Retirement Investing: Analyzing the
'Roth' Conversion and Re-characterization Options


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**Summary**


Beginning in 2010, all individuals, regardless of income level, have the opportunity to convert their traditional IRAs into a Roth IRA by paying ordinary income tax on the market value (at the time of conversion) of the assets being converted. In particular, even individuals with the largest tax-deferred accounts now are able to convert some or all of their tax-deferred holdings to Roth IRAs (prepaying the tax). The tax law also permits investors to reverse or "re-characterize" these conversions at an individual account level until the final income tax filing deadline for that year (October 15th of the following year). The nature of the resulting opportunities is very different than for traditional tax-deferred investments. At both a positive and normative level our results shed considerable light on the conversion and re-characterization decisions of investors. It also provides a potential framework to understand the implications of the Roth tax-deferred accounts (including the re-characterization option) for the dynamics of government deficits and revenue.

We examine the costs and benefits of converting to a Roth IRA from a traditional tax-deferred account and analyze the optimal conversion decisions by investors under various circumstances absent the re-characterization option. We then extend our analysis to allow the investor to re-characterize or reverse these conversions decisions and describe the implications for asset location. The implications that arise with respect to optimal conversion are much more subtle than in commonly perceived prescriptions, such as converting if and only if the investor's current tax rate is below his anticipated future tax rate. Volatility is very valuable for positions that are subject to potential re-characterization, which is in sharp contrast to the traditional asset location advice. Re-characterization leads to substantial optionality for investments in certain tax-deferred accounts. These perspectives raise interesting challenges for understanding the stochastic and dynamic structure of government revenue.

## 1.    Introduction

The recent financial market crisis has stimulated renewed appreciation of the importance of long-run savings in our economy and a growing recognition of the tax treatment of different savings vehicles. Consequently, there has been tremendous interest recently concerning strategies for tax-efficient savings and renewed focus upon tax-deferred investing. The landscape for retirement investing itself has shifted in the past decade to emphasize defined-contribution rather than defined-benefit plans. Of course, a basic feature of defined-contributions plans is the personal responsibility and opportunity of the owner to determine his own asset location and allocation choices. The opportunities for tax-deferred investing in defined-contribution plans have become more complex with the development of Roth IRAs (and the recently introduced Roth 401k and 403b plans). These "Roth" plans are typically not subject to taxation of withdrawals (though the Roth plans do not offer an up-front tax deduction) and also do not require withdrawals during the original owner's lifetime.[1]

Under specific conditions the owners can "convert" traditional tax-deferred IRAs into Roth IRAs by paying income tax on the amount converted with the option to re-characterize or reverse the conversion until the income tax filing deadline for that tax year (e.g., October 15th of the following calendar year—the final deadline for tax filings and extensions from the prior calendar year).[2] Throughout our discussion we refer to these options as the "conversion option" and "re-characterization option." These potential conversions are now attracting considerable attention because starting in 2010

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[1]Because withdrawals would not be required on a Roth IRA until it is inherited, in a setting with constant progressive tax rates over time it's plausible that the beneficiary of the inherited Roth IRA might be in a lower tax bracket than the original owner, who had accumulated a substantial fund. Of course, the statutory tax rates could change over time and indeed, there has been considerable recent speculation that tax rate schedules will rise over time.

[2]One important exception is that conversion is not allowed once an account has been inherited.

they are not limited to those taxpayers whose other taxable income does not exceed $100,000. Therefore, many large accountholders have become eligible to convert for the first time. A key source of interest in conversion emerges because the income tax liability can be paid by funds outside the tax-deferred regime, effectively expanding the proportion of an individual's financial base within the tax-deferred arena.

The re-characterization option itself has a dramatic impact on the "asset location" pattern of an investor, i.e., what assets to locate in various vehicles.[3] Specifically, the re-characterization option highlights the value associated with investment strategies that include very volatile assets in accounts that are subject to re-characterization. This is a new theme in asset location, which we will explore in more detail.[4] We characterize the optimal exercise of both the conversion and re-characterization options—for example, highlighting the universal value of conversion in the presence of a re-characterization option and characterizing the optimal re-characterization boundary in a number of ways.

This change in retirement investment opportunity raises an array of fundamental issues about asset location and allocation. For example, under what circumstances is conversion a beneficial strategy for investors? How should converted funds be invested? When will re-characterization be optimal? What are the implications of this for the use of traditional and Roth tax-deferred investing over time? How does the removal of the income cap for conversion influence the temporal structure of income tax revenues?

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[3]Among the features that distinguish the Roth accounts from traditional tax-deferred accounts are the (a) greater effective after-tax exposure that the Roth account can represent, (b) how the conversion and re-characterization options add significantly to the economic value of the Roth account and influence the optimal location patterns, and (c) how the Roth accounts do not require mandatory withdrawals during the investor's lifetime.

[4]Dammon, Spatt and Zhang (2004) show that it is optimal for an investor that doesn't face borrowing restrictions or costs to locate the high-yielding asset in his tax-deferred account, minimizing the investor's tax liability given his risk exposure.

How does the re-characterization option influence the stochastic structure of tax revenues? These issues relate to both financial planning, but also government revenues. Though we have previously studied tax-deferred investing (Dammon, Spatt and Zhang (2004)) and its contrast with taxable investing,[5] the specific opportunities associated with the conversion and re-characterization options for Roth IRAs have not been subject to analysis using the perspectives of modern financial economics. The interest in Roth IRAs, the richness of the tax environment and the apparent differences in conclusions from those in Dammon, Spatt and Zhang (2004) make exploration of these issues quite fruitful. In addition to our earlier work on asset location, the current analysis also builds upon the tools utilized in our work on the tradeoffs between realizing capital gains taxes and rebalancing one's portfolio (Dammon, Spatt and Zhang (2001a, 2001b, 2003)), insights on estate planning (Dammon, Spatt and Zhang (2007)) as well as the realization of capital gains as a function of time (Dammon and Spatt (1996)).

One of the key goals of this paper is to understand the impact of Roth IRAs upon asset location and allocation and retirement planning. More specifically, we will offer fundamental insights about investing tax-deferred Roth IRA portfolios subject to the re-characterization option. We will use basic finance principles to identify the inherent value of the conversion and re-characterization options. We will use arbitrage analysis to highlight the importance of possessing assets with considerable volatility in a Roth IRA portfolio still subject to re-characterization. We anticipate that the arbitrage analysis will lead to this conclusion not only relative to traditional tax-deferred accounts, but also relative to the taxable account. We later plan to undertake a series of welfare analyses to highlight the nature of the ex ante value of the conversion and re-characterization options.

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[5]Also, see Dammon, Poterba, Spatt and Zhang (2005).

We also plan to model the re-characterization decision by exploiting the basic insight that if a portfolio is re-characterized, there will be a series of subsequent conversion opportunities and re-characterization options. For example, if the Roth portfolio does not appreciate considerably after conversion while being subject to re-characterization, then the investor will want to re-characterize because of the subsequent ability to convert again (and augmented further by additional re-characterization potential) as well as the benefit of avoiding an immediate relatively high tax exposure. The investor re-characterizes when the portfolio value is sufficiently low. Secondarily, the threshold value such that the investor will terminate his current option and re-characterize will be somewhat dependent upon the current point in calendar time since the sooner the investor re-characterizes, the sooner he will be able to convert again (and later re-characterize again) adding to the value of that option.[6] The threshold would decline somewhat over the year because the value of the future re-characterization option shrinks with the passage of time during the year. This portion of our work will utilize the techniques of compound option analysis.[7]

The value of the re-characterization option could reflect not only the stochastic structure of asset prices, but uncertainty until the filing deadline associated with the evolution of the tax rate and anticipated future tax rates (typically financial models do not reflect tax rate uncertainty). Consequently, income risk and the possibility of legislated changes in tax rates (but not to the re-characterization option itself) could enhance the value of the re-characterization option as the investor's incremental tax situation would influence the positions that he chooses to re-characterize.

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[6]The IRS allows subsequent conversion thirty days after re-characterization.
[7]Such methods are illustrated by both Dammon and Spatt (1992, 1996). An early analysis of compound options is in Geske (1979).

Our formal analysis begins by considering the conversation option in various scenarios without the option to re-characterize, where conversion is a single "now or never" decision. We explore the tax effects associated with Roth conversion in Section II and evaluate the conversion option in Section III. We examine some numerical examples in Section IV. The interaction between Roth conversion and estate taxes is examined in Section V. We then introduce consideration of the re-characterization option in Section VI. We offer concluding comments in Section VII.

## II.    Tax Effects of a Roth Conversion

The decision to convert a traditional IRA into a Roth IRA ultimately depends upon whether the Roth conversion leads to higher after-tax wealth for the individual at retirement. In this section, we derive the after-tax wealth at retirement for a traditional IRA and for a Roth conversion. Section III evaluates the conditions under which a Roth conversion is beneficial for the individual as a one-time option.

*Strategy 1: Retain the Traditional IRA*

To begin our analysis, let's first consider a traditional IRA, with current market value of $V_0$. Without a Roth conversion, the after-tax value of the traditional IRA at retirement is:[8]

$$\text{After-Tax Value of Traditional} \quad = \quad [V_0(1+r)^N](1-T_{p,N}) \qquad (1)$$

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[8]Here we assume that the IRA is liquidated in its entirety at the retirement date, even though individuals are allowed to defer withdrawals until age 70½. (Any withdrawals after age 59½ are not subject to the 10% early withdrawal penalty.) However, assuming a constant tax rate during retirement, the present value of the annual tax payments is the same regardless of the timing of the withdrawals, because the government's claim is a fraction $T_{p,N}$ of the IRA account's value.

IRA at Retirement

where N is the number of years until retirement, r is the **realized** (geometric) average annual pre-tax rate of return on the assets held in the IRA account, and $T_{p,N}$ is the individual's ordinary tax rate during retirement. Equation (1) captures the fact that the individual earns the pre-tax rate of return, r, on assets held in the IRA account until the account is liquidated in retirement. Distributions from the traditional IRA are then taxed at the individual's ordinary tax rate during retirement, $T_{p,N}$.

### Strategy 2: Convert to a Roth IRA

Now suppose the individual converts the traditional IRA to a Roth IRA and pays the ordinary income tax on the market value of the IRA assets. There are two cases to consider: (A) individual liquidates assets held in the IRA account to pay the tax (and any penalty) and (B) individual liquidates assets held outside the IRA account to pay the tax. Each of these cases has a different effect on the after-tax value of the individual's retirement wealth.

**Case A:** *Finance the tax (and penalty) on the Roth conversion from the IRA assets.*

If the individual is forced to finance the tax (and penalty) on the Roth conversion from the IRA assets, the after-tax retirement wealth is:

After-Tax Value of Roth Conversion $= V_0[(1 - T_{p,0} - q)/(1 - q)](1+r)^N$       (2A)

     Financed with IRA Assets

where $T_{p,0}$ is the individual's current ordinary tax rate[9] and q is the penalty for early withdrawal when assets from the IRA are used to pay the tax (and penalty) on the conversion. Under current tax law, the penalty is q = 10% for individuals younger than 59½ and q = 0% for investors older than 59½.[10]

The after-tax retirement wealth under a Roth conversion captures the fact that the tax (and penalty) on the Roth conversion is paid immediately, with no further taxes due on the Roth distributions in the future. [11] If the individual uses IRA assets to pay the tax and penalty, then the value of the Roth IRA immediately falls to $V_0[(1 - T_{p,0} - q)/(1 - q)]$ after the conversion. The assets left in the Roth IRA then earn a tax-free return of r over the next N years.

***Case B:*** *Finance the tax on the Roth conversion from non-IRA assets.*

If the individual makes a Roth conversion and uses non-IRA assets to finance the tax payment, then the after-tax value of the investor's wealth at retirement is:[12]

After-Tax Value of Roth Conversion =

Financed with Non-IRA Asset

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[9]The current ordinary tax rate must be the individual's marginal tax rate, which would include the effect of $V_0$ in adjusted gross income on the individual's allowable personal exemptions and itemized deductions, the taxable portion of Social Security payments, and other tax-related items. The progressivity of marginal tax rates may make it optimal to spread the Roth conversions across multiple tax years. This issue is not addressed explicitly here.

[10] If an individual who is younger than 59½ converts to a Roth IRA and then withdraws funds from the Roth IRA within 5 years of the conversion, and before reaching age 59½, the early withdrawal penalty will apply (with some hardship exceptions).

[11]The tax on Roth conversions made in 2010 can actually be spread over two years. The analysis here makes the simplifying assumption that the tax on a Roth conversion is paid immediately.

[12]If the individual uses non-IRA assets to finance the tax payment on a Roth conversion, then, regardless of age, there is no penalty for early withdrawal.

$$V_0(1+r)^N - \left[\frac{V_0 T_{p,0}}{1 - gT_g}\right][1 + r(1 - T_i)]^N \qquad (2B)$$

where $g$ is the unrealized capital gain (as a percentage of current market value) on the assets sold to finance the tax payment on the Roth conversion, $T_g$ is the capital gains tax rate, and $T_i$ is the effective tax rate on investment income when assets are held in a taxable account (we don't derive the effective tax rate to shorten the exposition).[13]

If the individual uses non-IRA assets to pay the tax, the value of the Roth IRA remains $V_0$ after the conversion, which then earns a tax-free return of $r$ over the next N years. This is captured in the first term in Equation (2B). To finance the payment of the tax on the Roth conversion, however, the individual must sell non-IRA assets worth $V_0 T_{p,0}$ after capital gains taxes are paid on the sale. These non-IRA assets would have earned the individual an annual after-tax return of $r(1 - T_i)$ over the next N years when held outside the IRA.[14] This is captured in the second term of Equation (2B).

### III.     Evaluating the Roth Conversion Option

To determine whether it is beneficial for an individual to convert an existing traditional IRA into a Roth IRA it is necessary to compare the after-tax value of retirement wealth with a Roth conversion (Equation (2A) or (2B)) to the after-tax value of retirement wealth without a Roth conversion (Equation (1)).

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[13]We also don't adjust here for the difference in tax basis that results from the sale of some of the appreciated assets in the taxable account.
[14]To keep the individual's portfolio composition unchanged, we assume that the non-IRA assets that are sold to finance the tax payment are the same as those the individual holds in the IRA account. See Dammon, Spatt, and Zhang (2004) for an analysis of the optimal allocation and location of asset classes across taxable and tax-deferred accounts. In general, it is more tax-efficient to hold heavily-taxed assets (e.g., taxable bonds) in tax-deferred accounts.

**Case A:** *Finance the tax (and penalty) on the Roth conversion from the IRA assets.*

For an individual who is forced to use IRA assets to pay the tax (and penalty), a Roth conversion is beneficial only if the after-tax wealth in Equation (2A) is greater than the after-tax wealth in Equation (1). After some algebra, a Roth conversion is beneficial in this case provided the following condition is satisfied:

$$\frac{T_{p,N}}{T_{p,0}} > \frac{1}{1-q} \qquad\qquad (3A)$$

Equation (3A) says that the ratio of the expected future ordinary tax rate to the current ordinary tax rate must be greater than $1/(1-q)$ in order for a Roth conversion to benefit an individual who is forced to liquidate IRA assets to pay the tax (and penalty) on the conversion. Interestingly, notice that this condition is independent of the individual's planned retirement date, N. For all individuals younger than 59½ (where q = 10%), the ratio of tax rates must be greater than $1/(1-.10) = 1.11$, while for all individuals older than 59½ (where q = 0%), the ratio of tax rates must be greater than 1.0.

While much of the analysis assumes that the conversion decision is "now or never," even if Equation (3A) is satisfied currently, the individual may still be better off delaying the Roth conversion to a future year if $[1/(1-q)]T_{p,0}$ is expected to fall prior to retirement. This implies that a Roth conversion should be delayed to a future year for (1) individuals younger than age 59½ who are currently subject to the q = 10% penalty for early withdrawal and (2) individuals older than 59½ who expect their ordinary tax rate to decline further prior to retirement. It is also likely that delaying the Roth conversion will be beneficial if it allows the individual to accumulate sufficient non-IRA assets to pay the tax on the conversion. This is the case we consider next.

***Case B:*** *Finance the tax on the Roth conversion from non-IRA assets.*

For an individual who can finance the tax payment using non-IRA assets, a Roth conversion is beneficial provided the after-tax wealth in Equation (2B) is greater than the after-tax wealth in Equation (1). After algebraic manipulation, the Roth conversion is beneficial in this case provided the following condition is satisfied:

$$\frac{T_{p,N}}{T_{p,0}} > \left[\frac{1}{1 - gT_g}\right]\left[\frac{1 + r(1 - T_i)}{1 + r}\right]^N \qquad (3B)$$

Equation (3B) says that a Roth conversion, where the tax is financed from non-IRA assets, makes sense only if the ratio of the future ordinary tax rate to the current ordinary tax rate is above some critical level. When the embedded capital gain is $g = 0\%$, the critical ratio of tax rates is less than 1.0. This means that the individual may find it beneficial to convert to a Roth IRA, even though the anticipated future tax rate is less than the current tax rate (a definite departure from conventional wisdom). The reason a Roth conversion can be beneficial, even when the tax rate during retirement would be below the current tax rate, is because the payment of the tax from non-IRA assets is akin to allowing the individual to scale up his/her tax-deferred savings. The critical ratio of tax rates increases when an individual is forced to liquidate assets with an embedded capital gain to finance the tax payments. According to Equation (3B), the critical cutoff ratio of tax rates is likely to be lower for individuals who are younger (with more time until retirement), hold assets with higher expected returns and effective tax rates, and have the liquidity to fund the tax liability without triggering an embedded capital gain.

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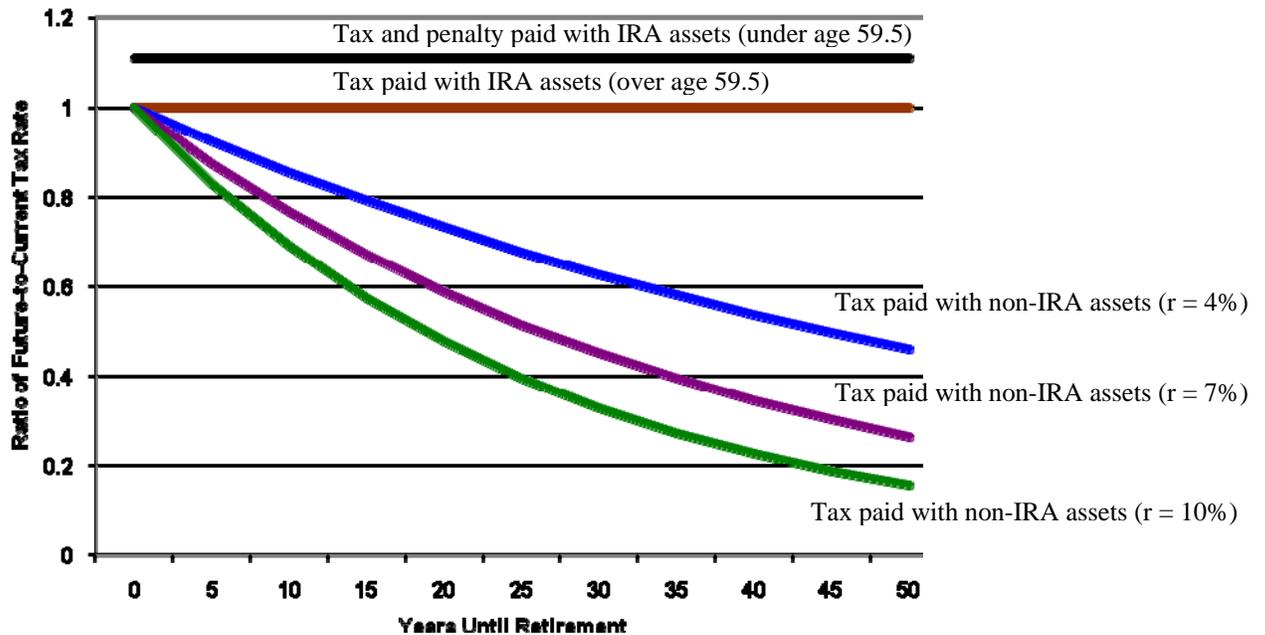**Figure 1: Critical Tax Ratios for Roth Conversion**



Figure 1 below shows the critical cutoff ratio of tax rates for different retirement horizons and different asset returns. When applicable, the penalty for early withdrawal is 10%. When non-IRA assets are used to fund the tax liability, it is assumed that the embedded capital gain is $g = 0\%$ and that $T_i = 40\%$ (i.e., interest income). It is beneficial for the individual to convert to a Roth IRA provided the ratio of the expected future ordinary tax rate to the current ordinary tax rate is above the critical ratios shown in Figure 1.

### IV.     Examples

***Example 1:*** *Young individual (younger than 59½) who is in the 28% tax bracket, has a traditional IRA, but has no non-IRA savings or ability to borrow.*

For this individual, a Roth conversion will generate both a tax liability and an early withdrawal penalty that is financed with the assets held in the IRA account. For this

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individual, the Roth conversion is optimal only if the expected ordinary tax rate in retirement is greater than $T_{p,N} > 28\% \times 1.11 = 31.11\%$ (see Eq. (3A)). This conclusion does not depend upon the assumed pre-tax return, r, or the planned retirement date, N.

*Example 2: High-taxed individual ($T_{p,0} = 40\%$) who can pay the tax on a Roth conversion using non-IRA assets with no embedded capital gain, g = 0%.  The individual holds high-yield corporate bonds ($T_i = 40\%$) in a traditional IRA with an expected pre-tax yield of 7%.  The individual has a planned retirement date in 20 years.*

According to Equation (3B), it is beneficial to convert to a Roth IRA provided the individual's expected ordinary tax rate in retirement is greater than 23.536% (i.e., .5884 x 40% = 23.536%).

*Example 3: High-taxed individual ($T_{p,0} = 40\%$) who can pay the tax on a Roth conversion by liquidating non-IRA assets with an embedded capital gain of g = 15%.  The capital gains tax rate is $T_g = 20\%$.  The individual holds high-growth stocks in a traditional IRA with an expected pre-tax return of r = 10% and an effective tax rate on investment income of $T_i = 16.2\%$.  The individual has a planned retirement date in 20 years.*

Once again, Equation (3B) tells us that this individual should convert to a Roth IRA as long as the expected ordinary tax rate in retirement is greater than 30.649% (i.e., .7662 x 40% = 30.649%).

## V.    Roth Conversion and Estate Taxes

A Roth conversion has some additional important benefits, such as potentially reducing estate taxes.

*Reduction in Estate Taxes*

Estate taxes are computed on the pre-tax value of the individual's estate, including the pre-tax value of any IRAs. If the IRA is a traditional pre-tax IRA, the owner also will be required to pay income taxes on the IRA assets as they are withdrawn from the IRA account. A Roth conversion can reduce potentially the value of an individual's estate, thereby reducing the estate tax liability, by selling assets to pay the income tax on the conversion. However, the benefit that comes from reducing the estate tax is offset, at least in part, by a potential increase in income taxes.

An important, but often overlooked, deduction in the tax code allows a beneficiary to reduce the impact of estate taxes on traditional pre-tax IRA accounts. This deduction is called an ***income in respect to a decedent (IRD)*** deduction and it allows the beneficiary to deduct the estate taxes paid on IRA assets against future taxable withdrawals from the IRA account.[15] The purpose of the IRD deduction is to reduce the burden of double taxation (income and estate taxes) on IRA assets, but it can also reduce the value of a Roth conversion.

The following two examples illustrate how the IRD deduction works, how estate and income taxes interact, and how a Roth conversion affects the total tax liability. In Example 4, the individual has non-IRA assets that exceed the estate tax exclusion. In Example 5, the individual has non-IRA assets that are worth less than the estate tax

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[15]IRD deductions are not subject to the 2% of adjusted gross income limitation.

exclusion, but total estate assets (non-IRA plus IRA) that exceed the estate tax exclusion. From these two examples it is clear that a Roth conversion allows an individual to reduce the impact of estate taxes only when the value of non-IRA assets is less than the estate tax exclusion, but the total value of the estate (non-IRA plus IRA) exceeds the estate tax exclusion.

**Example 4:** Non-IRA assets exceed the estate tax exclusion.

Suppose an individual has a $5 million estate: $4 million of non-IRA assets and $1 million of traditional pre-tax IRA assets. If the estate tax exclusion is $3.5 million, the estate must pay estate taxes on $1.5 million.[16] With an estate tax rate of 45%, the total estate tax liability is $675,000 (45% x $1.5 million). Without the IRA assets, the estate tax liability would have been $225,000 (45% x $500,000). Therefore, the IRS treats the remaining $450,000 of estate taxes as having been generated by the $1 million of IRA assets and allows the beneficiary a $0.45 IRD deduction on each $1 withdrawn from the IRA account (up to a total deduction of $450,000).

Assuming that the beneficiary has an ordinary income tax rate of 30%, the total tax liability (estate and income) on the inherited estate is:[17]

Total tax liability = Estate Taxes + Income Taxes

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[16]The estate tax exclusion had been $3.5 million in 2009 (with a maximum estate tax rate of 45% on the amount in excess of the exclusion), became unlimited in 2010 (i.e., no estate taxes), and reverts back to $1 million in 2011 and after (with a maximum estate tax rate of 55% on the amount in excess of the exclusion). Recent proposals in the U.S. Congress would have extended the 2009 estate tax exclusion and tax rate to 2010 and beyond; however, these proposals were not voted upon.

[17]In practice, the income tax liability and IRD deduction are realized at the time the beneficiary withdraws assets from the IRA account, or makes a Roth conversion. Here we assume that the IRD deduction is realized at the time that the beneficiary takes ownership of the estate.

$$= [0.45 \times (\$5.0 - \$3.5)] + [0.30 \times (\$1.0 - \$0.45)]$$

$$= \$675,000 + \$165,000 = \$840,000$$

Now suppose the individual converts his/her IRA assets to a Roth IRA immediately before death.[18] Assuming that the individual has the same ordinary tax rate as his/her beneficiary (i.e., 30%), the Roth conversion generates an immediate income tax liability of $300,000 (30% x $1.0 million). Assuming the individual liquidates non-IRA assets (with no embedded capital gain) to pay the income tax, the individual's remaining estate will be composed of $3.7 million of non-IRA assets and $1.0 million in a Roth IRA. The total tax liability (estate and income) paid by the individual and his/her beneficiary in this case is:

Total tax liability = Estate Taxes + Income Taxes

$$= [0.45 \times (\$4.7 - \$3.5)] + [0.30 \times \$1.0]$$

$$= \$540,000 + \$300,000 = \$840,000$$

Despite having reduced the estate tax, the total tax liability (estate and income) paid by the individual and his/her heir is the same with and without a Roth conversion.

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[18] In practice, the beneficiary of an inherited IRA is barred from doing a Roth conversion after death.

Example 4 is based upon the assumptions that (1) the individual and his/her beneficiary have identical ordinary income tax rates and (2) the non-IRA assets that are used to finance the income tax on a pre-death Roth conversion have no embedded capital gain. More generally, when an individual's estate includes non-IRA assets that are worth more than the estate tax exclusion, a Roth conversion immediately prior to death reduces total taxes (estate and income) provided the following condition is satisfied:

$$\frac{T_b}{T_p} > \left[ \frac{1}{1 - gT_g} \right] \qquad (4)$$

where $T_p$ is the individual's ordinary income tax rate, $T_b$ is the beneficiary's ordinary income tax rate, $T_g$ is the capital gains tax rate, and g is the embedded capital gain (as a percentage of current market value). Note that this condition is independent of the estate tax rate.

**Example 5:** Non-IRA assets worth less than the estate tax exclusion, total estate (non-IRA plus IRA) worth more than estate tax exclusion.

Now consider the same set of facts as in Example 4, except that the individual's $5 million estate is composed of $2.5 million in non-IRA assets and $2.5 million in a traditional pre-tax IRA. At the time of the individual's death, the estate tax liability is again equal to $675,000. Absent the IRA assets, the individual's estate tax liability would have been $0, since the non-IRA assets ($2.5 million) are worth less than the $3.5 million estate tax exclusion. Consequently, the IRS would consider the full $675,000 as

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attributable to the IRA assets and would allow the beneficiary a $0.27 IRD deduction on each $1 withdrawn from the IRA account (up to a maximum deduction of $675,000).[19]

The total tax liability (estate and income) paid by the beneficiary is:

Total tax liability = Estate Taxes + Income Taxes

$$= [0.45 \text{ x } (\$5.0 - \$3.5)] + [0.30 \text{ x } (\$2.5 - \$0.675)]$$

$$= \$675,000 + \$547,500 = \$1,222,500$$

If the individual converts his/her IRA assets to a Roth IRA immediately before death, then the income tax liability is $750,000 (30% x $2.5 million). Assuming the individual liquidates non-IRA assets (with no embedded capital gain) to pay the tax, the individual's remaining estate will be composed of $1.75 million of non-IRA assets and $2.5 million in a Roth IRA. The total tax liability (estate and income) paid by the individual and his/her beneficiary in this case is:

Total tax liability = Estate Taxes + Income Taxes

$$= [0.45 \text{ x } (\$4.25 - \$3.5)] + [0.30 \text{ x } \$2.5]$$

$$= \$337,500 + \$750,000 = \$1,087,500$$

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[19]The $0.27 IRD deduction for each $1 withdrawn from the IRA account is determined by dividing the total estate tax attributable to the IRA ($675,000) by the total dollar value of the IRA ($2.5 million).

In this case, the total tax liability (estate and income) is reduced by making a Roth conversion before death, even when the ordinary income tax rate is the same for the individual and his/her beneficiary. In contrast to Example 4, the individual's non-IRA assets are worth less than the estate tax exclusion. This reduces the amount of the IRD deduction per dollar of IRA assets and makes a pre-death Roth conversion more attractive.[20]

More generally, when the value of non-IRA assets is less than the estate tax exclusion, but the total estate is worth more than the estate tax exclusion, the condition under which a Roth conversion immediately prior to death will reduce the total tax payments (estate and income) for the individual and his/her beneficiary is:

$$T_b \left[ 1 - \frac{(V - X)T_e}{V_R} \right] + \left[ \frac{(V - X)T_e}{V_R} \right] > \left[ \frac{T_p}{1 - gT_g} \right] \qquad (5)$$

where $T_p$ and $T_b$ are the ordinary income tax rates for the individual and his/her beneficiary, respectively, $T_e$ is the estate tax rate, $T_g$ is the capital gains tax rate, V is the total value of the estate (non-IRA plus IRA assets), and $V_R$ is the value of the IRA assets. The right-hand side of Equation (5) is the total tax paid per dollar converted to a Roth IRA prior to death, where the ordinary income tax payment is financed by selling non-IRA assets with an embedded capital gain of g. The left-hand side is the total tax paid (estate and income) by the beneficiary if the Roth conversion is not made prior to death. The first term captures the ordinary income taxes paid on the inherited IRA (net

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[20]Our analysis makes the simplifying assumption that the IRD deduction is received at the time the IRA is inherited, instead of over time as the assets in the IRA are withdrawn.

of the IRD deduction) and the second term captures the estate tax payment per dollar of IRA assets.

## VI. The Re-characterization Option

One important benefit of a Roth conversion is the ability to reverse the transaction without penalty any time before October 15th of the year following the conversion. This is called *re-characterization*. Re-characterization can be particularly valuable when asset values decline following the original conversion. Recall that the tax on the Roth conversion depends upon the value of the assets held in the IRA account at the time of the conversion. If asset values subsequently decline, the individual may wish to reverse the transaction and execute (after a mandatory waiting period) a new Roth conversion using the lower asset values to compute the tax liability.[21],[22] Since the tax liability is computed based upon the conversion value, it can be optimal to reverse the conversion if the account value has declined substantially (or even risen only slightly) prior to October 15th in the next year. The cap on the tax liability for this creates an option as the investor can eliminate the liability by re-characterizing his conversion back to the traditional tax-deferred account. This also suggests that until the re-characterization option expires (or otherwise has little value) it can be valuable to locate volatile assets (and especially a highly concentrated portfolio) in a tax-deferred account, unlike the focus of the location analysis in Dammon, Spatt and Zhang (2004) in generic tax-

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[21] An individual who reverses a Roth conversion may not reconvert until the later of (1) January 1st of the year following the original conversion, or (2) 30 days after the re-characterization.
[22] Another discussion of the conversion and re-characterization provisions for traditional and Roth IRAs is in Lange (2006), but the import of the tools of financial economics is not developed there. The re-characterization option was independently identified by both Lange (2006) and earlier versions of our work on estate planning (current version is Dammon, Spatt and Zhang (2007)).

deferred settings.[23] The conversion and re-characterizations have become especially important starting in 2010 as 2006 tax legislation repealed the $100,000 income restriction for individuals and couples to be eligible to convert.[24] This will facilitate conversion by many of those with especially large tax-deferred accounts.[25] We can use arbitrage methods (see Dammon, Spatt and Zhang (2004)) to show that it is efficient to locate very volatile positions in the tax-deferred accounts still subject to the potential for re-characterization. We anticipate that this conclusion would obtain even relative to locating volatile positions in the taxable account (where the ability to benefit from losses is limited and gains liability is deferred rather than eliminated), but would plan to prove that formally.

Similarly, eligible participants can re-characterize a newly funded traditional IRA as a Roth IRA and a Roth IRA as a traditional IRA until October 15th of the year after the contribution. To maximize the option value it is advantageous to separate these

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[23]The special tax treatment for "net unrealized appreciation" for employer stock held in 401k plans also alters the conventional asset location advice, but will not be the focus of our analysis.

[24]The ability to convert to a Roth can lead to the optimality of after-tax annual IRA contributions by those not satisfying the income test for annual traditional or Roth contributions. The tax liability of converting after-tax contributions to a Roth IRA is solely the tax on the growth of the after-tax IRA account when the individual does not possess a traditional IRA. This tax likely would be modest if the after-tax contributions were made only a few years before. However, the attractiveness of after-tax contributions in this scenario can be limited due to "blending" rules on withdrawals if the individual already has a substantial traditional IRA accumulation. Under these rules the after-tax funds can only be withdrawn proportionate to the traditional IRA funds of the investor. Consequently, much of the advantage for marginal contributions of after-taxed funds of only being taxed on the growth of the funds would not be available in some situations in which only partial conversion would be optimal.

[25]Because of progressivity of the income tax schedule full conversion may not be optimal in a single year. Instead, it may be optimal to push to the end of an interval before which a particular marginal tax rate will jump up, assuming a stepped and progressive tax schedule. Alternatively, for taxpayers subject to the Alternative Minimum Tax (AMT) conversion of an amount consistent with eliminating the AMT liability (and therefore, an effective tax rate of 28% in many situations) would be advantageous in some circumstances. The formal boundary analysis of the optimal exercise of the re-characterization option would be modified slightly for the case in which conversion occurs over a number of years. While the context of progressive taxes and the Alternative Minimum Tax are somewhat different, the underlying principle in the examples is similar because in both we've focused on the possibility that the marginal effective tax rates are about to jump upward. Of course, the stochastic aspect of the re-characterization option also would be reflected in the formal analysis.

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accounts by their respective expiration dates. In effect, accounts in which the option to re-characterize expires on October 15<sup>th</sup> of the current year, those that expire on October 15<sup>th</sup> of the following year, and those for which the option is no longer available should not be mixed together.

A fundamental component of our paper is to characterize and solve for the optimal re-characterization decisions subsequent to conversion from the traditional tax-deferred account to the Roth account. To illustrate in its simplest form why re-characterization could be optimal, suppose that the investor converts $75,000 from his traditional tax-deferred account into his Roth IRA. If the investor is in a combined federal and state tax rate of 40%, then the tax liability would be $30,000. Suppose that the value subsequently declines by half prior to the re-characterization. The tax liability would be 80% of the reduced value. The total account wealth on an after-tax basis would be $22,500 after re-characterization versus $7,500 without re-characterization—suggesting a huge incentive to re-characterize. On the other hand, if the value of the converted account doubled to $150,000 the tax liability would also be $30,000. For a sufficiently low realization, it will be optimal to re-characterize. In general, re-characterization will be optimal only if the account performance is below a critical value. In fact, given the substantial option value associated with re-characterization the investor will find it optimal to re-characterize only if he is sufficiently compensated for foregoing the subsequent series of options to convert and re-characterize on those funds. Because the investor who does not re-characterize foregoes a series of future conversion and re-characterization options rather than just a single pair, the dynamic nature of these options makes it much more valuable to re-characterize and raises the threshold far above the critical value when there would be just a single pair of conversion and re-characterization options.

Consequently, the investor will re-characterize unless the performance in the relevant account is sufficiently strong. In effect, we are solving for the cutoff below which exercise of the re-characterization boundary is optimal.

*Proposition 0*: The investor will optimally re-characterize his conversion (at the expiration of the re-characterization option) unless the value of his account is above a critical value.

Building upon this we can identify several observations about optimal conversion and re-characterization. Of course, if the investor can costlessly re-characterize and reverse the conversion, then the set of situations in which initial conversion is optimal is greatly enhanced. In fact, the set of situations in which initial conversion is optimal is very general.

*Proposition 1*: In the presence of a costless re-characterization option, initial conversion is always optimal because the initial conversion can always be reversed.

This perspective just exploits the observation that the conversion option always has value due to the option to re-characterize the conversion.[26] The benefits associated with this strategy reflect not only the stochastic character of interest rates and asset prices, but also the effect of stochastic changes to tax rates and the investor's financial situation, which also can influence effective marginal tax rates. The only scenario that would appear to upset this conclusion is the possibility that the re-characterization option is repealed without the investor possessing the opportunity to reverse his decision.

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[26]This is true even if tax rates are expected to decline by the deadline because re-characterization allows the conversion to be costlessly reversed.

We also can point to a variety of comparative statics. For example, if future tax rates unexpectedly increased after the conversion but current tax rates were unchanged, then the willingness to re-characterize should decline to avoid the impact of the higher anticipated future tax rates. Arguably such an effect is especially strong at present due to the combination of an anticipated increase in future tax rates and the uncertainty about future tax rates.

Furthermore, the increase in the variability of asset prices during the last year highlights the huge potential value to the re-characterization option associated with conversion. For example, the future ability to re-characterize has become more valuable in a setting in which future asset prices are especially volatile and so the current re-characterization option becomes more beneficial.  Formally,

*Proposition 2*: An increase in exogenous asset price volatility increases the value of the future re-characterization option, expanding the set of states of the world in which the re-characterization of current conversion options is beneficial.

This emphasizes the value of appropriate option strategies to fully benefit from the re-characterization option. An interesting institutional aspect concerning how re-characterization works is that the investor can choose which specific accounts to re-characterize. More specifically, the investor can re-characterize some, but not all, accounts  towards the end of the relevant tax filing period, i.e., the re-characterization is not an all-or-none decision. Using this institutional observation and the idea underlying a central result in Merton (1973) that a portfolio of options is more valuable than an option on the underlying portfolio implies:

*Proposition 3*: Each distinct investment position or strategy should be structured separately to maximize the value of the portfolio of re-characterization options.

This would allow the maximal option value at the stage of potential re-characterization as the account holder could cherry pick specific components to re-characterize. Of course, the strategies themselves should not necessarily be viewed as fixed. In particular, the discussion highlights the contribution of the volatility of the underlying individual positions in this context and that the volatility of the underlying strategies should be endogenous. The combined conversion and re-characterization option over time makes volatility especially valuable. The investor could use accounts not subject to re-characterization to help meet his diversification goals and/or diversify across the basket of volatile positions and accounts. Consequently, the location choices between such accounts and the taxable account are very different than in the traditional tax-deferred and taxable account. In contrast, Dammon, Spatt and Zhang (2004) highlight the theme in the traditional tax-deferred investment context that the tax-deferred account should focus on the high yielding assets. In fact, the same analytics and comparative statics as in Dammon, Spatt and Zhang (2004) would apply to a Roth IRA account as well as the traditional tax-deferred account, absent the re-characterization option and also once the re-characterization option has expired (and conversion has been confirmed in the long-term dynamic).

*Proposition 4*: The re-characterization option increases the value of locating highly volatile assets in tax-deferred accounts in which the re-characterization option has not expired.

However, in the spirit of *Proposition 3* the importance of volatility is within individual component accounts subject to re-characterization rather than necessarily for the overall tax-deferred Roth portfolio that is subject to re-characterization. Substantial idiosyncratic risk and strategies that are not highly correlated with one another (or especially strongly negatively correlated) in individual component accounts would be especially helpful in this context. Appropriately structured option-based strategies can potentially eliminate a substantial amount of the tax liability associated with the tax-deferred investment.

At the expiration of a portfolio of re-characterization options the investor faces choices as to which of these options to exercise and reverse the conversion and for which to leave the original conversion standing (which is why the individual conversions are crucial—each faces a separate option).

*Proposition 5*: At the expiration of the re-characterization options in a particular time interval the investors will reverse the conversion of those below a critical value.[27]

The precise cutoff level for exercising the re-characterization option itself across accounts would depend upon the performance of the securities positions and the specifics of the marginal tax function. However, under the assumptions of a flat tax in each period, a constant tax rate over time and an infinite horizon, the optimal critical value will be time independent.

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[27]To avoid numerical complications associated with the correlation in the universe of assets, it may be useful numerically to limit the number of potential conversions per year, such as to once per month.

It's also interesting to consider what happens to the cutoff level as the investor ages. Several factors immediately point to non-stationarity in the underlying problem in practice:

a) The investor will be required to start mandatory withdrawals from the traditional tax-deferred account at age 70.5, but not for the Roth IRA;

b) Conversion is not allowed after the investor's death (e.g., by the inherited IRA beneficiary) and the investor's mortality likelihood increases over time.

c) The owner looses the potential advantage of additional effective tax-deferred assets in the interim by delaying conversion.

These factors in isolation point to the cost of delaying the conversion, but that has to be traded off against the re-characterization option as well as the potential option for lower tax rates (given the progressivity and uncertainty in rates, etc.) in the future.

*Proposition 6*: As a result of increasing mortality and the required withdrawal from the traditional tax-deferred account starting at age 70.5, the investor will re-characterize in fewer states as he ages.

To minimize his tax liability the investor will optimally let the conversion stand only for the accounts that performed best during the interval in which they possessed the re-characterization option. This is a robust idea that does not rely upon a constant tax environment over time or a flat tax rate in each period. Instead, the result is consistent with a progressive tax schedule and tax rates that change over time.

*Proposition 7:* The value of the re-characterization option is enhanced by the lack of predictability in both tax rates and the investor's specific tax circumstances.

This is an unusual aspect of the re-characterization option (at least assuming that the re-characterization option itself is not called into question) as most tax planning devices benefit from predictability in the tax environment. In effect, the re-characterization option provides the investor a partial hedge on changes in the tax rules.

This still leaves open the question of how does this cutoff level or boundary change over time prior to the expiration of the re-characterization option in a given year. First, we should note that ex ante a longer re-characterization option will be more valuable. Hence, early exercise of a prior re-characterization option may be optimal since that will lead to a longer subsequent re-characterization option as these still will expire at the final tax filing deadline during the following year (in mid-October).[28] This implies the following result:

*Proposition 8*: The optimal exercise boundary at each point in time will be characterized by a critical value (the investor only considers re-characterizing the lowest performing accounts). The critical value of the exercise boundary on the current re-characterization option will decline monotonically over time.

The solution to the exercise boundary (using methods from compound options) is crucial to helping investors understand when to terminate the re-characterization option. The

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[28]Once the investor exercises his current re-characterization option, he would be able to exercise another conversion option and obtain another re-characterization option only after thirty days (or January 1st of the year following conversion, if later). In the formal analysis it could be helpful to abstract from aspects of the tax year structure.

ranking of decisions across accounts about re-characterization before expiration of the option will be ranked by past performance. The volatilities of the various accounts will not influence the decisions about which accounts to re-characterize and reverse the conversion because absent trading costs these volatilities can be altered costlessly on a prospective basis within tax-deferred accounts.[29]


## VII.　　Concluding Remarks


The benefits of a Roth conversion depend upon a variety of factors. This proposal attempts to identify the most important factors that influence the tradeoff between the immediate tax cost and future tax benefits of a Roth conversion.  In some situations a Roth conversion can be beneficial even if the ordinary tax rate in retirement is expected to be less than the current ordinary tax rate.  The reason is that the payment of the tax on the Roth conversion using non-IRA assets is equivalent to allowing the individual to scale up his/her IRA savings, which has the advantage of earning pre-tax returns.[30]


A Roth conversion also has the potential to reduce the impact of estate taxes for some individuals.  However, the benefit of a Roth conversion for estate tax purposes is offset, at least in part, by an increase in ordinary income taxes.  The paper extends thinking about the role of different types of tax-deferred accounts as well as the taxable account, including both traditional and Roth tax-deferred accounts and accounts in which the

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[29]Of course, the effects associated with re-characterization prior to the end of the re-characterization period are likely to be secondary compared to exploiting the option at its expiration.

[30]The advantage of using non-IRA assets to pay these tax obligations is especially great for a wealthy investor, who typically has only a limited portion of his financial wealth available in tax-deferred vehicles (as reflected in the utility value to an investor of having a larger fraction of their wealth on a tax-deferred basis, when little of the investor's wealth is tax deferred—see Dammon, Spatt and Zhang (2004)).

possibility of re-characterization remains open. The use of arbitrage methods will provide fundamental insight about optimal asset location patterns and welfare analyses that focus upon the utility value or shadow price of wealth in different accounts will offer valuable guidance on the choice of optimal distribution decisions of these accounts (what to use for expenditures). The analysis of the re-characterization boundary will help guide decisions as to when the accountholder should re-characterize his conversion and later attempt to again convert. By varying our model assumptions and/or parameter values we would be able to undertake a range of sensitivity analyses.[31]

Our focus upon tax-deferred investing and the Roth IRAs also will potentially facilitate evaluation of contributions to "after-tax" IRAs that would be undertaken by individuals not permitted to make current deductible contributions to their traditional IRA (and not permitted to make Roth IRA contributions). The removal of the income cap for Roth IRA conversions will make it advantageous under some conditions to contribute to these "after-tax" IRAs because conversion to a Roth would subject the holder only to tax on the growth above the contributed non-deductible principal. We anticipate that our analysis will enhance our understanding of the potential efficacy of "after-tax" IRAs (however, the blending rules on withdrawals between traditional and "after-tax" IRAs could limit the effectiveness of this strategy).

While much of our analysis so far has approached the investor's decisions about conversion and re-characterization from a valuation perspective, it also will be interesting to explore further the time profile of government revenues, using results about investor strategies and the stochastic structure of asset returns.

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[31]Numerical solution is helpful because of the time dependence of the re-characterization boundary prior to expiration as well as the repeated nature of the option to convert and re-characterize until the investor decides not to re-characterize.

To the extent that conversion and especially re-characterization provide useful choices to investors, obviously those options come at the expense of the government's revenue (in present value terms). It's also interesting to consider the collateral effects on the time profile of the government's revenue. Roth conversions could generate considerable revenue initially, especially in the first years when they are allowed for high income individuals. These revenues are likely to taper over time as existing tax-deferred wealth has access to the opportunity for several years. The revenue effect may be especially strong in the first two years because the tax liability from initial year conversions will be spread over two years. Of course, the revenues from conversion will come at the expense of reduced withdrawals later from tax-deferred accounts. It is also important to recognize that the time profile of the revenue effects is stochastic because the decisions about whether to exercise the re-characterization options depend upon the price movements.

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