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Analysis of investment choices for retirement: a new approach and perspective

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Abstract

This paper evaluates deductible individual retirement accounts (IRAs), Roth IRAs, non-deductible IRAs, and open taxable investments using equal initial after-tax investments for the different choices. The concept of a break-even tax rate at the time of withdrawal of funds is used to analyze optimal choice between the deductible IRA and the Roth IRA. The break-even tax rate is seen to be a decreasing function of rate of return on the investment and the investment horizon. Regarding non-deductible IRAs, and open taxable investments, the findings indicate that the non-deductible IRA is the optimal choice for individuals with long investment horizons. © 2001 Published by Elsevier Science Inc.

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1. Introduction

Personal savings and investments are likely to become the most important source of retirement income for many Americans. The traditional three-legged stool of financial support for retirement living, comprising Social Security payments, employer provided pensions, and personal savings, is being replaced with retirement plans based predominantly on self-managed savings and investments.

The investment choices for retirement are affected by the tax treatment of the income generated by these investments. The Tax Relief Act of 1997 (TRA) made more choices available and created a new and very attractive avenue in the form of the Roth individual retirement account (IRA). The tax law changes passed in 2001 have increased the contribution limits for all the IRAs making the optimal choice among these even more

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important than before. The investment choices now available to the individual include the traditional tax-deductible IRAs, the new Roth IRA, the non-deductible IRA, and tax-deductible employer sponsored plans such as a 401(k), 403(b), SEP, or SIMPLE plan.

The actual choices available to specific individuals are determined by income levels and the availability of employer sponsored pension plans. An individual can also invest in open taxable accounts, which are not tax-advantaged in the traditional sense, but also not restricted by any rules with respect to income, withdrawals, or borrowing. Thus, there are several investment options open for most people and optimal choice is important.

The optimal choice is typically portrayed by financial planners and advisors as a trade-off of current tax deductions against future tax savings and one of maximizing the future of investment dollars with the aim of accumulating a certain dollar amount or achieving some financial target. However, the choice is far from simple or obvious because of the number of factors involved in the trade-off and the uncertainties surrounding them. Further, the simple trade-off approach often ignores the implicit options available with the different investment choices.

This paper analyzes the long-term investment avenues available for retirement goals using standardized or equal after-tax investments for the different investment avenues and suggests a new approach to determine the optimal choice, investment of $1 in the tax-deductible IRA is compared with $1 invested in the Roth IRA and $1 outside the IRA. The tax advantage of the deductible IRA is captured as tax savings, which is available for investment outside the IRA. This approach is different from the one used by Crain and Austin (1997), in that our approach allows the investor to use the full potential of the tax advantages of the different investment avenues. Conversely, Crain and Austin's (1997) approach uses equal before-tax investments. It is suggested that the choice should be made based not only on the tax-advantage and trade-off considerations but should also include qualitative evaluation of the options available with the different choices.

The paper is organized as follows. Section 2 provides a brief overview of the extant literature relating to investments with differential tax treatment and retirement accounts. Section 3 describes the framework and the models used for the analysis. These models are variations and extensions of the extant ones used in the past but use a different approach to the trade-off argument. The section also gives the results of simulation runs using the models. In addition, the section discusses the options and flexibility available with the different investment avenues and suggests explicit consideration of these options before choosing the investment avenue. Section 4 provides a summary and concluding comments.

2. Overview of literature

IRAs and other tax-deferred investments have attracted considerable research interest in the past. A good review is found in Horan, Peterson, and McLeod (1997). Early works include Burgess and Madeo (1980) who analyzed the impact of the premature withdrawal penalty on early withdrawals and use simulation to arrive at break-even investment horizons and optimal withdrawals from the IRAs. O'Neil, Saftner, and Dillway (1983) did similar work using the tax law changes in 1981. They found the impact of the premature withdrawal

penalty made non-IRA investments better for short-time investors. Randolph (1994) compares the non-deductible IRA with open taxable investments and finds that the former dominates the latter. Randolph (1994), however, did not allow for possible lower taxation of the open investments with capital gains. Scholes and Wolfson (1992) use lower capital gains tax rates and find that optimal choice is a function of investment horizon and percentage of return that is taxed at the lower rate.

The TRA expanded the choices available for retirement savings. The law not only made a number of changes to existing savings tools but has also created the new Roth IRA, which offers nearly unlimited potential for tax-free investment gains. The law also spawned a spate of new research evaluating these choices. Many financial services firms and mutual fund companies have created web-sites, which purport to help investors make the optimal choice between the traditional deductible IRA and the new Roth IRA. Recent examples of academic research covering this topic include the work by Crain and Austin (1997), Horan et al. (1997), Shanney-Saborsky (1999), Butterfield, Jacobs, and Larkins (2000) and Kutner, Doney, and Trebby (2001).

Crain and Austin (1997) evaluate deductible IRAs, Roth IRAs, non-deductible IRAs, and open taxable investments assuming the applicable tax treatment of mutual funds. Crain and Austin (1997) show that deductible IRAs and the Roth IRAs would produce identical future values if the investor's tax rate does not change. The investor would be better off with a deductible IRA if he expected to see a lower tax rate in the future. Conversely, a Roth IRA would be better if the investor expected an increase in his tax rate. The key to Crain and Austin's (1997) results is that they use, as mentioned before, equal before-tax investments in the deductible and the Roth IRA. In other words, an investor in the 28% marginal tax rate is assumed to invest $2,000 in the deductible IRA and only $1,440 in the Roth IRA. Thus, Crain and Austin (1997), implicitly assume that the investor has a constraint on funds available for investment and the funds available are limited to $2,000 (the amount of annual contribution limit for the IRAs) before tax. Alternately, their derivation implies that if the after-tax investment is held constant the tax savings obtained from the deductible IRA is invested in tax-deductible investments. If one assumes that the investor has at least $2,000 (or the amount of the annual contribution limit) after-tax and that the tax savings from the deductible IRA is invested in taxable investments, the Roth IRA will produce a higher future value even when the tax rate for the investor does not change. This is the approach used by us.

Crain and Austin (1997) also use actual mutual fund returns to compare the non-deductible IRA with taxable investments. In general, their results show that the Roth IRA and deductible IRA will dominate non-deductible IRA and taxable investments. The choice between non-deductible IRAs and taxable investments will depend on the rate of return and the percentage of income taxed at a lower capital gains rate.

Butterfield et al. (2000) use an approach very similar to that Crain and Austin (1997) and come up similar results. As mentioned before, this approach does not use the full tax saving potential of the Roth IRA and is thus biased towards the deductible IRA. Kutner et al. (2001) use equal after-tax investment to compare the investment performance of the deductible IRA with that of the Roth IRA and conclude that the investor's marginal tax rates at the time of investment and at the time of withdrawal affect the relative performance of the two types of IRAs.

We extend the prior research and use models similar to that used by Crain and Austin (1997) and Kutner et al. (2001). We assume, in an approach similar to Kutner et al. (2001), that the investor can invest the full amount permitted in the Roth IRA. Effectively, we are comparing $1 invested in the Roth IRA with $1 invested in the deductible IRA after fully accounting for the tax savings from the latter. Our approach allows the investor to use the full potential of the tax advantages of the different investment avenues up to the limit permitted by the tax laws.

We introduce the concept of a ''break-even tax rate'' defined as the tax rate at the time of withdrawal of funds for which alternate modes of investment will give exactly the same future value for a given investment horizon and rate of return. Our model for comparison of the Roth IRA with the deductible IRA solves for this break-even tax rate. Thus, the model focuses the decision on all the key uncertain variables: the investment horizon, the rate of return and the tax rate at the time of withdrawal of funds from the IRAs. The break-even tax rate tells the investor how low her tax rate has to be at the time of withdrawal of funds in order for her to benefit from investment in the deductible IRA in preference to the Roth IRA.

3. Analysis of IRAs and taxable investments

We use a simple analytical framework to evaluate the choices available to the individual investor. The typical choices available to investors today are the following five types:

1. Deductible IRA limited to $2,000 per year ($4,000 for married couples filing jointly) and available only to individuals meeting certain criteria. These investments receive favorable tax considerations but are restricted as to withdrawals before a certain period and age.
2. Employer sponsored retirement plans such as 401(k), 403(b), SEP and SIMPLE plans that are similar to IRAs in tax treatment but the amount of investment permitted is much larger. Similar plans are also available for self-employed (e.g., Keogh plan).
3. Non-deductible IRA that permits tax-deferred growth and limited to $2,000 per year ($4,000 for married couples filing jointly).
4. The new Roth IRA that permits tax-free investment returns but annual investment limited to $2,000 ($4,000 for married couples filing jointly).
5. Open taxable investments, which do not receive any preferential tax treatment except for lower taxes on long-term capital gains and are also not constrained in any way.

These investment avenues differ in tax treatment and the flexibility or lack of it with respect to the individual's ability to withdraw funds and use the investment proceeds. Note that in order to contribute to an IRA, the investor must have earned income at least equal to the amount invested in IRA. For married couples, either spouse can have the required earned income.

The tax cut package passed recently increases the individual contribution limit on IRAs to $3,000 for years 2002–2004, $4,000 for 2005–2007 and $5,000 for 2008. The law also provides for $500 increments for inflation adjustments after 2008. For tax-payers age 50 and over, the maximum limits are further increased by $500 for years 2002–2005 and by $1,000 in 2006. The annual limit applies to the total contribution made annually for all IRAs.

The TRA effectively divided investors into the following three broad groups with respect to their eligibility for different IRAs and other investment choices:

1. *Eligible for both IRAs*: This group would include investors with either low income (less than $52,000 for couples ($32,000 for single filers) in 2000) or those with no employer covered pension plans but much higher income levels ($150,000 for couples and $95,000 for single filers). This group faces the complicated choice between the two IRAs.
2. *Eligible for Roth IRA and non-deductible traditional IRA*: This group would include those who are covered by employer provided pension plans and whose income exceed the limits for eligibility for tax-deductible IRAs, but not that for the Roth IRA. This group would obviously be better off with the Roth IRA as a non-tax deductible IRA does not have any feature that makes it better than the Roth IRA.
3. *Eligible for the non-deductible IRA only*: This is the group with an income level too high for eligibility in the Roth IRA (couples with income over $150,000 and single filers with income of $95,000). They can invest only in the non-deductible traditional IRA.

The tax cut package of 2001 has raised the income limits for eligibility for deductible and Roth IRA from the year 2002. All groups can invest in open taxable investments. The choice of interest for the first group is between the deductible IRA and the Roth IRA. For the second group, the choice will always be the Roth IRA. It is obvious that the Roth IRA will dominate both the non-deductible IRA and the open taxable investments. For the third group, the choice is between the non-deductible IRA and open taxable investments. We take up the choice between the deductible IRA and the Roth IRA first. As mentioned before, we assume equal after-tax investments in each IRA.

We use the after-tax accumulated future value of the different investment choices for the evaluation of the optimal choice. The individual invests in the same type of investments for all investment modes and earns the same before-tax annual rate of return. The following notations are used:

k	rate of return (before tax) on investment, assumed to be same for all choices
t_0	marginal tax rate of the investor at the time of investment
t_1	marginal tax rate for the investor on all taxable investments
t_2	marginal tax rate of the investor at the time of withdrawal of funds from the IRA
t^*	the break-even tax rate or the tax rate at the time of withdrawal of funds for which the accumulated after-tax value is equal for the deductible IRA and the Roth IRA
n	number of years for which the funds remain in the IRA
FVAT	accumulated after-tax future value

The deductible IRA: The deductible IRA frees up $\$t_0$ for each dollar invested. We assume this would be invested at the same rate of return as the IRA, but the returns would be taxed each year at t_1, the marginal tax rate of the individual. Assuming a separate tax rate for the investment of the tax savings generated permits us to consider possible lower capital gains taxation for this investment. The key advantage of the deductible IRA is the extra cash flow of t_0 or the tax deduction generated for each dollar invested in the IRA. This has to be invested in taxable investments. Thus, $1 invested in the deductible IRA would result in an

after-tax accumulation at the end of n years as follows:

$$\text{FVAT for deductible IRA} = (1+k)^n(1-t_2) + t_0(1+k(1-t_1))^n \tag{1}$$

Roth IRA: Any investment in the Roth IRA would grow totally tax-free and the investor can expect to receive the total accumulation without any tax obligations, \$1 invested in the Roth IRA would result in an accumulation at the end of n years as follows:

$$\text{FVAT for Roth IRA} = (1+k)^n \tag{2}$$

The choice: The optimal choice would be a function of the three tax rates, t_0, t_1 and t_2, the rate of return and the investment horizon. We introduce a new approach to this decision framework by focusing on the tax rate at the time of withdrawal relative to the investor's current tax rate. The conventional wisdom is that the investor is better off with the deductible IRA if she is likely to face the same or lower tax rate at the time of withdrawal. Our model explicitly computes this tax rate and also shows that the tax rate is a function of the rate of return, the investment horizon and the current tax rate of the investor.

Equating (1) and (2), we can solve for t_2, the tax rate at withdrawal for which the accumulated values for either IRA would be exactly the same. We call this the ''break-even tax rate'':

$$t^* = \text{break-even tax rate} = \frac{t_0(1+k(1-t_1))^n}{(1+k)^n} \tag{3}$$

An investor can calculate the break-even tax rate given her current tax rate, expected rate of return and period of investment. If her expected tax rate at the time of withdrawal were lower than the break-even rate she would benefit by investing in the tax-deductible IRA. Otherwise, she would be better off with the Roth IRA. It can be seen that the break-even tax rate will always be lower than t_0, the investor's current tax rate. In other words, the investor *has to have* a lower tax rate at the time of withdrawal for the deductible IRA to perform better than the Roth IRA. It can also be seen that the break-even rate decreases with higher rates of return, longer investment horizon, and higher values for t_1. Of course, t_1 can be lower than t_0. This happens when the taxable investment is in the form of long-term capital gains.

A special case arises when the entire investment return from the taxable investment is in the form of long-term capital gain realized only at the time of withdrawal of the IRA itself. In this case the accumulated value for each dollar of the deductible IRA will be:

$$\text{FVAT} = (1+k)^n(1-t_2) + t_0(1+k)^n - (t_0(1+k)^n - t_0)t_g \tag{4}$$

where t_g is the capital gains tax rate. The first term on the right-hand side is the after-tax accumulation from the IRA investment. The last two terms capture the after-tax accumulation of the tax savings invested for the same period as the IRA and taxed only at the end of the investment horizon. The equation can be simplified as below:

$$\text{FVAT} = (1+k)^n(1-t_2) + t_0(1+k)^n(1-t_g) + t_0t_g \tag{5}$$

The break-even tax rate for this very special case can be obtained by combining (5) and (2) and solving for t_2:

$$t^* = t_0(1-t_g) + \frac{t_0t_g}{(1+k)^n} \tag{6}$$

Table 1
Tax-deductible vs. Roth IRA: break-even tax rate

Investment horizon (years)	Rates of return (A: tax on taxable investment = 10%)				Rates of return (B: tax on taxable investment = 8%)			
	6%	8%	10%	12%	6%	8%	10%	12%
5	9.7%	9.6%	9.6%	9.5%	9.8%	9.7%	9.6%	9.6%
10	9.4%	9.3%	9.1%	9.0%	9.6%	9.4%	9.3%	9.2%
15	9.2%	8.9%	8.7%	8.5%	9.3%	9.1%	9.0%	8.8%
20	8.9%	8.6%	8.3%	8.1%	9.1%	8.9%	8.6%	8.4%
25	8.7%	8.3%	8.0%	7.6%	8.9%	8.6%	8.3%	8.1%
30	8.4%	8.0%	7.6%	7.2%	8.7%	8.4%	8.0%	7.7%
35	8.2%	7.7%	7.3%	6.9%	8.5%	8.1%	7.7%	7.4%
40	8.0%	7.4%	6.9%	6.5%	8.3%	7.9%	7.5%	7.1%

Marginal tax rate at the time of investment = 10%.

The investor will be better off with the tax-deductible IRA if her expected tax rate at withdrawal of funds is less than the break-even rate.

For long investment horizons, this would approximate to $t_0(1 - t_g)$. Thus, for an investor with a current tax rate of 15% and a capital gains tax rate of 10%, the break-even tax rate will be 13.5%.

Under the new tax cut package rules, investors with current marginal tax rates of up to 30% can be eligible (subject to other conditions) for both the Roth IRA and the deductible IRA. We calculate the break-even tax rates for different values of current tax rates, rates of return and investment horizon. For each set of simulations, we use two values for t_1: the value of t_0 and the lower capital gains tax rate applicable.

Table 1 shows the results for initial tax rate of 10%. The results are revealing. The break-even tax rate is a decreasing function of the rate of return and investment horizon. An investor with current marginal tax rate of 10% and investment horizon of 20 years and earning a rate of return of 8% would have to have a marginal tax rate lower than 8.6% at the time of withdrawal to benefit from the deductible IRA. Panel B shows the results when the taxable investment of the tax savings from the deductible IRA is taxed at the lower capital gains rate. The break-even tax rate is still very low at 8.9%. Results for initial tax rates of 15%, 27% and 30% are shown in Tables 2–4, respectively. An investor with current tax rate of 27% earning 8% return and an investment horizon of 15 years will have to be at a tax rate of less than 19.9% (21.6% with the lower capital gains rate taxation of taxable investments) to benefit from the deductible IRA (Table 3).

In general, the Roth IRA will be a better choice for individuals with long investment horizons even when they are at current tax rates of 27% or 30%. The choice between the deductible IRA and the Roth IRA can be framed as the following trade-off:

Deductible IRA—known current tax saving to be invested in taxable investments.
Roth IRA—total avoidance of taxes on future investment gains.

The Roth IRA will be favored as the future investment gains increase. Thus, the higher the rate of return, more likely the investor will be better off with the Roth IRA. Similarly, the longer the investment horizon, more likely the Roth IRA is the better choice. The results shown in Table 1 through four clearly reveal this trade-off.

Table 2
Tax-deductible vs. Roth IRA: break-even tax rate

Investment horizon (years)	Rates of return (A: tax on taxable investment = 15%)				Rates of return (B: tax on taxable investment = 10%)			
	6%	8%	10%	12%	6%	8%	10%	12%
5	14.4%	14.2%	14.0%	13.8%	14.6%	14.5%	14.3%	14.2%
10	13.8%	13.4%	13.1%	12.8%	14.2%	13.9%	13.7%	13.5%
15	13.2%	12.7%	12.2%	11.8%	13.8%	13.4%	13.1%	12.8%
20	12.6%	12.0%	11.4%	10.8%	13.4%	12.9%	12.5%	12.1%
25	12.1%	11.3%	10.6%	10.0%	13.0%	12.5%	11.9%	11.5%
30	11.6%	10.7%	9.9%	9.2%	12.7%	12.0%	11.4%	10.9%
35	11.1%	10.1%	9.3%	8.5%	12.3%	11.6%	10.9%	10.3%
40	10.7%	9.6%	8.7%	7.8%	12.0%	11.1%	10.4%	9.7%

Marginal tax rate at the time of investment = 15%.

The investor will be better off with the tax-deductible IRA if her expected tax rate at withdrawal of funds is less than the break-even rate.

Our model does not address the uncertainty surrounding the tax rate at retirement or withdrawal of funds from the IRA. Note that this rate is a function of both the income of the investor and the prevalent tax law at the time of withdrawal. Any reduction in future marginal tax rates favors the deductible IRA. However, the uncertainty itself cannot be said to favor the deductible IRA because tax rates are just as likely go up as they are to go down.

3.1. Options and flexibility

In general, the Roth IRA has all the features of the deductible IRA, except the current tax deduction. However, the Roth IRA has greater flexibility and more options than the deductible IRA. The Roth IRA permits tax-free withdrawals of all contributions anytime.

Table 3
Tax-deductible vs. Roth IRA: break-even tax rate

Investment horizon (years)	Rates of return (A: tax on taxable investment = 27%)				Rates of return (B: tax on taxable investment = 20%)			
	6%	8%	10%	12%	6%	8%	10%	12%
5	25.0%	24.4%	23.8%	23.3%	25.5%	25.1%	24.6%	24.2%
10	23.1%	22.1%	21.1%	20.1%	24.1%	23.3%	22.5%	21.7%
15	21.4%	19.9%	18.6%	17.4%	22.8%	21.6%	20.5%	19.5%
20	19.8%	18.0%	16.4%	15.0%	21.5%	20.0%	18.7%	17.5%
25	18.4%	16.3%	14.5%	13.0%	20.3%	18.6%	17.1%	15.7%
30	17.0%	14.7%	12.8%	11.2%	19.2%	17.3%	15.6%	14.1%
35	15.7%	13.3%	11.3%	9.7%	18.1%	16.0%	14.2%	12.7%
40	14.6%	12.0%	10.0%	8.3%	17.1%	14.9%	13.0%	11.4%

Marginal tax rate at the time of investment = 27%.

The investor will be better off with the tax-deductible IRA if her expected tax rate at withdrawal of funds is less than the break-even rate.

Table 4
Tax-deductible vs. Roth IRA: break-even tax rate

Investment horizon (years)	Rates of return (A: tax on taxable investment = 30%)				Rates of return (B: tax on taxable investment = 20%)			
	6%	8%	10%	12%	6%	8%	10%	12%
5	27.5%	26.8%	26.1%	25.5%	28.3%	27.8%	27.4%	26.9%
10	25.3%	24.0%	22.8%	21.6%	26.8%	25.8%	25.0%	24.2%
15	23.2%	21.4%	19.8%	18.4%	25.3%	24.0%	22.8%	21.7%
20	21.3%	19.1%	17.3%	15.6%	23.9%	22.3%	20.8%	19.5%
25	19.6%	17.1%	15.0%	13.3%	22.6%	20.7%	19.0%	17.5%
30	17.9%	15.3%	13.1%	11.3%	21.3%	19.2%	17.3%	15.7%
35	16.5%	13.7%	11.4%	9.6%	20.1%	17.8%	15.8%	14.1%
40	15.1%	12.2%	9.9%	8.1%	19.0%	16.5%	14.4%	12.6%

Marginal tax rate at the time of investment = 15%.

The investor will be better off with the tax-deductible IRA if her expected tax rate at withdrawal of funds is less than the break-even rate.

First-time homebuyers are permitted tax-free withdrawals of earnings after 5 years. Other advantages include no requirement for distribution at any age, the option to contribute at any age, and possible advantages as a better vehicle for estate conveyance to younger heirs (Slesnick and Suttle (2000)). Schmidt (1999) and Lederman and Cole (1999) discuss a number of issues relating to the use of IRAs as estate planning tools. The main point made by both Schmidt (1999) and Lederman and Cole (1999) is that the traditional IRA is a great estate-planning tool. The Roth IRA is an even better tool; because it can do pretty much everything the deductible IRA does and actually enjoys the options flexibility mentioned. These options and flexibility should make the Roth IRA more attractive than the deductible IRA for many investors.

3.2. Non-deductible IRA versus open taxable investments

This choice has been studied by Randolph (1994) and Scholes and Wolfson (1992). Our models are essentially same. The accumulated values for these two choices can be written as:

$$\text{FVAT for non-deductible IRA} = 1 + [(1 + k)^n - 1](1 - t_2) \tag{7}$$

$$\text{FVAT for open, taxable investments} = (1 + k(1 - t_1))^n \tag{8}$$

The open taxable investments can do better than the non-deductible IRA, if the value of t_1 is significantly lower than t_2. This is possible if a significant part of the taxable investment returns are in the form of long-term capital gains. We do a set of simulations which assume that the open investments are taxed annually but at the lower capital gains tax rate of 10% for the 15% tax rate investor and 20% for those with higher tax rates. Results are shown in Table 5. Panels A1–A4 show the accumulated value for each dollar invested in the non-deductible IRA. The corresponding values for the open investments are shown in Panels B1–B4. The numbers in bold values indicate that open investments are better.

Table 5
Non-deductible IRA vs. open taxable investment accumulated value of $1 invested

Investment horizon (years)	Rates of return (A1: non-deductible IRA $- t_2 = 15\%$)				Rates of return (B1: open investment taxed annually at the rate of 10%)			
	6%	8%	10%	12%	6%	8%	10%	12%
5	1.2875	1.3989	1.5189	1.6480	**1.3008**	**1.4157**	**1.5386**	**1.6699**
10	1.6722	1.9851	2.3547	2.7900	**1.6920**	**2.0042**	**2.3764**	2.7887
15	2.1871	2.8463	3.7007	4.8025	**2.2009**	2.8374	3.6425	4.6569
20	2.8761	4.1118	5.8684	8.3493	2.8629	4.0169	5.6044	7.7767
	Rates of return (A2: non-deductible IRA $- t_2 = 27\%$)				Rates of return (B2: open investment taxed annually at the rate of 20%)			
	6%	8%	10%	12%	6%	8%	10%	12%
5	1.2469	1.3426	1.4457	1.5565	**1.2642**	**1.3637**	**1.4693**	**1.5814**
10	1.5773	1.8460	2.1634	2.5373	**1.5981**	**1.8596**	2.1589	2.5010
15	2.0195	2.5857	3.3194	4.2657	**2.0203**	2.5359	3.1722	3.9551
20	2.6112	3.6725	5.1811	7.3118	2.5540	3.4581	4.6610	6.2548
	Rates of return (A3: non-deductible IRA $- t_2 = 30\%$)				Rates of return (B3: open investment taxed annually at the rate of 20%)			
	6%	8%	10%	12%	6%	8%	10%	12%
5	1.2368	1.3285	1.4274	1.5336	**1.2642**	**1.3637**	**1.4693**	**1.5814**
10	1.5536	1.8112	2.1156	2.4741	**1.5981**	**1.8596**	**2.1589**	**2.5010**
15	1.9776	2.5205	3.2241	4.1315	**2.0203**	**2.5359**	3.1722	3.9551
20	2.5450	3.5627	5.0092	7.0524	**2.5540**	3.4581	4.6610	6.2548
25	3.3043	5.0939	7.8843	12.2000	3.2287	4.7156	6.8485	9.8915
30	4.3204	7.3439	12.5146	21.2719	4.0817	6.4306	10.0627	15.6429
	Rates of return (A4: non-deductible IRA $- t_2 = 35\%$)				Rates of return (B4: open investment taxed annually at the rate of 20%)			
	6%	8%	10%	12%	6%	8%	10%	12%
5	1.2198	1.3051	1.3968	1.4955	**1.2642**	**1.3637**	**1.4693**	**1.5814**
10	1.5141	1.7533	2.0359	2.3688	**1.5981**	**1.8596**	**2.1589**	**2.5010**
15	1.9078	2.4119	3.0652	3.9078	**2.0203**	**2.5359**	**3.1722**	**3.9551**
20	2.4346	3.3796	4.7229	6.6201	**2.5540**	**3.4581**	4.6610	6.2548
25	3.1397	4.8015	7.3926	11.4000	**3.2287**	4.7156	6.8485	9.8915
30	4.0833	6.8907	11.6921	19.8239	4.0817	6.4306	10.0627	15.6429

Open taxable investments assumed to be taxed annually at capital gains tax rate.

t_2 is the tax rate at the time of withdrawal of funds. Bold values indicate that open investments are better than non-deductible IRA.

In general, open investments are better for lower rates of return and higher values of t_2. As the investment horizon gets longer, the non-deductible IRA gets better. For rates of returns of 6% or higher, a non-deductible IRA is the better choice if the investment horizon is longer than 25 years, even if the investor has to pay 35% tax at the time of withdrawal.

The actual taxation of open investments is harder to model. Typically, part of each year's returns come from current income and are taxed at the current tax rate and the remaining

taxed at the lower, capital gains rate. A significant portion of the capital gains can and often are deferred for a long time and thus the effective advantages of open investments are harder to simulate. An extreme case is when all of the returns are from capital gains, which are deferred till the end of the investment horizon. For this case, the investor will be clearly better off with the taxable investment as his accumulated value would be:

$$\text{FVAT} = 1 + [(1 + k)^n - 1](1 - t_g) \tag{9}$$

where t_g is the long-term capital gains rate. This rate would surely be lower than t_2.

3.3. Options and flexibility

The ultimate advantage of the open taxable investments relative to the non-deductible IRA are the options and flexibility one has. These include:

- Ability to defer taxation indefinitely
- Use as estate and gift planning vehicles
- Use as margin accounts for borrowing
- Total flexibility in use of funds

Individual investors will do well to consider these factors before choosing the vehicle for long-term investment.

4. Summary and conclusion

This paper evaluates retirement and other long-term investment avenues available to individuals. Many investors are likely to face the difficult choice between the deductible IRA and the Roth IRA. The optimal choice is a function of the individual's investment horizon, rate of return for the investment and three different marginal tax rates. We use standardized after-tax investment in each to model the choice. Thus, the model compares $1 invested in the deductible IRA with $1 invested in the Roth IRA. The tax savings from the deductible IRA investment is fully accounted for by being invested in taxable investments at the same rate of return and same investment horizon. This model permits the investor to take advantage of the full potential of Roth IRA. We use the concept of break-even tax rate at the time of withdrawal of funds. This is the tax rate at the time of withdrawal that would make the individual indifferent between the two choices. The findings indicate that the break-even tax rate is always less than the investor's tax rate at the time of investment. This means that the investor has to have a lower tax rate at the time of withdrawal in order to benefit from the deductible IRA. The break-even rate is a decreasing function of: (i) the rate of return on the investment; (ii) the investment horizon, and (iii) the rate at which the taxable investment generated by the savings in initial taxes is taxed. Thus, most individuals with long investment horizons would probably be better off with the Roth IRA. Finally, the options and flexibility available with the Roth IRA make it an even better choice.

We also evaluate the choice between the non-deductible IRA and open taxable investments. Our research indicates the non-deductible IRA would be preferred by those

with long investment horizons. However, if the open investment returns come in the form of long-term capital gains, which are deferred till the time of withdrawal, the non-deductible IRA loses its advantage. Further, one has to consider the options and flexibility available with open investments. These would make the open taxable investments, a serious challenger to the non-deductible IRA, especially for those individuals with shorter investment horizons.

The findings illustrate the complexity that investors are faced with today regarding their investment choices. The decisions are far from clear-cut due to the uncertainty associated with long time horizons. Therefore, the responsibility lies with practitioners to adequately inform their clients as to what options would best enable them to achieve their financial goals. Specifically, when choosing between a deductible or Roth IRA, practitioners must decide the point at which the investment horizon is so great as to render the prediction of a tax rate at the time of withdrawal impractical. Thus, for younger investors, the Roth IRA must be the favored choice over the deductible IRA since the uncertainty regarding future tax rates is too great.

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