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The international retirement savings dilemma: Insights from U.S. IRAs with global relevance

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Abstract

This study evaluates the long-term financial outcomes of Roth and traditional IRAs, with their different tax advantages. Global applicability to countries with similar types of retirement plans is emphasized. A full factorial simulation assessed 54 unique combinations of IRA type, investment mix, and tax rates during working and retirement years. Results indicate that investment type plays a more critical role than IRA type in determining outcomes. Portfolios with significant exposure to the S&P 500 consistently achieved higher ending balances and longer-lasting funds compared to portfolios relying on lower-yield investments. Traditional IRAs, leveraging frontend tax advantages, performed best when tax savings were reinvested, though Roth IRAs provided tax-free withdrawals, maximizing backend benefits.

Key findings include the importance of starting early, maintaining significant equity exposure throughout life for higher returns, and understanding that IRA type often has a marginal impact relative to investment strategy. The study highlights that the most effective strategy is situational, influenced by factors such as tax rates and market conditions. These insights, while grounded in U.S. data, offer guidance for retirement planning systems globally. Policymakers and individuals are encouraged to prioritize early, consistent, and aggressive investment strategies to optimize retirement outcomes.

Keywords

- retirement
- financial planning
- personal investing
- taxes
- portfolio analysis

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Introduction

In the United States, individual retirement accounts (IRAs), both traditional and Roth, offer valuable opportunities for tax-advantaged retirement savings. Ideally, individuals would maximize contributions to both types of IRAs, but for most people, this is not financially feasible. Therefore, many are left with the crucial decision of choosing between a traditional IRA and a Roth IRA.

Many countries face similar challenges regarding retirement savings, offering various investment plans for individuals to choose from. While this study focuses on the United States as a case study, the issues discussed have global relevance and can be applied to retirement systems in other countries facing similar dilemmas. The goal is for the results to be applicable not only in the U.S. but also in other countries that offer retirement investment choices.

When investing for retirement in the United States, the two common individual account options are the traditional IRA and the Roth IRA. Both offer tax advantages, but they differ primarily in the timing of those tax benefits as summarized in Table 1.

Table 1. Summary of tax benefits: traditional vs. Roth IRA

Tax treatment	Traditional IRA	Roth IRA
Contributions (during working years)	**Not taxed:** contributions reduce taxable income	**Taxed:** contributions do not reduce taxable income
Withdrawals (during retirement)	**Taxed:** withdrawals are taxed as ordinary income	**Not taxed:** no tax on withdrawals, neither original contributions or investment earnings

Source: own study.

Because the traditional IRA offers a frontend advantage, as contributions are tax-deductible, this allows individuals to invest more each year compared to a Roth IRA. For instance, someone in the 20% tax bracket who budgets $1,000 for retirement contributions could effectively invest $1,250 in a traditional IRA. This is because the $1,250 contribution would result in a $250 tax deduction, reducing the net cash outflow to $1,000. In contrast, Roth IRA contributions are made with after-tax dollars, offering no frontend tax break but providing tax-free withdrawals in retirement.

The Roth IRA's main appeal is its backend advantage – both the original contributions and any earnings can be withdrawn tax-free in retirement. This means that every dollar in a Roth IRA goes further than in a traditional IRA once with-

drawals begin. For example, for someone in a 15% tax bracket, a $1,000,000 Roth IRA is equivalent to $1,176,471 in a traditional IRA after taxes.

Choosing the better option depends on various factors, many of which are difficult to predict. One such factor is tax rates, both during the working and retirement years. Ideally, one would prefer to be taxed at a lower marginal rate. If the marginal tax rate is expected to be higher during the working years, a traditional IRA with its frontend tax break might be more beneficial. Conversely, if the tax rate is anticipated to be higher during retirement, the Roth IRA's tax-free withdrawals could be more advantageous.

Though using tax rates to guide the choice between traditional and Roth IRAs is common advice, it is not possible to know what actual tax rates will be. Furthermore, the concept is vague. For example, how significant must the difference in tax rates be to affect cash flows? If tax rates remain the same during both working and retirement years, will the total cash flow be equivalent between the two IRAs?

This study aims to provide a clearer understanding of the financial consequences associated with selecting between a traditional and Roth IRA. While grounded in the U.S. retirement savings framework, the analysis aspires to offer insights that may be relevant in international contexts where similar investment vehicles exist. By addressing the complexities of retirement planning – particularly in light of widespread financial illiteracy in the United States (Fisch et al., 2019) and globally (Turner & Muir, 2012) – the study seeks to offer practical guidance for individuals navigating long-term savings decisions, both in the United States and in countries with comparable retirement systems.

1. Literature review

The landscape of retirement planning in the United States underwent a transformative shift in 1980 when Ted Benna introduced the first 401(k) (defined contribution) employee savings plan for his employees at the Johnson Company (Porter, 2017). The implementation of 401(k) plans marked the beginning of a trend where defined contribution retirement plans became increasingly popular, as traditional defined benefit plans gradually phased out. Between 1983 and 2016, the percentage of workers covered by defined benefit pensions plummeted from 62% to 17% (Sklansky, 2023). Today, the defined contribution 401(k) is the most widely used employer-sponsored retirement plan in the U.S., and the number of individuals investing for retirement continues to grow.

This shift is not unique to the United States; it reflects a broader global trend. Retirement systems worldwide are increasingly transitioning toward defined contribution plans, as part of efforts to balance the roles of government, the private sector, and employers in securing retirement income (Cohen, 2022). As early as 2005, over 30 countries had already implemented individual retirement accounts, reflecting a widespread move to strengthen retirement security (Kritzer, 2005). For example, the United Kingdom's Individual Savings Account (ISA) mirrors the U.S. Roth IRA, while the Self-Invested Personal Pension (SIPP) parallels the traditional IRA (De Villa, 2024). Similarly, Germany's Level 3 Private Pension and Base Pension correspond to Roth and traditional IRAs, respectively (German IRA, n.d.). Other countries with some form of individual defined contribution retirement plans include Australia, Canada, Japan, New Zealand, Austria, Singapore, Czech Republic, Denmark, Greece, Finland, Ireland, Netherlands, Slovenia, and Spain (Baldwin, 2015; Cannon & Tonks, 2013).

This global alignment is driven by growing challenges facing traditional pension systems. Many developed nations, particularly in Europe, have historically relied on pay-as-you-go social security programs, which now face significant unfunded liabilities due to aging populations and increased life expectancy (Gruber & Wise, 2002; Miles & Timmermann, 1999). France exemplifies these challenges: in April 2023, rising pension costs prompted President Emmanuel Macron to raise the retirement age from 62 to 64, despite strong labor union opposition (Armstrong, 2023; Cohen, 2024). The worldwide proliferation of individual retirement accounts underscores a collective effort to shift responsibility toward individuals while addressing the financial pressures associated with demographic change and strained public resources. Because retirement savings and funding support for the elderly are common concerns across countries, comparative studies have emerged. Examining and learning from other countries' experiences with defined contribution systems is both relevant and beneficial (GAO, 212; Kritzer, 2005).

In the United States, there is limited and inconclusive quantitative research comparing the two government-sponsored retirement plans: the traditional IRA and the Roth IRA. LaChance (2012) found that choosing a traditional IRA over a Roth creates small welfare losses in only a few situations, specifically for those with higher incomes. However, Loudenback (2024) finds that the choice between a Roth IRA and traditional IRA is situational, depending on how much you earn and projected income during retirement. Similarly, Kotlikoff et al. (2008) found that middle-income, single-parent households benefit slightly more from Roth accounts; other single and married households generally fare better with a traditional IRA. Yet, future tax changes can dramatically change these findings. A behavioral study finds that regardless of selected IRA, savings is typically suboptimal and is influenced by gender, patience, and risk aversion measures (Bohr et al., 2023).

These mixed and inconclusive findings underscore a key research problem: individuals and policymakers often lack clear, evidence-based guidance on which retirement account structure is most advantageous under varying financial conditions. This study examines three critical factors that influence long-term retirement outcomes: the type of IRA (Traditional vs. Roth), the investment strategy employed during both the accumulation and withdrawal phases, and the applicable tax rate. The objective is to determine whether specific combinations of these variables lead to systematically better outcomes, thereby helping investors make more informed decisions. In addition, the growing global prevalence of individual retirement accounts raises the question of whether findings from the U.S. context can be adapted to countries with similar tax-deferred and tax-exempt retirement savings frameworks. To explore these questions, the study uses a historical simulation based on actual market data from 1984 to 2024 and projects retirement outcomes under different conditions. The analysis aims to strike a balance between clarity and analytical rigor, offering insights that are both meaningful and accessible.

2. Methodology

A simulation was developed to compare the performance of the traditional IRA (frontend tax benefit) and Roth IRA (backend tax benefit). The simulation has two distinct parts, the working/investing (W/I) years and the retirement/withdrawal (R/W) years. A summary of the key assumptions used in the simulation is provided in Table 2.

The W/I section of the simulation is used to replicate the working years when an individual is investing for retirement. The purpose of this portion of the simulation is to determine the total investment amount at the end of the W/I years that can be drawn from during R/W years. During the W/I years it is assumed that, regardless of whether investing in the Roth or traditional IRA (or blend of both), there are only two investment choices, either an S&P 500 index fund (equities) or a cash investment earning the average one-year CD rate (which also approximates inflation). All funds are invested in either S&P index fund, the CD, or a mix of both, consisting of 50% S&P index and 50% CD. The “mix” investment portfolio is rebalanced yearly to maintain 50% S&P and 50% CD mix. The simulation uses real historical data for the S&P 500, money market rates, and inflation. The data collected and used in the simulation was the actual annual closing prices on the first business day of the new year for the S&P 500 and the current one-year CD rate, for 1984 to 2024.

During the W/I years, it is assumed that an annual investment is made. Each year, on the first working day of the year, an investment is purchased. The first

investment was made on January 2, 1984. Annual investments were then made for the first working day of the year with the last investment made on January 2, 2024. A total of 41 investments were made. The first investment amount, in January 1984, was $2,000. This was determined by calculating the present value of $7,000 in January 2024, discounted at the inflation rate over the past 40 years. This was to approximate an annual investment of $7,000 each year in today's (2024) terms, which reflects a realistic average contribution amount (Chang, 2023). Each subsequent year, after 1984, the investment amount was increased by the approximate inflation amount (estimated by the one-year CD rate). Following this pattern, the final investment, in January 2024, was $7,006 (very close to the target $7,000).

Another assumption of this simulation is that the frontend tax savings from the traditional IRA will be invested. There are two situations for which this is applicable, the 100% investment in the traditional IRA and also the blended portfolio of 50% Roth IRA and 50% traditional IRA. The total yearly investment amount for a 100% traditional IRA, including the additional amount because of the frontend tax break, is computed by taking the yearly Roth investment divided by 1 minus the tax rate during the W/I years. For example, if the tax rate (savings is 20%) and the Roth target investment amount is $2,000, then the traditional IRA investment amount is $2,500, computed as: $2,000 / (1 – 0.20). As shown by this example, a $2,500 traditional IRA investment is a net cost of $2,000, after the $500 tax savings ($2,5000 × 0.2). Similarly, with a blended IRA, 50% of the investment goes into a Roth IRA and 50% into the traditional IRA, there is a tax saving (from the traditional IRA investment). The calculation of total yearly investment for the blended IRA portfolio, including the additional amount resulting from the frontend tax break, is computed by taking the yearly Roth investment divided by 1 minus one-half the tax rate during the W/I years. For example, if the tax rate (savings is 20%) and the Roth target investment amount is $2,000, then the total blended IRA investment amount is $2,222, computed as: $2,000 / (1 – 0.1). Half of this amount, $1,111 is invested in the Roth IRA and half in the traditional IRA. As shown by this example, a $2,222 Blended IRA investment is a net cost of $2,000, after the $222 tax savings from the $1,111 invested in the traditional IRA ($1,111 × 0.2).

Granted, the assumption that the frontend tax savings from the traditional IRA being invested each year may not be the situation for all investors (Beshears et al., 2014). If the tax savings are not taken advantage of, by increasing the investment amount, this naturally will decrease the results. Although not a factor examined in this study, it would be interesting to examine the impact of the two possibilities. Either the tax savings obtained with the traditional IRA is used to increase the amount invested or it is not.

The investment on January 2, 2024 represents the final investment for the W/I years. This will have been 40 years with 41 investments, a realistic approximation of the number of years one might invest for retirement. For example, if an

individual completes university at the age of 22 and begins investing annually for retirement immediately after graduation, 41 annual investments would take the individual to 62 years of age, a good approximate age for retirement. According to a 2024 MassMutual retirement happiness study, although 63 years of age is the ideal age for retirement, the average actual retirement age is 62 (MassMutual, 2024).

Immediately after the final investment, it is assumed that the individual retires and is now in the R/W stage of the simulation. On the same day as the final investment, the first withdrawal is taken for the first year of retirement. Subsequent withdrawals are taken on the first working day of the year. Just as the annual investment amount is realistic, so is the withdrawal amount. On January 2, 2024 a withdrawal is taken from the investment that is equal to $60,000 after taxes. This is slightly higher than the average spending of a retiree of $54,975 in 2022, based on the U.S. Bureau of Labor Statistics (Farrell & Allamani, 2024). Although the annual withdrawal amount was not a factor examined in this study, it is a possible factor to examine in the future. Does a withdrawal amount higher or lower than $60,000 impact results?

For the Roth IRA, since there are no taxes because of the backend tax advantage, the first-year withdrawal amount will be equal to $60,000. However, for both the traditional IRA and the blended IRA (50% Roth and 50% traditional) the withdrawal will be greater than $60,000 because of taxes. For the 100% traditional IRA the total withdrawal amount, including the additional amount to pay for taxes, is computed by taking the yearly Roth withdrawal amount divided by 1 minus the tax rate during the R/W years. For example, if the tax rate is 20% and the Roth withdrawal amount is $60,000, then the traditional IRA withdrawal amount is $75,000 computed as: $60,000 / (1 – 0.20). A $75,000 withdrawal will result in net withdrawal of $60,000 after paying $15,000 in taxes ($75,000 × 0.20). A blended portfolio also requires a greater withdrawal amount resulting from the portion that is taken from the traditional IRA that will be taxed. Within the blended portfolio, to maintain an equal amount of money in the Roth and traditional IRA, an equal amount is taken from both IRAs each year so that after taxes are paid, the net amount remaining will equal the target withdrawal amount, in this case $60,000. The calculation of total yearly withdrawal for the blended IRA portfolio is computed by taking the yearly Roth investment divided by 1 minus one-half the tax rate during the R/W years. For example, if the tax rate (savings is 20%) and the Roth target withdrawal amount is $60,000, then the total blended IRA withdrawal amount is $66,667, computed as: $60,000 / (1 – 0.1). Half of this amount, $33,333 is withdrawn from the Roth IRA and half from the traditional IRA. This will result in a net withdrawal of $60,000 after the resulting tax of $6,667 from the traditional IRA withdrawal ($33,333 × 0.20).

Each subsequent year during the R/W years the amount withdrawn, after taxes, is increased by an estimated inflation rate of 3%. This then continues an ap-

proximate net annual withdrawal of around $60,000, each year. Additionally, each year the investment balance is increased based on how it is invested, either an S&P index fund, a CD money market, or a mix of both, consisting of 50% S&P index and 50% CD. With a "mix" investment, at the end of each year the portfolio is rebalanced to maintain 50% S&P and 50% CD mix.

Table 2. Summary of simulation assumptions and parameters used in the study

Category	Assumption
Simulation structure	Two phases: Working/Investing (W/I) years and Retirement/ Withdrawal (R/W) years.
Annual investment (W/I years)	Made on first business day of each year; 41 total investments from 1984 to 2024.
Investment type	Only traditional IRA, only Roth IRA, or 50/50 blend.
Investment options	Only S&P 500 Index Fund, 1-year CD, or 50/50 mix.
Data used (W/I years)	Historical S&P 500 closing values and 1-year CD rates from 1984 to 2024.
Investment amount	$2,000 in 1984, increasing annually by inflation (CD rate), reaching ~$7,000 in 2024.
Tax savings reinvestment	Assumes traditional IRA tax savings are reinvested (applies to traditional and blended IRAs).
Annual withdrawal (R/W years)	2024 to 2070; until money is depleted up to maximum 47 years.
Withdrawal amount	$60,000 (after-tax) withdrawn on first day of retirement; increases by 3% annually (inflation).
Tax treatment withdrawals	Grossed-up to meet $60,000 or inflation-adjusted equivalent (applies to traditional and blended IRAs).
Growth assumptions (R/W)	S&P 500 return = 7%, CD/inflation rate = 3%.
Rebalancing	50/50 mix portfolios of S&P 500 and CD are rebalanced annually to a 50/50 mix during both W/I and R/W phases.

Source: own study.

Unlike the W/I years that used actual past historical data from 1984 to 2024, there is no actual data for the R/W years. Therefore, both the S&P 500 return and the CD money market rate (or inflation rate) are estimated. During the retirement years, the S&P 500 return is estimated to be a constant 7%. This is a conservative estimate, based on the average historical return of the S&P 500 being 9.9% since its inception in 1957 to 2023 (Maverick et al., 2025). However, many analysts believe the future return on the stock market will be lower than historical returns (Erdogan & McMoore, 2025). The inflation rate and one-year CD rate are estimated to be 3%. This is slightly lower than the average inflation rate for the past 50 years, which was approximately 3.3%, and similar to recent years, which was

approximately 3.0% for the past 10 years (Srinivasan et al., 2025). Again, neither the S&P return nor the inflation rate are factors examined in this study (e.g., by varying these rates), but they might be useful to explore in future research.

Factors examined

The simulation is used to examine four factors to compare the performance of the Roth IRA (backend tax advantage) with the traditional IRA (frontend tax advantage). They are as follows:

1. IRA type (3 levels)
2. Investment choice during W/I years (3 levels)
3. Investment choice during R/W years (3 levels)
4. Tax rate during R/W years (2 levels)

The first factor examines the IRA blend used for retirement investing. The factor has three levels. There are two IRA choices, either the Roth IRA, with the backend tax advantage, or the traditional IRA, with the frontend tax advantage. The simulation looks at three possible blends. Either 100% of money is invested in the Roth IRA or 100% of money is invented in the traditional IRA, or money is split equally between both the Roth IRA and the traditional IRA. Even though this study only looks at three different blends between the Roth IRA and the traditional IRA, future research may want to look at the impact of various blend percentages. Is there one that is preferable depending on circumstances?

The second and third factors examine the investment choice within the IRA or IRAs. For each factor, there are three levels. The second research factor specifically examines the choice during the W/I years. The third research factor specifically examines the choice during the R/W years. There are two investment choices, either an S&P 500 index fund or a CD money market earning approximately the rate of inflation. The simulation looks at three possible mixes. Either 100% of the invested money is in the S&P 500 index fund or 100% of invested money is the CD or the investment money is split equally between both the S&P 500 index fund and the CD. The mix during the W/I years may be different from the mix during the R/W years.

The fourth and final factor examines the tax rate during the R/W years. This factor has two levels: either the tax rate during the R/W years is identical to the W/I years, at 20%, or it is lower during the R/W years, at 15%. One reason the tax rate may be lower in the R/W years is that earned income is typically reduced in retirement, resulting in a possibly lower marginal tax rate.

3. Results and discussion

A full factorial design was conducted to simulate all combinations. Below is the list of the four factors and the corresponding code.

1. IRA type:

- Roth IRA (R),
- Traditional IRA (T),
- Blend of 50% Roth IRA and 50% traditional IRA (B).

2. Investment choice during W/I years:

- S&P 500 Index (S),
- CD, Money Market, Inflation rate (C),
- Mix 50% S&P 500 Index and 50% CD (M).

3. Investment choice during R/W years:

- S&P 500 Index (S),
- CD, Money Market, Inflation rate (C),
- Mix 50% S&P 500 Index and 50% CD (M).

4. Tax rate during R/W years:

- 20% (H),
- 15% (L).

Based on the above, a simulation with the code TSML would represent a situation that invests entirely in a traditional IRA, has an investment mix of 100% S&P 500 index during the W/I years, a mix of both S&P 500 and CD during the R/W years, and a 15% tax rate during the R/W years. A full factorial analysis of the four factors, at various levels, was conducted, yielding 54 unique situations. Each was evaluated on three different measures, as follows:

1. Value of the IRA at the end of the W/I years that will be available during the R/W years.
2. Given similar withdrawal amounts across all simulations, the number of years until retirement savings is depleted.
3. Taxes paid in total, during both the W/I years and the R/W years.

Table 3 shows all results, sorted by investment total. Table 4 is sorted by years until depleted and Table 5 is sorted by total taxes paid.

Table 3. Results of simulation sorted by investment total

Strategy*	Investment total	Years until depleted	Total taxes paid
TSSH	$1,372,172	47	$1,505,948
TSSL	$1,372,172	47	$1,062,998
TSML	$1,372,172	24	$364,507
TSMH	$1,372,172	22	$458,052
TSCL	$1,372,172	19	$265,937
TSCH	$1,372,172	18	$351,217
BSSL	$1,219,709	31	$271,938
BSSH	$1,219,709	30	$345,860
BSML	$1,219,709	23	$186,558
BSMH	$1,219,709	22	$232,264
BSCH	$1,219,709	18	$184,779
BSCL	$1,219,709	18	$142,586
RSSH	$1,097,738	30	$51,615
RSSL	$1,097,738	30	$51,615
RSMH	$1,097,738	22	$51,615
RSML	$1,097,738	22	$51,615
RSCH	$1,097,738	18	$51,615
RSCL	$1,097,738	18	$51,615
TMSL	$865,618	16	$213,421
TMSH	$865,618	14	$256,295
TMML	$865,618	13	$165,361
TMMH	$865,618	12	$212,880
TMCL	$865,618	12	$150,262
TMCH	$865,618	11	$192,117
BMSL	$769,439	15	$119,159
BMSH	$769,439	14	$142,590
BMMH	$769,439	12	$123,293
BMML	$769,439	12	$97,719
BMCH	$769,439	11	$114,065
BMCL	$769,439	11	$90,985
RMSH	$692,495	14	$51,615
RMSL	$692,495	14	$51,615
RMMH	$692,495	12	$51,615
RMML	$692,495	12	$51,615
RMCH	$692,495	11	$51,615
RMCL	$692,495	11	$51,615
TCSH	$359,065	5	$79,637

cont. Table 3

Strategy*	Investment total	Years until depleted	Total taxes paid
TCCL	$359,065	5	$56,213
TCML	$359,065	5	$56,213
TCSL	$359,065	5	$56,213
TCCH	$359,065	4	$62,754
TCMH	$359,065	4	$62,754
BCSH	$319,168	5	$64,071
BCML	$319,168	5	$54,504
BCSL	$319,168	5	$54,504
BCCH	$319,168	4	$56,567
BCMH	$319,168	4	$56,567
BCCL	$319,168	4	$49,028
RCSH	$287,252	5	$51,615
RCSL	$287,252	5	$51,615
RCCH	$287,252	4	$51,615
RCCL	$287,252	4	$51,615
RCMH	$287,252	4	$51,615
RCML	$287,252	4	$51,615

*First letter – IRA type: R – Roth, T – Traditional, B – Blend of 50% R and 50% T.

Second letter – Investment during W/I years: S – S&P 500; C – Certificate of Deposit (CD); M – Mix of 50% S and 50% C.

Third letter – Investment during R/W years: S – S&P 500; C – Certificate of Deposit (CD); M – Mix of 50% S and 50% C.

Fourth letter – Tax rate during R/W years: H – 20%; L – 15%.

Source: own analysis.

Table 4. Results of simulation sorted by years until depleted

Strategy*	Investment total	Years until depleted	Total taxes paid
TSSH	$1,372,172	47	$1,505,948
TSSL	$1,372,172	47	$1,062,998
BSSL	$1,219,709	31	$271,938
BSSH	$1,219,709	30	$345,860
RSSH	$1,097,738	30	$51,615
RSSL	$1,097,738	30	$51,615
TSML	$1,372,172	24	$364,507
BSML	$1,219,709	23	$186,558
TSMH	$1,372,172	22	$458,052
BSMH	$1,219,709	22	$232,264
RSMH	$1,097,738	22	$51,615

cont. Table 4

Strategy*	Investment total	Years until depleted	Total taxes paid
RSML	$1,097,738	22	$51,615
TSCL	$1,372,172	19	$265,937
TSCH	$1,372,172	18	$351,217
BSCH	$1,219,709	18	$184,779
BSCL	$1,219,709	18	$142,586
RSCH	$1,097,738	18	$51,615
RSCL	$1,097,738	18	$51,615
TMSL	$865,618	16	$213,421
BMSL	$769,439	15	$119,159
TMSH	$865,618	14	$256,295
BMSH	$769,439	14	$142,590
RMSH	$692,495	14	$51,615
RMSL	$692,495	14	$51,615
TMML	$865,618	13	$165,361
TMMH	$865,618	12	$212,880
TMCL	$865,618	12	$150,262
BMMH	$769,439	12	$123,293
BMML	$769,439	12	$97,719
RMMH	$692,495	12	$51,615
RMML	$692,495	12	$51,615
TMCH	$865,618	11	$192,117
BMCH	$769,439	11	$114,065
BMCL	$769,439	11	$90,985
RMCH	$692,495	11	$51,615
RMCL	$692,495	11	$51,615
TCSH	$359,065	5	$79,637
TCCL	$359,065	5	$56,213
TCML	$359,065	5	$56,213
TCSL	$359,065	5	$56,213
BCSH	$319,168	5	$64,071
BCML	$319,168	5	$54,504
BCSL	$319,168	5	$54,504
RCSH	$287,252	5	$51,615
RCSL	$287,252	5	$51,615
TCCH	$359,065	4	$62,754
TCMH	$359,065	4	$62,754
BCCH	$319,168	4	$56,567
BCMH	$319,168	4	$56,567

cont. Table 4

Strategy*	Investment total	Years until depleted	Total taxes paid
BCCL	$319,168	4	$49,028
RCCH	$287,252	4	$51,615
RCCL	$287,252	4	$51,615
RCMH	$287,252	4	$51,615
RCML	$287,252	4	$51,615

* See Table 3.

Source: own analysis.

Table 5. Results of simulation sorted by total taxes paid

Strategy*	Investment total	Years until depleted	Total taxes paid
TSSH	$1,372,172	47	$1,505,948
TSSL	$1,372,172	47	$1,062,998
TSMH	$1,372,172	22	$458,052
TSML	$1,372,172	24	$364,507
TSCH	$1,372,172	18	$351,217
BSSH	$1,219,709	30	$345,860
BSSL	$1,219,709	31	$271,938
TSCL	$1,372,172	19	$265,937
TMSH	$865,618	14	$256,295
BSMH	$1,219,709	22	$232,264
TMSL	$865,618	16	$213,421
TMMH	$865,618	12	$212,880
TMCH	$865,618	11	$192,117
BSML	$1,219,709	23	$186,558
BSCH	$1,219,709	18	$184,779
TMML	$865,618	13	$165,361
TMCL	$865,618	12	$150,262
BMSH	$769,439	14	$142,590
BSCL	$1,219,709	18	$142,586
BMMH	$769,439	12	$123,293
BMSL	$769,439	15	$119,159
BMCH	$769,439	11	$114,065
BMML	$769,439	12	$97,719
BMCL	$769,439	11	$90,985
TCSH	$359,065	5	$79,637
BCSH	$319,168	5	$64,071

cont. Table 5

Strategy*	Investment total	Years until depleted	Total taxes paid
TCCH	$359,065	4	$62,754
TCMH	$359,065	4	$62,754
BCCH	$319,168	4	$56,567
BCMH	$319,168	4	$56,567
TCCL	$359,065	5	$56,213
TCML	$359,065	5	$56,213
TCSL	$359,065	5	$56,213
BCML	$319,168	5	$54,504
BCSL	$319,168	5	$54,504
RSSH	$1,097,738	30	$51,615
RSSL	$1,097,738	30	$51,615
RSMH	$1,097,738	22	$51,615
RSML	$1,097,738	22	$51,615
RSCH	$1,097,738	18	$51,615
RSCL	$1,097,738	18	$51,615
RMSH	$692,495	14	$51,615
RMSL	$692,495	14	$51,615
RMMH	$692,495	12	$51,615
RMML	$692,495	12	$51,615
RMCH	$692,495	11	$51,615
RMCL	$692,495	11	$51,615
RCSH	$287,252	5	$51,615
RCSL	$287,252	5	$51,615
RCCH	$287,252	4	$51,615
RCCL	$287,252	4	$51,615
RCMH	$287,252	4	$51,615
RCML	$287,252	4	$51,615
BCCL	$319,168	4	$49,028

* See Table 3.

Source: own analysis.

Table 3 highlights that the type of investment is more significant than the type of IRA. Historical data reveals that the S&P 500 Index consistently delivered the highest returns. Consequently, the top 18 portfolios with the highest ending balances were fully invested in the S&P 500 Index. The next 18 portfolios, which achieved slightly lower totals, allocated 50% to the S&P 500 Index in a mixed strategy. In contrast, the lowest 18 portfolios did not include any investments in the S&P 500 Index.

The type of IRA, however, plays a role within these tiers (100% S&P 500, mixed, and 100% CD). Among the portfolios in each tier, traditional IRAs achieved the highest ending balances, Roth IRAs the lowest, and blended IRA types fell in the middle. This performance disparity is primarily due to the traditional IRA's frontend tax advantage, which allows for additional investment in the IRA.

It is crucial to note that the superior performance of traditional IRAs hinges on reinvesting the tax savings into the account. Without this additional investment, the final balance of a traditional IRA would be lower. Unfortunately, prior research has found no evidence that total traditional IRA contributions are higher because of the frontend tax savings (Beshears et al., 2014).

Table 4 reveals that only two of the fifty-four combinations maintain a continually growing balance, as their yearly withdrawals are less than their earnings. After 47 years, the TSSH and TSSL combinations achieved balances of $6,097,239 and $7,552,470, respectively, with both continuing to grow. In contrast, all other combinations depleted their funds within 4 to 31 years.

The most effective strategy, based on the situational returns, is a traditional IRA invested in the S&P 500 during both the W/I years and the R/W years, particularly with a lower tax rate during the R/W years.

An additional insight is that the initial balance at the start of the R/W years is not the sole factor in determining how long the funds last. In some cases, a lower starting balance outperformed a higher one in terms of longevity. This outcome underscores the greater influence of both the investment type during the R/W years and the applicable tax rate during retirement on the depletion timeline.

Lastly, as observed during the W/I years, the type of investment remains critical. The six combinations that lasted the longest – 30 years or more before depletion – all invested in the S&P 500 during both the W/I and R/W years.

Table 5 highlights that paying a significant amount in taxes represents a "win-win" scenario for both the individual and the government. For the individual, maintaining a large retirement balance that is not depleted quickly leads to substantial tax payments over time – a success for the investor and a benefit for the government. This underscores the mutual interest, for both the individual and the government, in ensuring retirement investments are successful.

Notably, the five combinations with the highest total tax payments all involve a traditional IRA. The government's strategy of offering a frontend tax advantage results in larger retirement balances, ultimately leading to higher tax revenues over the long term. This approach of delayed gratification by the government – deferring tax collection until retirement – proves advantageous for the government.

Conclusions

Among the many observations in this study, three key insights emerge.

First, starting early is crucial. Regardless of the type of IRA selected, the most important step is to begin investing as soon as possible – ideally in a tax-advantaged IRA if available. Early and consistent investing allows more time for assets to grow during the working and investing (W/I) years, leading to significantly larger balances by retirement.

Second, the type of investment appears to have a greater impact on outcomes than the type of IRA. While equities carry higher risk, investing in an S&P 500 index fund during both the working and investment (W/I) years and the retirement and withdrawal (R/W) years is a primary driver of strong performance. This finding challenges the conventional guidance to reduce equity exposure with age (Jagannathan & Kocherlakota, 1996). A more aggressive, equity-heavy strategy throughout the life cycle can yield superior returns, provided it aligns with an individual's risk tolerance (Levine, 2016). This conclusion reinforces and expands upon earlier work by Cannon and Tonks (2013), who studied 16 countries using historical data from 1909 to 2000 and employed a different evaluative metric – the dividend replacement ratio (Diamond, 1977).

Third, the type of IRA – Roth versus traditional – is of secondary importance. While one may slightly outperform the other under certain conditions, the differences are typically minor. For example, the impact on how long retirement savings last often amounts to just one or two years.

Given uncertainties about future tax rates, career length, and lifespan, these findings suggest that the choice between IRA types is not a decisive factor. This conclusion should reassure investors: there is no "wrong" choice between account types. Instead, early, consistent, and growth-oriented investing is what matters most. These straightforward, actionable insights can help reduce anxiety around retirement planning. Furthermore, because the framework is intentionally general, the findings may be broadly applicable to other countries with similar retirement systems.

Nevertheless, the study has limitations. One is its reliance on historical market conditions. While actual S&P 500 returns from 1984 to 2024 (averaging 8.44% annually) were used for the W/I years, future returns may differ significantly. The same applies to the R/W years, for which estimated returns were selected to reflect plausible outcomes. Any variation in future returns could influence the conclusions. Additionally, the variety of possible defined contribution retirement scenarios is extensive, and it is not feasible to address all of them within a single study. These limitations highlight opportunities for future research.

Future research could explore a wider range of return scenarios – such as high, moderate, and low returns – as well as patterns like constant versus variable returns. While the expectation is that higher returns produce stronger outcomes, it would be valuable to test whether the study's general conclusions hold under different conditions.

Another potential extension involves dynamic portfolio rebalancing based on age. This study used three fixed investment conditions without reallocation. However, conventional wisdom suggests that asset allocation should shift from equities to bonds over time (Bali et al., 2009). Future studies could evaluate whether incorporating such age-based rebalancing affects the findings.

Lastly, further research could examine similar retirement investment strategies in other countries. While this study was designed to be broadly applicable, country-specific tax laws, retirement structures, or economic factors may influence the results. Comparative studies could test whether the insights presented here hold across different national contexts or require adaptation.

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