# The Retirement Income Challenge

## Deferred Income Annuities Before Retirement

*by Michael Finke, Ph.D., CFP® and Wade D. Pfau, Ph.D., CFA*

**Brief Biographies:**

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# EXECUTIVE SUMMARY

- Most deferred income annuities (DIAs) purchased today have a relatively short deferral period before annuity payments begin, suggesting that these short deferral DIAs are particularly appealing to clients nearing retirement who value the ability to plan on a fixed nominal income stream after retirement.

- Unlike Advanced Life Deferred Annuities (ALDAs or longevity insurance) which are meant to provide late-life income primarily to protect against longevity risk, Deferred Income Annuities (DIAs) are products offered by insurance companies that provide for steady guaranteed income payments. They can be used to pre-fund retirement spending over the entire retirement life cycle. DIAs are not market investments and as such do not fluctuate with market ups/downs. They do not have a cash value and the guarantees are backed solely by the claims-paying ability of the issuer.

- Setting assets aside before retirement to buy a DIA places a portion of the retirement portfolio into a bond-like financial vehicle and these funds should be viewed as such when evaluating the overall asset allocation from the household balance sheet perspective.

- In this paper, the cost of retirement is defined as the actual cost of paying for a given income in retirement in the face of unknown variables such as longevity and asset returns. When a retirement plan allocates a portion of its assets to a DIA, the average cost of retirement is reduced by softening the financial blow of a long lifetime or poor market returns.

- The purchase of a DIA before retirement is particularly valuable for clients who would have maintained a stock allocation lower than 70%. The tradeoff is that retirees would have been better off without a DIA in simulations where portfolio returns are very high or when retirees die early.

- Our findings suggest that short deferral DIAs can reduce the cost of funding retirement, provide longevity protection, and provide important behavioral benefits to clients concerned about near retirement market performance.

# WHITEPAPER – THE RETIREMENT INCOME CHALLENGE

Financial professionals creating a retirement income plan for their clients need to do more than manage an investment portfolio. Today's retiree will increasingly be responsible for developing a strategy that provides a satisfying lifestyle while avoiding the risk of outliving assets. This means taking enough out of retirement savings over time to cover retirement expenses, but not so much that a retiree is forced to cut back on spending later in life or rely on family to cover later-life expenses.

This balance of spending today and the risk of outliving assets presents a challenge when both longevity and asset returns are unknown. Asset returns, particularly immediately before and just after retirement, can have a big impact on the amount a retiree is able to safely spend each year. Sustaining income over a long and healthy life also puts pressure on an investment portfolio as assets are gradually spent down. Managing assets to create income becomes a significant challenge for the increasing percentage of Americans who suffer from dementia in old age. A retiree can reduce all of these risks through the purchase today of a guaranteed income stream in the future.

Deferred income annuities (DIAs) allow a client to allocate a portion of their retirement portfolio to an income annuity that begins making payments at a future date. The amount of income one can buy for each dollar placed in a DIA depends on the client's age and the number of years between purchase and when the income stream begins. The length of time between when the DIA is purchased and when the annuity payments begin is known as the deferral period. A longer deferral period will allow a client to buy a larger annuity payment.

The deferral feature of a DIA is useful for two primary purposes. A worker approaching retirement with significant financial assets may value the option to transfer some investments today into an income that will last a lifetime. Research on the sequence of returns risk highlights the importance of asset returns when the retirement nest egg is the largest. Rather than worrying about the very real risk that poor portfolio returns near retirement will decrease assets available to fund a retirement lifestyle, a client can simply take money off the table right now in order to fund an income that begins at a later date. This pre-retirement DIA strategy can provide important psychological benefits to the client, and we will illustrate later that the addition of a deferred income annuity can improve the performance characteristics of a retirement portfolio on an efficient frontier.

A DIA can also be beneficial as insurance to protect against the risk of outliving assets either due to poor investment performance or reduced cognitive ability in old age. A DIA provides a solution for a client who worries that a bear market will put them at risk of eventually running out of money. Placing a percentage of the client's assets in a product that pays a guaranteed income later in life is an efficient way to address the risk that spending will need to be reduced to preserve assets in advanced age. In addition to the risk of outliving assets, many retirees will lose their ability to independently manage an investment portfolio due to cognitive impairment. A DIA provides protection against the risk of making inappropriate investment decisions that may be associated with dementia by providing an automatic income that is easier to manage than drawing income from an investment portfolio.

### Short Deferral Income Annuities

The significant majority of deferred income annuities (DIAs) purchased today have a relatively short deferral period before annuity payments begin. This suggests that DIAs are particularly appealing to clients nearing retirement who value the ability to plan on a fixed nominal income stream after retirement. Unlike Advanced Life Deferred Annuities (ALDAs) which are meant to provide late-life income primarily to protect against

longevity risk, a shorter duration deferred income annuity is purchased to provide a steady income to fund retirement spending over the entire retirement life cycle.

A fixed short deferral DIA may more easily be viewed similar to a portfolio whose return is guaranteed for a period of time after which a single premium immediate annuity is purchased. However, unlike an investment portfolio a DIA has no cash accumulation value. The primary advantage of a short deferral DIA is the ability to establish a defined minimum level of retirement spending. Clients who have experienced significant gains in their investment portfolio may be particularly attracted to short deferral DIAs in order to reduce concern that a bear market right before retirement will reduce income security.

While the desire to lock in a secure income may be driving demand for short deferral DIAs, their impact on retirement portfolios has not been examined in the financial planning literature. Previous research including Pfau (2011) and Pfau (2014), however, suggests that portfolio returns right before retirement have an outsize influence on retirement income sustainability. Pfau (2013) finds that the purchase of a single premium immediate annuity can serve as an efficient substitute for the fixed income portion of a retirement portfolio by better protecting a spending level on the downside while also increasing the average legacy value of assets.

Setting assets aside before retirement to buy a fixed deferred income annuity places a portion of the retirement portfolio into a bond-like retirement asset. The funds used to buy a fixed deferred income annuity should be viewed as a substitute for a bond investment when evaluating a holistic retirement portfolio. In other words, if 20% of a 50/50 retirement portfolio is invested in a fixed deferred income annuity, then the equity portion of the remaining investment portfolio should be increased (in this case to 50/30 or 62.5%) to maintain the appropriate amount of investment risk.

Allocating funds to purchase a deferred income annuity allows a near retiree to obtain a bond-like retirement asset whose income generating duration matches anticipated future spending needs. Depending on the age of the investor during the deferral period and the design of the income benefit, additional mortality credits may improve the expected return on fixed income investments prior to the initiation of annuity payments.

The amount of future income one can buy for each dollar placed in a DIA depends on the client's age and the number of years between purchase and when the income stream begins. A longer deferral period will allow a client to buy a larger annuity payment since the assets purchased by the insurer to back the product have more time to grow, there will be fewer years of distribution, and more mortality credits are available.

This paper discusses the use of deferred income annuities within a retirement income plan. We assume a fundamental income strategy in which an investment portfolio is gradually decumulated over time to fund retirement living expenses. We compare building a retirement income without a deferred income annuity with the benefits and tradeoffs of incorporating a partial deferred income annuity strategy to supplement retirement income. Our findings suggest that short deferral DIAs can both reduce the cost of funding retirement and provide important behavioral benefits to clients concerned about near retirement market performance.

## An Analysis of Investment Portfolio Strategies Incorporating Deferred Income Annuities

Retirees don't know how long they will live. They also don't know what stock and bond returns will be realized in the future. One way to estimate the potential value of a DIA is to see how ownership would have impacted the cost of retirement in longer and shorter lifespans, during bull and bear stock markets, and during periods of high and low inflation. We can estimate the average cost of retirement by simulating 50,000 retirements with

random longevity and asset returns in order to better understand the impact a deferred income annuity has on a retirement income plan.

The cost of retirement, also known as the stochastic (or random) present value of retirement, is the actual cost of paying for a given income in retirement when the unknown variables of longevity and asset returns are allowed to occur by chance. The stochastic present value of retirement is the current amount of assets a couple would require today (assuming no future savings) to meet their desired retirement expenses. In other words, a retired couple who does not live very long in retirement and experiences high portfolio returns will have a very low cost of funding a desired level of spending. Couples who live a long time and experience modest portfolio returns will need to have saved more by retirement to fund their spending. Each simulation has a random age of death for the last remaining survivor in a couple, and a specific sequence of stock and bond returns over the couple's remaining lifetime. Milevsky (2006) provides a more mathematical treatment of the stochastic present value concept.

### Simulated Ages of Death

To simulate the costs for retirement, we require simulations for survival and market returns. Survival is calculated using the Society of Actuaries' RP-2014 Mortality Tables Draft for Healthy Annuitants. Mortality rates are provided for males and females, and joint survivorship is simulated assuming independence for the ages of death with each member of the couple. While in 5% of cases both spouses will be deceased by age 73, 50% of couples will have at least one member live to at least 87, and 5% of couples will have at least one member live to age 99.

### Simulated Asset Returns

We assume that financial assets are held in a portfolio of stocks and bonds with annual rebalancing to the targeted asset allocation and a 1% annual fee to cover fund management costs and advisory fees.

The data we use to guide the capital market simulations is available from Yale University professor and Nobel laureate Robert Shiller's website[1]. Our investment portfolios include large-capitalization stocks (Standard and Poor Composite Stock Price Index) and long-term U.S. government bonds. Additional information about our return simulation assumptions can be found in Appendix 1.

### Simulating the Cost of Retirement

Based on 50,000 ages of death for the second member of the couple, as well as 50,000 sequences of asset returns through each age of death, we are able to investigate the present value for the cost of retirement based on different asset allocation and product allocation strategies. The stochastic present value is the amount of assets required today to successfully finance a retirement spending objective through death based on the actual age of death and the experienced portfolio returns. It assumes no additional contributions are made in the future, and no money remains at death.

These retirement costs could only be known in hindsight, but they reflect the amount of assets a retiree requires today in order to ensure a successful retirement. A strategy which lowers the cost of retirement is desirable in the sense that it increases the probability that the retiree will have enough assets to support their retirement. A higher age of death (since this requires spending support for more years) and poor market returns will both lead to higher costs of retirement in terms of the amount of assets needed to be set aside today. There will be an

[1] http://www.econ.yale.edu/~shiller/data.htm.

entire distribution of outcomes for the costs of retirement, and we can focus on different parts of the distribution to obtain an idea about the upside potential and downside risks associated with different strategies.

For ease of analysis, we assume that retirees want $100,000 of inflation-adjusted spending for each year that at least one member of the couple remains alive in retirement.

We consider cases in which only a financial portfolio with stocks and bonds is used to support retirement, and cases in which 50% of the bond allocation in the median case (with a maximum of $500,000) is used today to purchase a deferred income annuity (DIA).

We investigate three primary scenarios:
- A 55-year old couple planning to retire at age 65 (10-year deferral period)
- A 45-year old couple planning to retire at age 65 (20-year deferral period)
- A 62-year old couple planning to retire at age 65 (3-year deferral period)

The baseline case we emphasize is the first one listed, as it reflects the most common use of DIAs purchased today (for the benefit of providing certain future income at retirement and reducing sequence of returns risk, rather than as pure longevity-only protection).

We assume at least one member of the couple survives to the retirement age, since the premium oftentimes can be refunded and the probability that both members of a couple will not live this long is negligible.

For cases with partial annuitization, we add the premium paid for the income annuity to the cost of retirement. We then subtract any income received from the income annuity from the desired spending amount for any year in retirement that the annuity provides income. The financial portfolio is used to fill in the income gap not covered by the income annuity. When partial annuitization is not employed, the financial portfolio must cover the full cost of retirement. In the rare case that the real value of income provided by the income annuity exceeds the desired spending target for any year, the excess income from the income annuity will be returned to the financial portfolio, which would further help to reduce the total cost of retirement.

### Deferred Income Annuity Quotes

Table 1 shows DIA quotes which are provided from CANNEX, an industry annuity quote service. These quotes are for nominal income starting at age 65, and there are no adjustments made for inflation.

**Table 1**

*Deferred Income Annuity Quotes from CANNEX*

| | Monthly Income | Annual Income |
|---|---|---|
| 45-year old couple planning to retire at age 65 (20-year deferral period) | $5,480.78 | $65,769.36 |
| 55-year old couple planning to retire at age 65 (10-year deferral period) | $3,578.53 | $42,942.36 |
| 62-year old couple planning to retire at age 65 (3-year deferral period) | $2,578.39 | $30,940.68 |

Assumptions include Wisconsin as the state of residence, a same-age opposite-gender married couple, joint and 100% survivor's income, a $500,000 premium from qualified funds, a 10-year certain period for income, and return of premium before the income start date in the event of early death. The annuity quotes are averages of the top-5 quotes provided on August 19, 2014.

In the event that the second member of the couple passes away after income begins but before the full 10 years of period certain payments are received, we lower the cost of their retirement by the present value of any remaining period certain payments that would be included as part of the couple's legacy.

### Baseline Results for the 55-Year Old Couple – Investment Portfolios with DIAs

The distribution of our calculations for the stochastic present value of retirement allow us to investigate the efficient frontier for retirement income with and without the use of a DIA, and to further determine whether partial annuitization is able to broaden the frontier to create more efficient retirement outcomes.

Table 2 provides the numbers, and Figure 1 provides a visual display of the numbers for a 55-year old couple planning to retire in 10 years at age 65. To obtain a sense of the potential outcomes both on the downside and upside, the table and figure show the costs for retirement at the 90th percentile of the distribution on the horizontal axis, and the median costs for retirement on the vertical axis.

The 90th percentile reflects the downside risk of a strategy. These are cases when retirement becomes more expensive due to some combination of long life and/or poor market returns. The median reflects the more typical cost: half of the time retirement would cost more and half of the time it would cost less.

**Table 2**

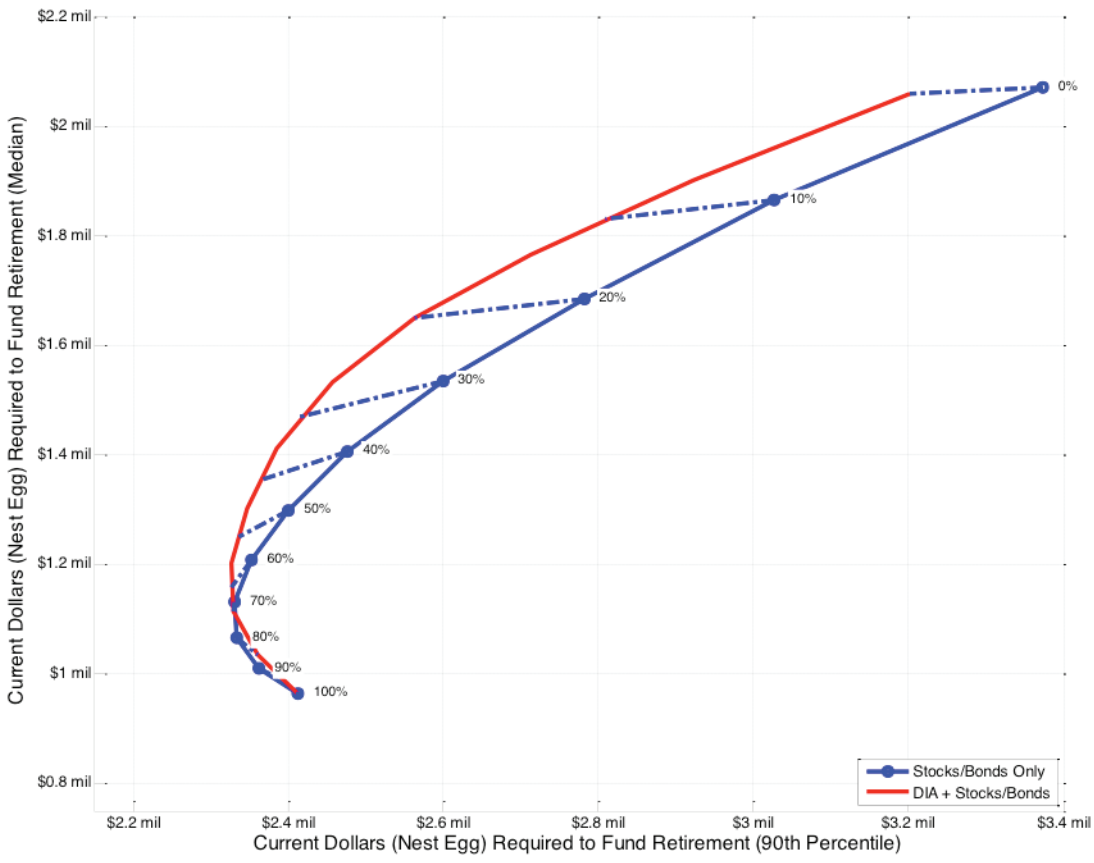
Retirement Income Frontier
Downside Retirement Cost vs. Average Retirement Cost (in thousands)
For a 55-Year Old Couple with a 10-Year Deferral Period and 10-Year Period Certainty

| Investments Only – No DIA Allocation | | | Implied Stock Holdings at Median | Outcomes with an allocation to DIA at age 55 | | | Difference in Cost Positive = DIA lowers cost Negative = DIA raises cost | |
|---|---|---|---|---|---|---|---|---|
| Stock Allocation | Retirement Cost (Median) | Retirement Cost (90th %tile) | | Stock Allocation for Remaining Financial Assets | Retirement Cost (Median) | Retirement Cost (90th %tile) | Retirement Cost (Median) | Retirement Cost (90th %tile) |
| 0% | $2,070 | $3,374 | $0 | 0% | $2,060 | $3,202 | $10 | $172 |
| 10% | $1,865 | $3,027 | $186 | 15% | $1,830 | $2,809 | $34 | $218 |
| 20% | $1,685 | $2,781 | $337 | 30% | $1,651 | $2,562 | $35 | $219 |
| 30% | $1,535 | $2,599 | $460 | 45% | $1,470 | $2,415 | $65 | $184 |
| 40% | $1,407 | $2,476 | $563 | 55% | $1,355 | $2,364 | $52 | $112 |
| 50% | $1,297 | $2,400 | $649 | 65% | $1,251 | $2,336 | $47 | $64 |
| 60% | $1,208 | $2,352 | $725 | 75% | $1,157 | $2,326 | $50 | $27 |
| 70% | $1,130 | $2,330 | $791 | 80% | $1,114 | $2,329 | $16 | $1 |
| 80% | $1,066 | $2,333 | $852 | 90% | $1,035 | $2,360 | $31 | -$27 |
| 90% | $1,010 | $2,361 | $909 | 95% | $999 | $2,378 | $11 | -$17 |
| 100% | $965 | $2,412 | $965 | 100% | $965 | $2,412 | $0 | $0 |

Note: Retirement goal is to spend an inflation-adjusted $100,000 per year from age 65 through the death of the second spouse. All retirement costs are expressed in thousands of dollars. The amount allocated to the DIA is half of the fixed income allocation assuming the investor has saved their median cost of retirement for that allocation, with a maximum DIA allocation of $500,000.

These costs reflect the amount of assets which would be required today (at age 55) to fund the desired retirement starting at age 65, assuming the couple does not make any additional contributions to their savings in the future. Naturally, future savings would reduce the assets required at present, but future savings would not change the relative positions of the efficient frontiers in terms of understanding the role of partial annuitization. Non-annuitized assets held today will have 10 years to grow (or shrink, depending on realized market returns) as a lump-sum investment before withdrawals begin at 65.

**Figure 1**
Retirement Income Frontier
Downside Retirement Cost vs. Average Retirement Cost
For a 55-Year Old Couple with a 10-Year Deferral Period and 10-Year Period Certain




Note: Percentages in chart represent stock allocation for "Stocks/Bonds Only" asset allocations.

Table 2 and Figure 1 show frontiers for clients based on the different possible allocations between stocks and bonds, with and without the use of a DIA. The blue frontier shows stock/bond combinations without a DIA. The percentages identified in the figure are the stock allocations. They range from 0% stocks in the upper-right part of the figure to 100% stocks at the lowest part of the figure. These numbers are also listed in the first columns of Table 2. The client's objective is to minimize retirement costs, and this means that more efficient strategies would move us toward the lower-left hand part of the figure. Downward and leftward movement reduces both median retirement costs as well as worst-case retirement costs.

The 0% stock allocation, for instance, leads to a median retirement cost (the cost of funding a real $100,000 per year in today's dollars starting at age 65) of just over $2 million, and retirement would cost $3.38 million in the unlucky 90th percentile. On the downside, the 90th percentile retirement cost with an investment-only approach would be minimized at 70% stocks, with a retirement cost of $2.3 million. With this allocation, the median retirement cost (the amount needed today) is $1.1 million. Meanwhile, 100% stocks will minimize the median retirement cost (as the equity risk premium can be adequately relied upon at the median) at $965k, but it does create greater downside risks with a 90th percentile retirement cost of $2.4 million.

The table and figure also show outcomes with partial annuitization, which is shown as the red frontier. Partial annuitization consists of different asset allocation combinations along with an immediate purchase of a DIA which begins income at age 65. This purchase represents a dollar amount equal to half of the fixed income allocation, up to $500k, assuming the individual has accumulated the median amount necessary by age 55 to fund their retirement goal. Dashed lines between the blue frontier and the red frontier also indicate points with the same overall initial allocation to stocks from a total wealth perspective in the median case after part of the financial portfolio is used to purchase the DIA. These allocations are also provided in Table 2 and require some explanation.

For this analysis, we assume that someone who purchases a DIA considers their premium as part of their fixed income allocation, so that their remaining financial portfolio will have a more aggressive stock allocation. For instance, someone with a 30/70 allocation to stocks and bonds without partial annuitization *cannot* properly be compared to someone who places a large sum into a DIA contract *and* subsequently maintains a 30/70 allocation with their remaining financial assets. From a household balance sheet perspective, this individual would have a much higher total allocation to fixed income because the DIA can be viewed similar to a bond portfolio held within an annuity wrapper. Alternatively, we could consider that the dollar amount they have invested in stocks will fall dramatically if they maintain the same stock allocation after partial annuitization. A proper comparison of portfolios requires that the couple have the same dollar amount in stocks regardless of their decision about partial annuitization.

To create a better comparison, we assume that for each stock/bond allocation for the no-annuity case, the couple currently holds the median amount of wealth required for a successful retirement. We adjust the stock allocation so the dollar amount held in stocks stays the same after purchasing a DIA.

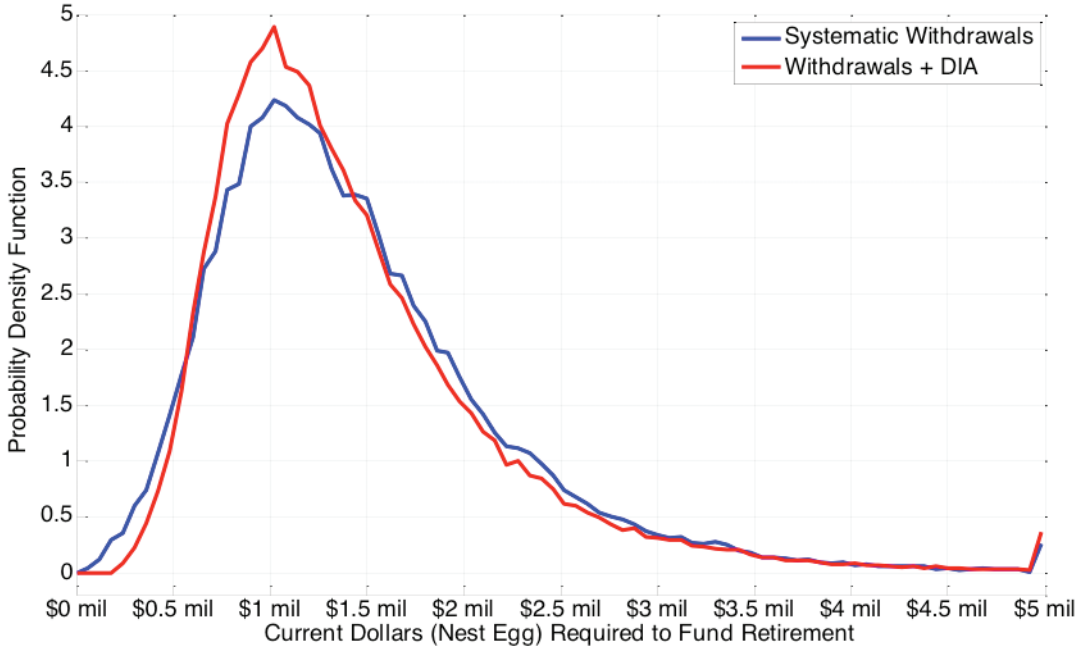
In Table 2 and Figure 1, partial annuitization improves outcomes when the dashed red line moves from the blue curve to the red curve in a direction toward the bottom left-hand corner of the chart. This implies lower average and downside costs for retirement with partial annuitization. A couple willing to hold up to 70% stocks will clearly benefit from partial annuitization as costs are lowered both at the median and at the extreme. Couples willing to hold more than 70% stocks will still reduce median costs with partial annuitization, though downside costs rise. However, the increase in downside costs is not a result of the DIA, but rather because in these scenarios not enough was shifted to the DIA and the overall stock holdings have increased with the higher stock allocation. This is a side effect of planning the DIA purchase based on median wealth requirements.

While Figure 1 created an efficient frontier using two points from the distribution of outcomes (the median and 90th percentiles of retirement costs), it is worthwhile to also consider the entire distribution of retirement costs. Because these distributions provide more detailed information, it is important to show them for a specific asset allocation in order to avoid overloading the figures. The distributions are illustrated for the case of holding a 50% stock allocation without the use of a DIA, and for the case of maintaining a 65% stock allocation with remaining financial assets after devoting $324k (half of the median allocation to fixed income) to the DIA.

These distributions are illustrated in Figures 2 and 3. Figure 2 provides the probability density function which shows the distribution of possible retirement costs. We can observe that the DIA helps to narrow the distribution of outcomes with fewer very low cost retirements, but also fewer high cost retirements.

**Figure 2**

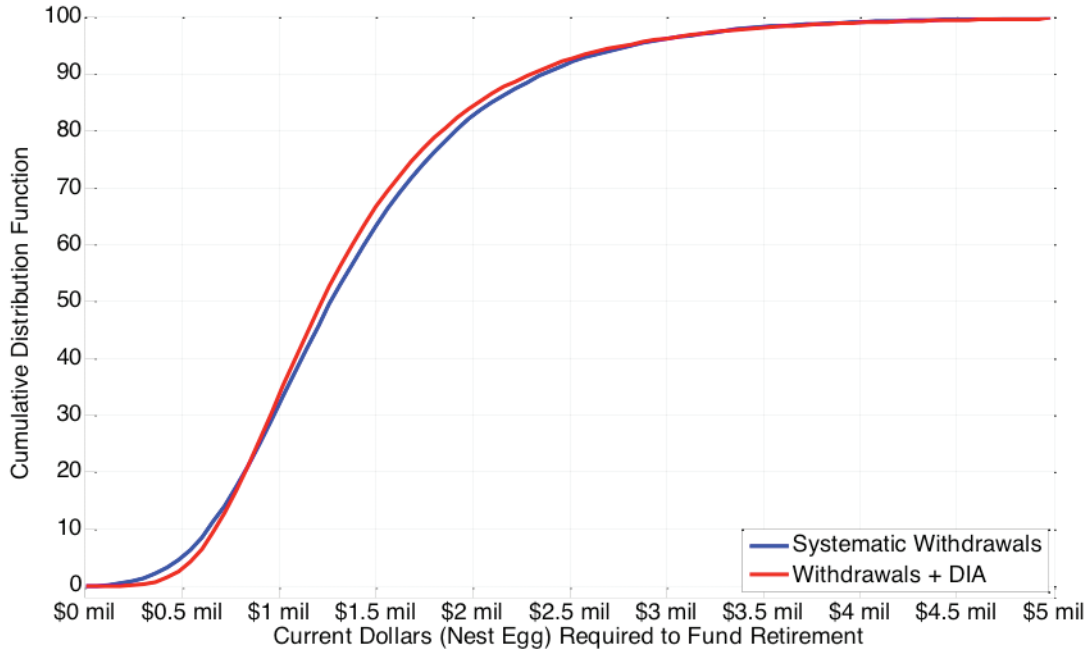
Stochastic Present Value (SPV) of Retirement Costs
For Fixed 50% Stock Allocation without Annuity, 65% Stock Allocation with Annuity
For a 55-Year Old Couple with a 10-Year Deferral Period and 10-Year Period Certain




While Figure 2 is helpful to see the full range, it is easier to provide further analysis with the cumulative distribution function shown in Figure 3. This figure shows the probability that retirement will cost less than the numbers shown on the horizontal axis. For instance, with the investment-only strategy, there is a 29.8 % chance that retirement will cost less than $1 million, and there is a 31.1% chance that retirement is less than $1 million when partially annuitizing.

Although non-annuitization provides a better chance for success at very low wealth levels (less than about $800k), the probability of success is so low in such cases that most clients working with financial professionals would be unsatisfied and would seek to improve the performance of their plan by working longer, saving more, or planning to spend less in retirement. For wealth levels with any reasonable chance for success, the partial annuitization improves odds for the couple relative to an investment-only strategy. This is the overwhelming theme of the figure: for individuals who have been saving sufficiently for their retirement, partial annuitization using DIAs helps to improve outcomes. It is a risk management strategy.

**Figure 3**
Stochastic Present Value (SPV) of Retirement Costs
For Fixed 50% Stock Allocation without Annuity, 65% Stock Allocation with Annuity
For a 55-Year Old Couple with a 10-Year Deferral Period and 10-Year Period Certain




## Results for the Other Scenarios

While the basic story remains the same for 45-year old and 62-year old couples, it is worthwhile to also consider the results for these cases to highlight some of the age-related trends for retirement costs and partial annuitization. Detailed numbers for the efficient frontiers are shown in Appendix 2. Generally, being younger will allow more time for assets to grow before withdrawals begin. This explains why older couples require more assets at the present in order to fund their retirement spending goals. Nonetheless, the general conclusions found with the 55-year old case, that the use of DIAs as a fixed income substitute reduce the median cost and risk of a retirement portfolio up to about a 70% equity allocation, are also seen with the other cases as well. Benefits are most clear for the age 45 scenario.

## Expanding the Analysis to Include Northwestern Mutual's Portfolio Deferred Income Annuity

One potential criticism of deferred income annuities is that the future annuity payment may be subject to purchasing power risk if inflation outstrips the return on premium. When a fixed deferred income annuity is purchased, the future annuity payment is determined by current rates of return on safe assets purchased by the insurer. If rates of inflation rise in the future, annuity payments may not provide the level of lifestyle anticipated by a retiree. This risk may be particularly worrying if long-term interest rates are low relative to the historical average at the time of annuity purchase.

Ideally, the amount placed in the deferred income annuity would be used to purchase an income stream that rises in after-inflation value during the deferral period. A retiree who wishes to protect against inflation risk before annuitizing has two options. The first is to simply defer the purchase of an immediate annuity by setting

aside a portion of their investment portfolio with the intention of using these assets to buy an annuity at a later date. The second is to select a deferred income annuity product that is backed by a portfolio of investment assets that are less subject to inflation risk than the investments backing traditional deferred income annuities.

A Portfolio Deferred Income Annuity (PDIA) is similar to a traditional DIA, but allows a consumer to purchase an annuity backed by a portfolio of assets that are more likely to keep pace with inflation. PDIA purchasers can choose to use non-guaranteed dividends paid on the PDIA to purchase additional income or to keep the dividends for short-run income.

### PDIA Quotes

A Portfolio Deferred Income Annuity (PDIA) quote was prepared for the age 55 couple used in the DIA analysis, with the policy illustrations provided by Northwestern Mutual created on August 15, 2014. Guaranteed monthly income is $1,974.44.

### PDIA Dividends

The PDIA also provides a mechanism for dividend payments, and as long as dividends are used to purchase additional income and grow at rates higher than the guaranteed minimums of 2% through age 75 or for 20 years (whichever is sooner) and 1% thereafter, the total income provided by the PDIA can grow. Dividends could be simulated through Monte Carlo analysis, though such an effort has not been attempted at this stage due to the difficulties of simulating the many different components which work together to determine the overall dividend rates. Rather, the stochastic present value can be calculated when using a PDIA by considering the simulated age of death and market returns for the investment portfolio, combined with static illustrations for the PDIA.

Two dividend scenarios were considered, one reflecting the current dividend scale in which PDIA cash income was based on a constant 5.5% dividend scale interest rate, and a second more conservative scenario in which the PDIA cash income was based on a constant 4.5% dividend scale interest rate. For the first 10 years of the contract, dividend interest rates are subject to a dilution adjustment that grades to zero. We assume that all dividends are reinvested to provide future income until the date that income begins, and then 25% of dividends are reinvested while 75% of dividends are taken as cash. Neither the existence nor the amount of a dividend is guaranteed on any policy in any given policy year.

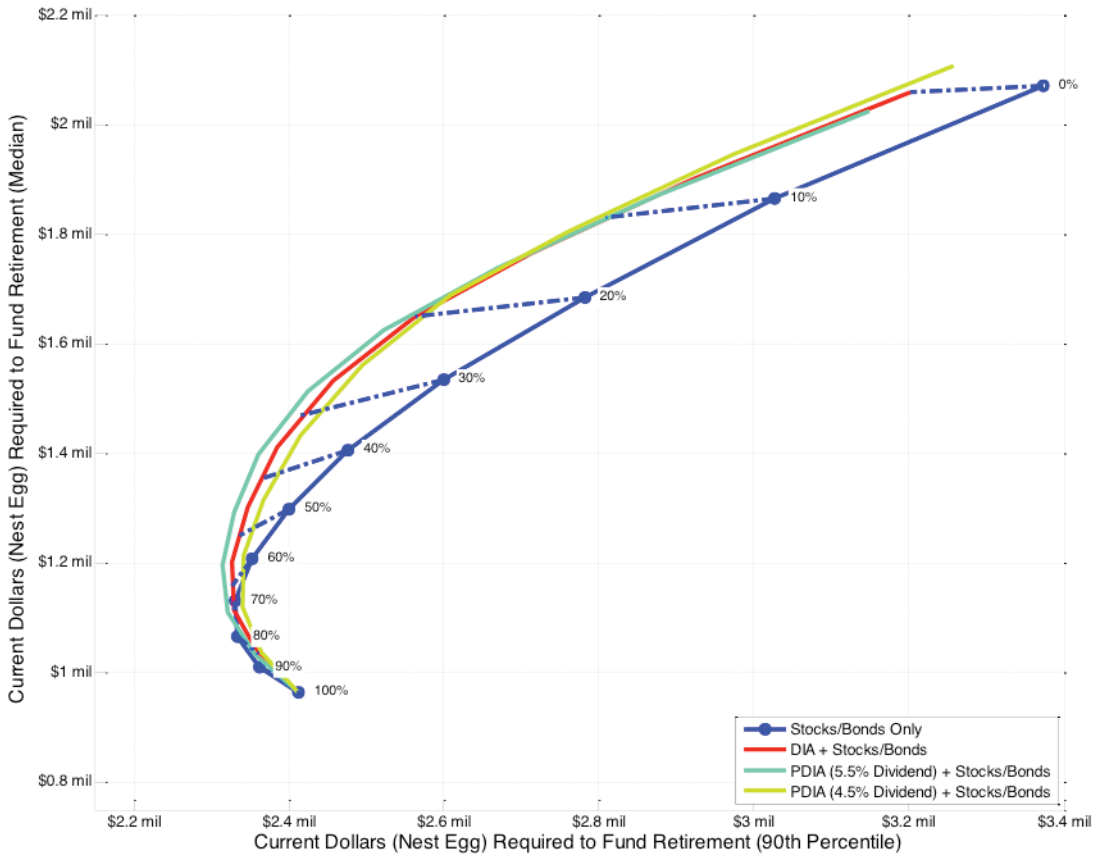
### Results for the 55-Year Old Couple – Investment Portfolios with PDIAs

In Figure 4, we re-create Figure 1 by also including the efficient frontier for the PDIA illustrations with a 5.5% and a 4.5% dividend interest rate. We can observe that the DIA curve generally falls between the PDIA with 5.5% interest curve and the PDIA with 4.5% interest curve. With the higher dividend rate, the PDIA provides more efficient outcomes for retirees with an overall reduction of retirement costs across the distribution of outcomes.

For the 55 year old couple with a 10-year deferral, the 5.5% dividend rate will support a higher level of income already by age 65 with the PDIA. The DIA provides a constant $42,942 for each year of life starting at 65. By 65, the PDIA with 5.5% interest provides a cash income of $43,811. It continues to grow, reaching $49,509 by 75 and $47,902 by 85.

With the 4.5% dividend rate, it does take longer for the PDIA to catch up to the DIA. At 65, the PDIA provides $37,054. It will actually not be until age 106 that the PDIA can catch up to provide the same income as the DIA.

**Figure 7**
Retirement Income Frontier
Downside Retirement Cost vs. Average Retirement Cost
For a 55-Year Old Couple with a 10-Year Deferral Period and 10-Year Period Certain




Note: Percentages in chart represent stock allocation for "Stocks/Bonds Only" asset allocations.

## Advantages of Automatic, Guaranteed Income in Old Age

According to a recent academic analysis of retiree satisfaction by University of Wisconsin researcher Keith Bender (2012), older households who receive a higher guaranteed regular income from sources such as a pension or annuities are happier than retirees who create income from pulling money out of an investment account. Why does annuitization make retirees more satisfied?

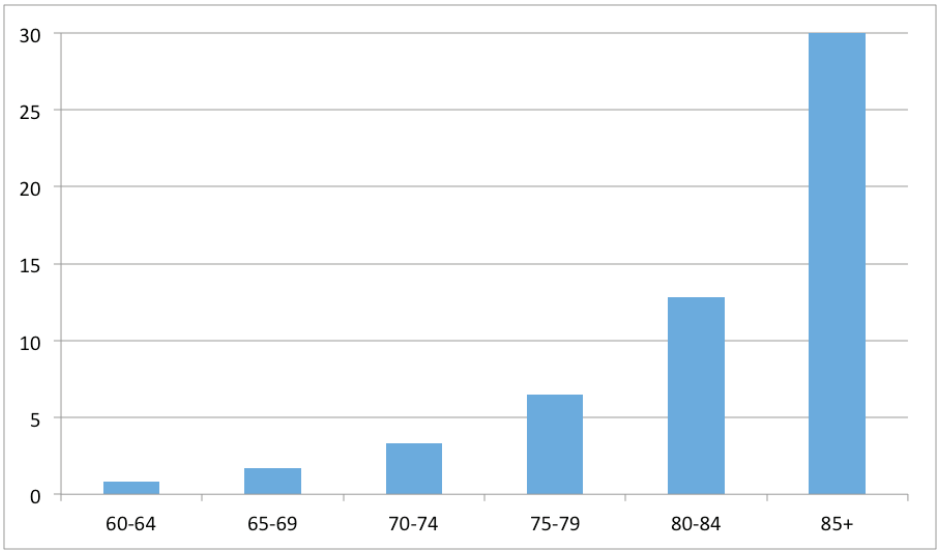
The previous examples assume that retirees are able to manage their retirement portfolio effectively no matter how long they live. Many retirees experience cognitive decline in old age either as a result of natural aging or because of a disease like Alzheimer's (Figure 12). Using established tests of cognition, Hsu and Willis (2013) show that retirees who suffer from dementia are far more likely to have a sudden drop in wealth in old age. And many retirees who are experiencing dementia are unaware of their vulnerability and continue to manage their assets without the help of a financial professional or family member.

As significant as the sudden onset of cognitive impairment, is the gradual decline in fluid intelligence (ability to quickly and efficiently process new information) and crystallized intelligence (ability to solve problems). In a study of over 4,000 respondents over age 60, Finke, Howe and Huston (2014) find that the ability to correctly answer basic financial questions declined by about 2 percent per year in retirement. Since financial decision making peaks in late middle age, this decline does not appear to impair judgment until later in retirement. The study finds that most who live to advanced age do experience a significant decline in financial decision making ability in old age. Perhaps most importantly, confidence in one's ability to make financial decisions actually appears to increase in old age. This leaves many seniors who must manage their investment portfolio at the right tail of the longevity distribution particularly vulnerable to making financial mistakes that may compromise their ability to avoid running out of assets.

At later ages, the risk of cognitive decline may be an even more important predictor of retirement income shortfall than a few years of negative stock returns. Our previous simulations show how an income base created by a DIA improves spending outcomes later in life. Another important benefit of a DIA is that it can reduce the burden of managing an investment portfolio.

**Figure 12**

Rates of Dementia (%) by Age Category




Source: Ferri et al., 2006

# CONCLUSIONS

A short deferral DIA provides a future guaranteed retirement income stream. As a conventional DIA, it will pay a specified amount in the future, which is a function of today's bond returns and expected mortality rates when the DIA payment begins.

The short deferral DIA can be a valuable complement to a conventional portfolio withdrawal strategy. We show that a product which provides lifetime income can lower the cost of funding retirement by softening the financial blow of a long lifetime or poor market returns. Simulations in which we vary asset returns and length of life in retirement provide evidence that partial annuitization can reduce costs in the worst-case retirements and in average retirements. Financial professionals creating a retirement income strategy can reduce the expected costs of funding a retirement income by allocating a portion of their client's investments to a DIA, particularly if the retiree is worried about investment risk in the near term or running out of money later in life.

There are two primary reasons to purchase a DIA. The first is to lock in retirement income prior to retirement in order to avoid the possibility that a poor sequence of asset returns will jeopardize retirement income sustainability. A pre-retirement DIA purchase can also provide a psychological benefit to a client who is able to take current gains off the table and buy an income that will last a lifetime. Our simulations show that the pre-retirement purchase of a DIA can significantly reduce the likelihood of negative outcomes that can endanger a client's ability to maintain a desired spending goal.

The second reason to purchase a DIA is to protect against the risk of running out of money in old age. While not considered in detail in this paper, a DIA with a longer post-retirement deferral period can be seen as an insurance product that pays out a significant income per dollar of premium later in retirement when a client is most at risk of outliving assets. The use of a DIA for longevity protection may also be an important psychological tool that reduces the anxiety of short-run portfolio volatility by ensuring that the client will never bear substantial lifestyle risk later in life.

DIAs are more attractive when clients are risk averse and would otherwise prefer a portfolio with a lower stock allocation. Shifting assets from a low-risk portfolio to a DIA involves fewer tradeoffs when the client would have otherwise invested in similar safe assets. Shifting bonds into a DIA will always provide a bonus because the client receives a bond-like return with the added longevity protection of annuity. In addition, in the current low interest rate environment, the client avoids the market risk associated with rising interest rates.

Because a partial annuitization DIA strategy shifts a percentage of the portfolio into a bond-like financial vehicle, the percentage stock allocation in the rest of the portfolio will need to be increased to match the level of portfolio risk that would exist in a non-annuitized portfolio. For clients who may be unwilling to accept an increase in stock holdings within an investment portfolio, a smaller DIA purchase with a longer deferral period may be a more appropriate way to buy long-life income protection.

An innovative variation on the DIA is the portfolio deferred income annuity (PDIA), which is backed by the Northwestern Mutual general account portfolio. The portfolio design is intended to provide returns responsive to inflation and rising interest rates, while the DIA has no inflation protection and is dependent on interest rates in effect when it is purchased. A PDIA will generally provide superior income as compared to a conventional DIA when dividend interest rates are higher than the interest rates used to construct a DIA.

The PDIA's dividend mechanism, which is based in part on the earnings of a diversified, long term investment portfolio, allows the product to provide more protection against the risk of inflation than a conventional DIA. The portfolio design is a particularly important consideration if the client selects a longer deferral period and is willing to accept some variation in future annuity payments. A PDIA also provides income flexibility through the use of the dividend which helps mitigate spending and sequence risk. A client can take more of the dividend as cash to spend when markets are down, and use more of the dividend to purchase additional income when markets are up.

By providing a guaranteed income for life, DIAs may also serve as insurance against the risk of poor financial decisions due to cognitive decline later in life. Many retirees will lose their ability to manage an investment portfolio later in life either gradually from natural cognitive aging, or suddenly from a disease such as Alzheimer's. Research shows that dementia is an important source of risk that can affect the likelihood of depleting portfolio assets later in life. A DIA hedges against this risk, especially if the DIA has a longer deferral period that begins making annuity payments when rates of dementia begin to climb after age 80.

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# APPENDIX 1

## Market Return Simulations

Our simulations for bond returns are based on data from Robert Shiller's website, using data for each January between 1871 and 2014. For bonds, Shiller collected yields on 10-year Treasuries in years since 1953, and Shiller used the government bond yields provided in Sidney Homer's *A History of Interest Rates* for the period prior to that. For bond returns, we use the following formula to approximate the return for year t using the yields (r) for year t and t+1:

$$return_t = 100\left(\frac{r_t}{r_{t+1}} + \frac{\left(1-\frac{r_t}{r_{t+1}}\right)}{\left(1+\frac{r_{t+1}}{100}\right)^{10}} - 1 + \frac{r_t}{100}\right)$$

With this historical data, bond yields averaged 4.6% with a standard deviation of 2.25%. With the decline in interest rates over the period, bond returns averaged 4.9% with volatility of 6.2%. The compounded return on bonds was 4.7%.

Bond yields are simulated from an initial value of 2.86%, which was the 10-year Treasury yield in January 2014. The simulations follow an autoregressive AR(1) process based on the historical data, with simulated yields representing the bond yield in January of each year. The formula to simulate yields is:

$$yield_t = 0.2674 + .9430 * yield_{t-1} + \varepsilon_t$$

In which $\varepsilon_t$ is normally distributed with a mean of zero and a standard deviation of 0.8. This random error allows for the simulated yields to experience the same standard deviation as in the historical data. We add an additional constraint to bond yields between 0% and 20%. Though bond yields are low at the present, this autoregressive process allows bond yields to gradually move toward their historical average levels. Total bond returns are calculated from these yields using the formula above.

For stocks, we add a risk premium to the simulated bond yields to calculate a total stock return. We use Morningstar data for the historical equity premium since 1900 for a GDP-weighted portfolio of 20 developed market countries. The arithmetic mean historical equity premium is 4.6% with a volatility of 15.6%. For inflation, we assume average inflation of 3.1% with a standard deviation of 4.2%, based on data since 1926 from Robert Shiller.

Inflation and the stock risk premium are both simulated as independent and identically distributed normal distribution processes. This approach preserves the historical stock risk premium. To calculate stock returns, these simulated risk premia are added to simulated bond yields. This ensures that stock returns are centered around a lower average at times when bond yields are also low, so as not to create an outsized risk premium in today's low interest rate environment. For any analysis which will use current product pricing on income annuities, it is important to also have stock and bond returns reflect the same low interest rate environment which also reduces the available payout rates for income annuities.

# APPENDIX 2

## Results for Other Cases

### Table 3

Retirement Income Frontier
Downside Retirement Cost vs. Average Retirement Cost (in thousands)
For a 45-Year Old Couple with a 20-Year Deferral Period and 10-Year Period Certainty

| Investments Only – No DIA Allocation | | | Implied Stock Holdings at Median | Outcomes with an allocation to DIA at age 45 | | | Difference in Cost Positive = DIA lowers cost Negative = DIA raises cost | |
|---|---|---|---|---|---|---|---|---|
| Stock Allocation | Retirement Cost (Median) | Retirement Cost (90th %tile) | | Stock Allocation for Remaining Financial Assets | Retirement Cost (Median) | Retirement Cost (90th %tile) | Retirement Cost (Median) | Retirement Cost (90th %tile) |
| 0% | $1,849 | $3,481 | $0 | 0% | $1,824 | $3,189 | $25 | $292 |
| 10% | $1,591 | $2,981 | $159 | 15% | $1,557 | $2,644 | $34 | $337 |
| 20% | $1,380 | $2,628 | $276 | 30% | $1,335 | $2,329 | $45 | $299 |
| 30% | $1,208 | $2,381 | $362 | 45% | $1,120 | $2,128 | $88 | $253 |
| 40% | $1,066 | $2,206 | $426 | 55% | $997 | $2,037 | $68 | $169 |
| 50% | $951 | $2,086 | $475 | 65% | $887 | $1,982 | $64 | $104 |
| 60% | $854 | $2,007 | $512 | 75% | $794 | $1,952 | $61 | $54 |
| 70% | $776 | $1,963 | $543 | 80% | $750 | $1,944 | $26 | $19 |
| 80% | $708 | $1,943 | $566 | 90% | $673 | $1,949 | $35 | -$6 |
| 90% | $652 | $1,949 | $587 | 95% | $639 | $1,963 | $13 | -$14 |
| 100% | $608 | $1,977 | $608 | 100% | $608 | $1,977 | $0 | $0 |

Note: Retirement goal is to spend an inflation-adjusted $100,000 per year from age 65 through the death of the second spouse. All retirement costs are expressed in thousands of dollars. The amount allocated to the DIA is half of the fixed income allocation assuming the investor has saved their median cost of retirement for that allocation, with a maximum DIA allocation of $500,000.

## *Appendix 2 continued*

### Table 4

Retirement Income Frontier
Downside Retirement Cost vs. Average Retirement Cost (in thousands)
For a 62-Year Old Couple with a 3-Year Deferral Period and 10-Year Period Certainty

| Investments Only – No DIA Allocation | | | Implied Stock Holdings at Median | Outcomes with an allocation to DIA at age 62 | | | Difference in Cost Positive = DIA lowers cost Negative = DIA raises cost | |
|---|---|---|---|---|---|---|---|---|
| Stock Allocation | Retirement Cost (Median) | Retirement Cost (90th %tile) | | Stock Allocation for Remaining Financial Assets | Retirement Cost (Median) | Retirement Cost (90th %tile) | Retirement Cost (Median) | Retirement Cost (90th %tile) |
| 0% | $2,178 | $3,320 | $0 | 0% | $2,202 | $3,229 | -$24 | $91 |
| 10% | $2,028 | $3,056 | $203 | 15% | $2,028 | $2,918 | $0 | $138 |
| 20% | $1,892 | $2,865 | $378 | 25% | $1,927 | $2,784 | -$36 | $82 |
| 30% | $1,771 | $2,735 | $531 | 40% | $1,799 | $2,647 | -$28 | $88 |
| 40% | $1,668 | $2,644 | $667 | 55% | $1,647 | $2,576 | $21 | $69 |
| 50% | $1,578 | $2,588 | $789 | 65% | $1,554 | $2,561 | $25 | $27 |
| 60% | $1,499 | $2,564 | $899 | 75% | $1,467 | $2,562 | $32 | $1 |
| 70% | $1,432 | $2,558 | $1,002 | 80% | $1,427 | $2,572 | $5 | -$14 |
| 80% | $1,375 | $2,575 | $1,100 | 90% | $1,353 | $2,601 | $21 | -$27 |
| 90% | $1,326 | $2,606 | $1,193 | 95% | $1,318 | $2,631 | $8 | -$25 |
| 100% | $1,284 | $2,665 | $1,284 | 100% | $1,284 | $2,665 | $0 | $0 |

Note: Retirement goal is to spend an inflation-adjusted $100,000 per year from age 65 through the death of the second spouse. All retirement costs are expressed in thousands of dollars. The amount allocated to the DIA is half of the fixed income allocation assuming the investor has saved their median cost of retirement for that allocation, with a maximum DIA allocation of $500,000.