the number of feasible retirement plans,  $n$ , is determined. Longevity risk is computed as  $(1-n/N)$ .

Other differences include:

1. Outcomes of the optimization model are determined in each sampled scenario using linear programming. These outcomes include the annual amounts withdrawn from each account type, the amount of federal taxes, and the annual amounts of Roth conversions.
2. Annual pre-federal tax expenses in this paper are fixed initially for all sampled scenarios at \$115,000 followed by inflationary growth. However, for other studies and analyses, the pattern of expenses may be at the discretion of the user and is not limited to inflationary growth.

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