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Choosing the Right Asset Mix:

Guidance for Individuals with
New Wealth Who Have Access
to Private Illiquid Investments

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Executive Summary

When individuals or families come into significant new wealth, they often have questions about how to invest what they have received. This is especially so in circumstances where they have not previously had substantial financial assets to manage. If the new wealth results from entrepreneurial activity (e.g., a liquidity event for a company nurtured over a period of years), the recipient may be inclined to commit some of the funds to investments in other promising private companies. At a certain level, such investments can present liquidity challenges.

To provide guidance to individuals in these circumstances, we constructed a model that enables comparisons of different investment strategies. We use the example of a husband-and-wife couple who gain new wealth of \$100 million and assume that they have two primary objectives: (1) maintain assets sufficient to support the life they desire for their remaining years; and (2) at death, maximize the amount transferred to heirs and other beneficiaries. We simulate different asset mixes, including allocations to private investments, and evaluate the results relative to the couple's goals. Finally, we examine the role that life insurance can play to help manage the illiquidity associated with a meaningful commitment to private investments.

Not surprisingly, financial outcomes for the couple's heirs vary widely depending on the choice of investment strategy. In the scenarios we present, a safe all-cash strategy leaves heirs only \$16 million after a period of 40 years. A 60/40 portfolio of publicly traded stocks and bonds increases that amount to \$134 million for the same period, and a somewhat unrealistic portfolio of 100% private investments grows the initial \$100 million to \$965 million. We assume the couple pairs their preference for private investments with an allocation to the 60/40 portfolio. A 30/70 combination of the two leaves \$521 million to the couple's heirs, an amount which could increase to \$532 million or more when life insurance is incorporated into the financial plan. Given the allocation to private investments, adding life insurance also significantly reduces the likelihood of a liquidity squeeze when estate taxes are due.

Introduction

In the dynamic centers of entrepreneurial business activity across the U.S., individuals or families can experience events that leave them with significant new wealth. It might be the sale of a privately-owned company nurtured over a period of several years. In many such situations, the recipient has not previously had meaningful financial assets to oversee and invest. A divorce or inheritance could produce a similar result where there is newfound wealth to manage. This paper aims to provide guidance to individuals in such circumstances, particularly if they have access to and want to include illiquid private investments in an investment strategy that achieves long-term financial goals.

We assume that the individual or couple has two primary objectives: (1) maintain assets sufficient to support the life they desire for their remaining years; and (2) at death, maximize the amount transferred to heirs and other beneficiaries. Given this, what are the different investment strategies that the couple might consider? What are the benefits and shortcomings of each? What is an appropriate mix of cash, other liquid assets, and private investments? Should a financial advisor be hired? What role might life insurance play in the financial plan?

Given the uniqueness of individual circumstances, there are no universal answers to such questions. It is possible, though, to construct a framework to evaluate different options. We consider the specific situation of a husband-and-wife couple who have recently gained new wealth of \$100 million. They are deciding how best to invest these funds for themselves and their heirs. We use a fairly simple model to examine different choices and assess the results relative to the couple's two primary objectives.

Assumptions and Methodology

The model makes several core assumptions, any one of which can be modified to fit the circumstances of a particular client.

| | |
|-----------------------------------|---|
| Husband | age 54 |
| Wife | age 50 |
| Initial investable assets | \$100 million |
| Inflation | 2% per year |
| Annual spending (excluding taxes) | \$2 million initially, increasing with inflation |
| Income taxes | 35% on income and capital gain based on mark-to-market asset values |
| Estate tax exemption | \$11.4 million initially, indexed to inflation |
| Estate tax taxable amount | private investments marked down 15% due to illiquidity |
| Estate taxes | 40% |

Through the multi-decade periods we consider, income and estate tax rates and exemptions will undoubtedly change, as will the amount of the couple's annual spending. We keep them constant to simplify the modeling.

In order to determine what will ultimately be available to the couple's heirs and other beneficiaries, we focus on the year of second death. That is, the year in which the surviving member of the couple passes away. For each of those years—represented by points along the x-axis in the graphs below—we ran 20,000 trials using Monte Carlo simulations. The trials reveal the range of outcomes that could result from different investment strategies chosen by the couple.¹ Please see the Appendix for a discussion of how we determined the probabilities of death in any given year for the husband and wife.

What follows is an examination of seven different approaches that the couple might consider. Each is assessed against the objectives expressed above. A summary table of results appears in the concluding section along with a series of observations that emerge from the analysis.

¹For the simulations, we assume that annual returns are serially uncorrelated. We further assume that portfolio returns have a lognormal distribution, though it would be easy, in the alternative, to model log returns as having skew or excess kurtosis.

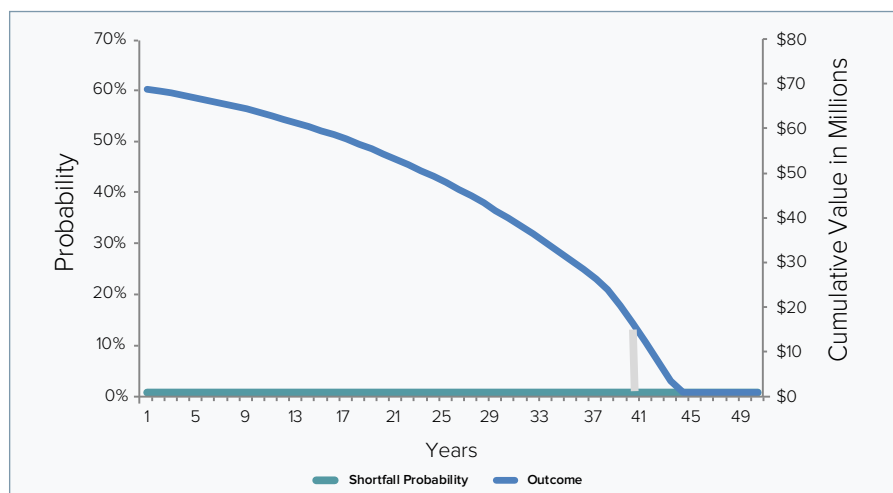
Cash Portfolio

One option for the couple is to keep all of its new wealth in cash. That is certainly a safe strategy; however, it does not serve well the goal of maximizing the amount passed to heirs. Moreover, it may present financial challenges for the couple during their lifetime.

For an all-cash portfolio, we assume an expected annual nominal return of 2%. Embedded in this assumption is an annual rate of inflation of 2% and a real return on cash of 0%.² We also assume that the variability of expected annual nominal returns is 0%.³

The blue line in Figure 1 plots how the initial \$100 million changes through time, following the second death and payment of estate taxes. For example, in the highly unlikely event that both the husband and the wife die in the first year of this simulation, \$69 million (right-side vertical axis) would be available to their heirs after payment of estate taxes.

FIGURE 1 | CASH PORTFOLIO



Since the standard deviation of returns for the all-cash portfolio is 0%, there is only one outcome for each year of second death (x-axis), which is captured by the solid blue line. The grey vertical bar rests at the 40th year of the simulation since, as noted in the Appendix, this is around the time that the second death is most likely to occur based on the life expectancies of the husband and wife. At that point, after payment of estate taxes, the couple's original investable wealth of \$100 million has declined to a little less than \$16 million. The modest 2% nominal return on the cash portfolio was not sufficient to keep pace with the couple's annual spending of \$2 million (growing by 2% inflation each year) plus yearly income taxes on the portfolio's earnings. Consequently, the amount available to the couple's heirs erodes significantly over time.

The final outcome can be expressed alternatively as a multiple of the initial \$100 million of investable assets. To calculate the multiple at the 40th year, we take the amount that remains after payment of estate taxes (\$16 million), add to it the couple's cumulative spending through the 40 years (\$177 million), and divide the sum by the original \$100 million. The couple's spending starts at \$2 million in the first year and grows by inflation (2%) each year thereafter. For the all-cash portfolio, the multiple at the 40th year is 1.93.

The aqua line in the graph displays the likelihood that the couple's estate will not have sufficient liquid assets to pay estate taxes when they are due following the second death. This is referred to as the Shortfall Probability. Given that the all-cash portfolio is completely liquid, the Shortfall Probability is zero (left-side vertical axis) throughout the simulation. Funds are always available to satisfy the estate tax obligation.

²This closely tracks both inflation and returns on 12-month Treasury bills during the past two decades. 12-month Treasury bills have provided nominal returns of around 2% per year while inflation has averaged 2%. Also, looking forward, the Federal Reserve's target for inflation is 2%.

³Variability here refers to the likelihood that the actual return will differ from the expected return. A measure frequently used to explain the range of possible outcomes is standard deviation. In the all-cash scenario, we assume that the couple always receives the 2% investment return. There is no risk of a different outcome. Therefore, the standard deviation of returns is 0%.

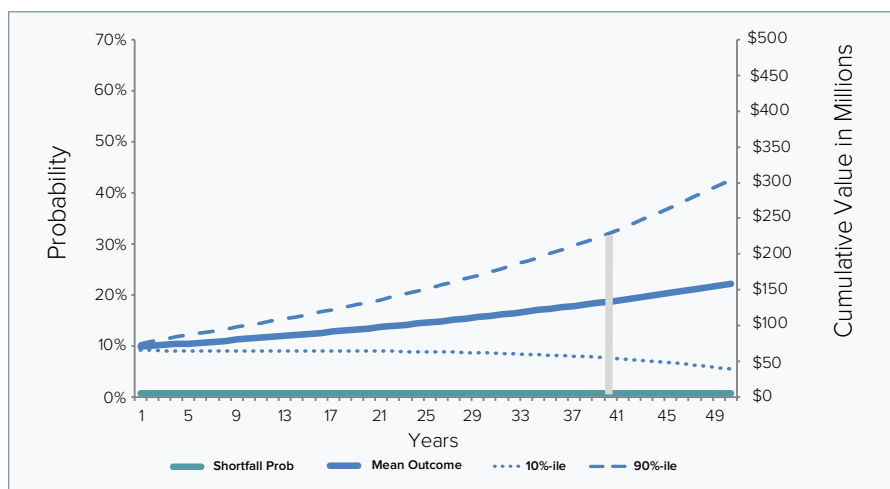
As the graph reveals, if one or both members of the couple survive past the 44th year, when the husband would be 98 or the wife 94, none of the original capital remains. That is clearly a catastrophic outcome. Adjustments to annual spending would surely have been made long in advance of that result; nonetheless, the simulation highlights the challenge of achieving the couple's objectives with an all-cash investment strategy.

Mixed Asset Liquid Portfolio

An alternative for the couple is to invest their wealth in a portfolio of assets that is as liquid as the all-cash portfolio but has more growth potential. We assume this to be a diversified mix of publicly traded stocks and bonds and assign it an expected annual nominal return of 6% and a standard deviation of returns of 9%.⁴ Unlike the all-cash strategy, with this portfolio, there is risk that the expected return of 6% will not be earned consistently from year to year. In any given year, it might be more, or less, than 6%. Hence, there is a positive standard deviation.

Figure 2 presents the results for this scenario. The analysis is exactly the same as with the all-cash portfolio except that, because the standard deviation of returns here is positive, we ran 20,000 trials for each year of possible second death to determine the final value of the couple's assets following payment of estate taxes. There is therefore a range of outcomes for any given year. The solid blue line plots the mean of the results for each year. The other blue lines show the range of possible outcomes around the mean by capturing the 10th (dotted) and 90th (dashed) percentile results.

FIGURE 2 | MIXED ASSET LIQUID PORTFOLIO



The grey bar again rests at the 40th year of the simulation. If the second death occurs at that point, the mean outcome is that the couple will pass \$134 million to their heirs following payment of estate taxes. This is a better outcome than with the all-cash portfolio given the mixed liquid portfolio's superior investment return. The range of actual outcomes, however, could vary from \$54 million at the 10th percentile to \$230 million at the 90th percentile.

Expressed as a multiple of initial investable assets, the mean outcome at the 40th year for this investment strategy produces a multiple of 3.11, which compares favorably with 1.93 for the all-cash strategy. The calculation uses the same cumulative spending by the couple over the 40-year period.

As with the all-cash portfolio, the Shortfall Probability (aqua line) is zero throughout the simulation given that the mixed asset portfolio is also entirely liquid. There will always be sufficient funds at the time of the second death to satisfy the estate tax liability.

⁴We use a 60/40 portfolio consisting of 60% MSCI All Country World Index, 20% Bloomberg Barclays US Aggregate Bond Index, and 20% Bloomberg Barclays Municipal Bond Blend 1-10 Year Index, rebalanced monthly. For the period 1/1/97 to 9/30/18, that portfolio generated a nominal annual return of 6.27% with annual volatility of 9.23%. With inflation of approximately 2% during that same historical period, that implies a real return of 4%, which we are comfortable using in the modeling for this portfolio.

Also, in contrast to the all-cash strategy, there is a very low probability that the couple will exhaust their wealth during their lifetime, even if they continue with the same level of annual spending into their final years.

Finally, it is important to note that this simulation effectively rebalances the portfolio back to the 60/40 asset allocation on a monthly basis. If the couple manages the mixed liquid portfolio on their own, the asset mix can drift over time with the effects of market cycles and the subconscious biases in human decision-making that studies of behavioral finance have revealed. Engaging a financial advisor can help the couple ensure that their portfolio benefits from regular rebalancing, which is one of the hallmarks of successful long-term investing.

Private Investments Portfolio

If their new wealth resulted from successful entrepreneurial activity, the couple might favor investments in young, privately owned companies with significant growth potential. They may feel this has greater potential to compound wealth than publicly traded stocks and bonds. Further, they may be confident about their ability to succeed as private investors given their experience and personal and professional networks. We assume that the couple, not their financial advisor, makes all decisions concerning private investments.

In the extreme case graphed below, the couple commits the entire \$100 million to a portfolio of private investments. For such a portfolio, we assume an expected annual nominal return of 13.5% and a standard deviation of returns of 11%, consistent with actual performance of Cambridge Associates Private Equity Index through the period 1/1/97 to 9/30/18 (nominal annual return of 13.53% and annual volatility of 10.42%).⁵

In addition, we assume that the couple receives distributions each year to help finance spending and income taxes. We appreciate that distributions from private investments are lumpy rather than consistent and predictable. They are also not common until a portfolio has matured. Nonetheless, considering the 13.5% annual return on the portfolio as well as periodic recycling of initially invested capital, we assume that the couple receives distributions equal to 5% of the market value of the portfolio each year (5% distributions yield). Any portion of the 5% that is not needed to finance spending and taxes is invested in the mixed liquid portfolio described on the previous page. Further, any distributions in excess of the 5% are re-invested in new private investments.

FIGURE 3 | PRIVATE INVESTMENTS PORTFOLIO
5% Distributions Yield

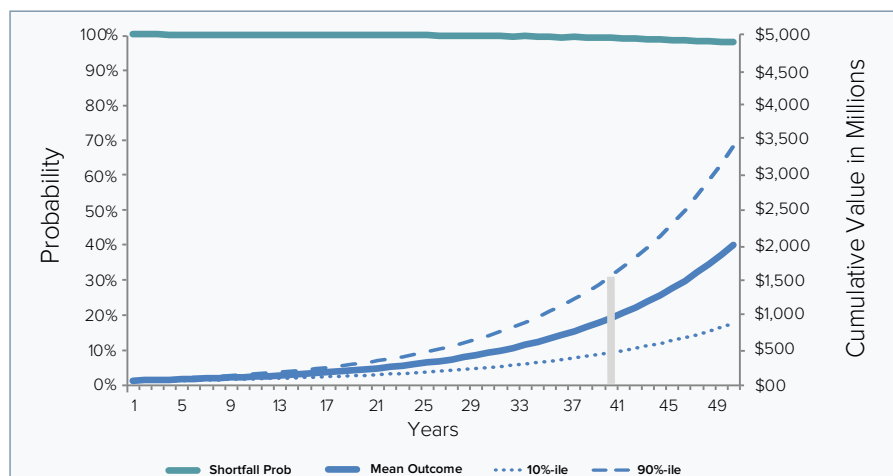


Figure 3 shows that the couple's heirs would benefit from the priority given to private investments. If the second death occurs in the 40th year, the mean outcome is that the original \$100 million, post-estate taxes, has grown to \$965 million (or a multiple of 11.42 on initial capital). This compares to \$134 million for the mixed asset liquid portfolio (3.11 multiple) and \$16 million for the all-cash portfolio (1.93 multiple). Given the higher standard deviation of returns, the range of possible outcomes is wider: \$476 million at the 10th percentile and \$1,564 million at the 90th percentile.

⁵The couple might build a portfolio of private investments that is highly concentrated in areas of personal interest and/or expertise. That collection of investments would have little resemblance to the diversified mix of investments in the Cambridge index. Nevertheless, the mean and standard deviation of this index is a reasonable proxy for the mean and standard deviation of such a portfolio. The volatilities of private equity portfolios are typically much higher on a mark-to-market basis, primarily due to lead/lag effects in pricing. Since we assume the independence of returns from year to year, we use a more standard "smoothed" volatility to adjust for this effect.

While the financial results are superior, the illiquidity of the private investments portfolio introduces significant risk that funds will be available to satisfy the estate tax obligation. The Shortfall Probability is elevated throughout the simulation, never dipping below 95%, even though surplus amounts from the 5% distributions yield accumulate in the mixed asset liquid portfolio. At the 40th year, there is a 99% probability of a liquidity shortfall.

What this means is that sufficient liquidity to satisfy the tax obligation exists in only 1% of the 20,000 trials run for that year. It's important to note, though, that we did not constrain the amount of the shortfall to a certain threshold. A trial registers as a deficiency if the shortfall is \$1 or \$1 million. Obviously, there would be more concern for shortfalls of larger amounts.

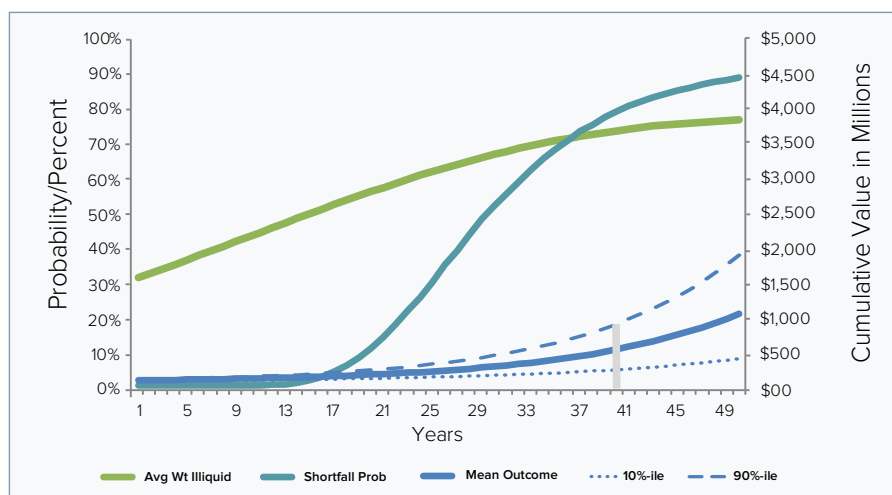
Combining Liquid and Private Investments

Given the Shortfall Probability risk associated with a portfolio of exclusively private investments, the couple might want to pair their preference for private investments with a complementary portfolio of liquid assets. We examine below a combination of the mixed asset liquid portfolio (A) and private investments portfolio (B). We chose the mixed liquid portfolio over the all-cash portfolio because of its potential for superior financial returns.

Reviewing the key assumptions, Portfolio A has an expected nominal return of 6% and a standard deviation of 9%, while Portfolio B has an expected nominal return of 13.5% and a standard deviation of 11%. In addition, we assume that the couple engages a professional advisor to manage Portfolio A and that the advisor tries to limit overlapping exposures between the couple's liquid and illiquid investments. This is represented by a correlation of 0.75 between the A and B portfolios.⁶ Finally, we continue the assumption that 5% of illiquid Portfolio B can be withdrawn each year and transferred to the liquid Portfolio A.

Figure 4 displays the results for the scenario where the couple allocates 30% of the \$100 million to private investments (Portfolio B) and entrusts the remaining 70% to the advisor for the liquid portfolio (Portfolio A).

FIGURE 4 | **70% LIQUID + 30% PRIVATE INVESTMENTS**
5% Distributions Yield



The graph plots the same information as in earlier figures. In addition, the green line shows the percentage of the couple's total investments (A + B) that are in the private investments (B) portfolio (left-side y-axis). Here, that percentage starts at 30 and rises steadily to nearly 80 due to the superior returns generated by the private investments portfolio.

If the second death occurs in the 40th year, the mean outcome is that the initial \$100 million grows to \$521 million after payment of estate taxes (6.98 multiple). That's a better outcome than with either the all-cash portfolio or the mixed asset liquid portfolio. The amount available to heirs, however, is not as substantial as what a strategy of only private investments produces. Balanced against this is a shift in the Shortfall Probability

⁶ This is approximately the historic correlation between the 60/40 portfolio and the Cambridge Associates Private Equity Index for the period 1/1/97 to 9/30/18.

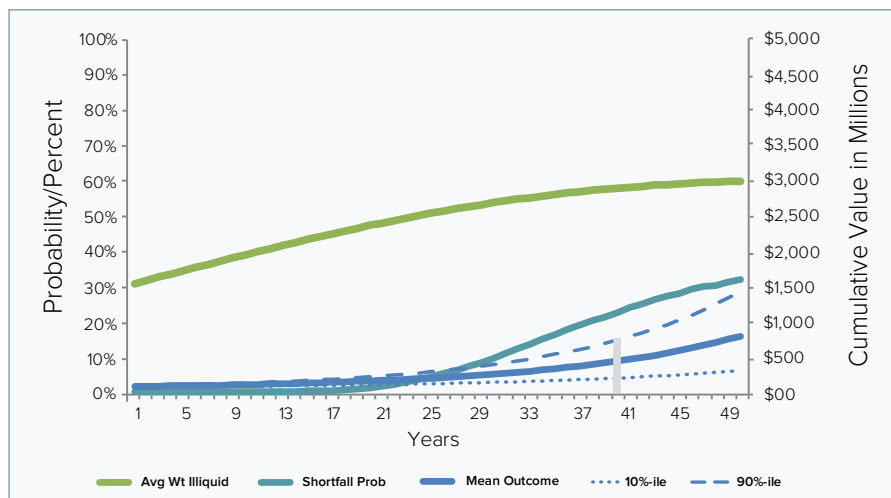
risk profile versus the portfolio of only private investments. At the 40th year, that probability is still elevated at 80%, though down from 99% with the private investments-only strategy. The benefit is more pronounced in the first two decades of the simulation should both deaths occur during that early period. At the 20th year, there is only an 11% probability of not having sufficient liquidity to fund the estate tax obligation.

It's worth noting that, even if a shortfall is avoided, the estate could risk exhausting most of its liquidity to satisfy the tax obligation. This could lead to a dramatic shift in an asset allocation that was developed thoughtfully over a period of many years. It could also limit cash distributions to beneficiaries until remaining illiquid private investments are sold. Further, it could complicate the funding of future capital calls on outstanding private investment commitments.

One option for improving the liquidity profile of the couple's investments is to increase the rate of withdrawal from the private investments portfolio. Figure 5 below presents the same 70/30 mix of the A and B portfolios and changes only the distributions yield, increasing it from 5% to 6%.

The result is a significant decline in the Shortfall Probability, from 80% in Figure 4 to 23% here. The trade-off, however, is less wealth available to heirs and other beneficiaries. In the 40th year, the mean outcome is \$432 million versus \$521 million in Figure 4 (17% less). The higher rate of annual withdrawal slows the accumulation of assets in the private investments portion of the couple's portfolio.

FIGURE 5 | **70% LIQUID + 30% PRIVATE INVESTMENTS**
6% Distributions Yield



Investment advisors often use rebalancing out of private investments in order to achieve greater liquidity for the total portfolio. When illiquidity is too high, the rate of reinvestment of distributions from private investments will be slowed in favor of directing a greater share of the distributions to liquid investments. For investors with access to high-performing private investments, the favorable effect on overall liquidity has a cost, namely reduced return potential for the portfolio.

Life Insurance

Another option for the couple to consider is adding life insurance to their financial plan. How might that impact both the Shortfall Probability and financial outcomes? Will pairing life insurance with allocations to private investments lead to better results?

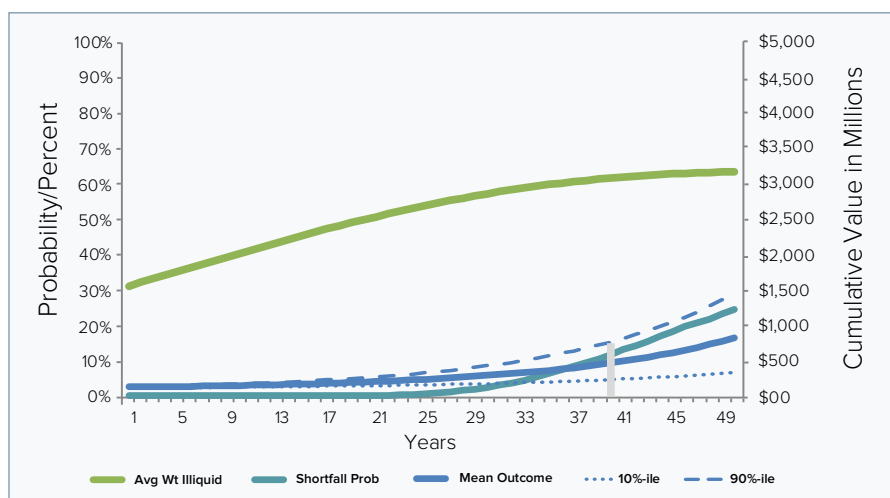
In Figure 6 we consider the scenario where the couple allocates 30% of the \$100 million to private investments (Portfolio B) and commits the remaining 70% to the mixed asset liquid portfolio managed by the professional advisor (Portfolio A). The correlation between the two portfolios is 0.75, and the distributions yield from the private investment portfolio continues at the higher rate of 6% introduced above.

To examine the effect of adding life insurance, we assume that, at the beginning of the simulation, the couple purchases a term life insurance policy with a \$50 million benefit (one-half of initial investable assets) that is

payable upon the occurrence of the second death. The policy is owned by an irrevocable trust whose beneficiaries are the couple's descendants.⁷ We further assume that the policy has a constant annual premium through the simulation until the occurrence of the second death. The couple pays the premium⁸ each year with payments credited against the exemption available to their estate at the time of the second death.

Comparing Figure 6 (70/30 with insurance) with Figure 5 (70/30 no insurance), adding insurance generally improves financial outcomes and, at the same time, reduces the shortfall risk exposure. At the 40th year, with \$50 million of insurance, the mean outcome for the couple's heirs is \$464 million (compared with \$432 million in Figure 5—a 7% improvement), despite incremental annual spending on the policy premium. The multiple expands from 6.09 to 6.41. Purchasing insurance also cuts the Shortfall Probability in half: in the 40th year, a 12% probability versus 23% for the same portfolio without insurance.

FIGURE 6 | **70% LIQUID + 30% PRIVATE INVESTMENTS, \$50MM INSURANCE**
6% Distributions Yield



In order to manage the Shortfall Probability down even further, the couple might add to the initial insurance coverage as the portfolio grows in value. Periodic purchases of incremental amounts would help to ensure that, at the time of second death, liquid assets are available to satisfy the estate tax obligation.

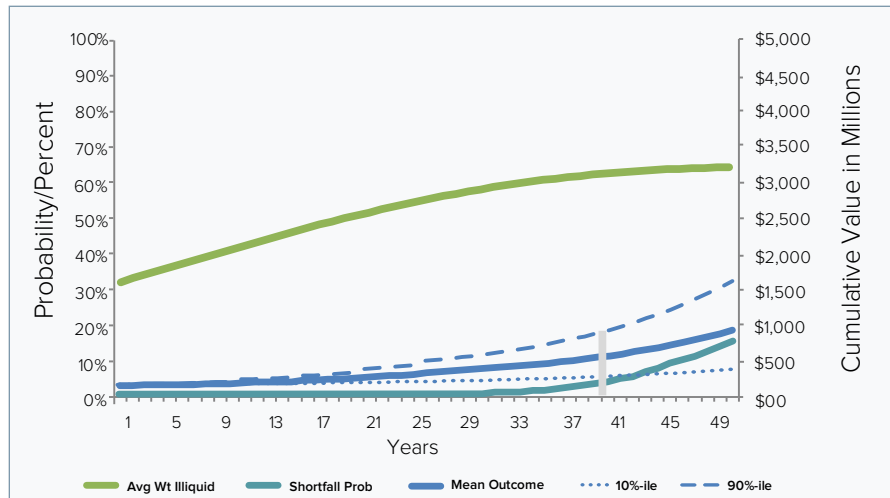
In the final scenario, we assume that the couple starts with the same asset allocation and \$50 million of life insurance but commits to revisit the relationship between the insurance coverage and the value of the investment portfolio on a periodic basis, specifically every five years. Their target is to maintain coverage that is equal to one-half of the value of the portfolio. If the portfolio grows by more than 15% by the 5-year reset mark, the couple purchases additional insurance to return to the one-half coverage relationship. If, on the other hand, the portfolio declines in value by more than 35% by the 5-year mark, the couple cuts back on insurance to restore the 1:2 ratio. There are no further adjustments in the insurance coverage once one member of the couple reaches age 80. Any of these parameters—the 1:2 ratio, every five years, 15% up, 35% down, age 80—can be adjusted to fit client circumstances.

⁷This is not the only way to structure the insurance arrangement. There are alternatives that might be a better fit with a client's particular circumstances.

⁸The amount of the premium is a function of the initial age of the husband and wife. The figure that we used for the \$50 million policy for this couple was provided by an insurance specialist firm with which Athena has collaborated.

The results appear below.

FIGURE 7 | **70% LIQUID + 30% PRIVATE INVESTMENTS, VARYING INSURANCE**
6% Distributions Yield



Adjusting the insurance coverage dynamically over time in response to changes in the value of the investment portfolio leads to more favorable financial outcomes. It also reduces the likelihood of a liquidity squeeze at the time of the second death. At the 40th year, the mean outcome for the couple’s heirs is \$532 million (7.09 multiple) versus \$464 million (6.41 multiple) in the scenario with a fixed \$50 million of insurance (Figure 6). Moreover, at the same year, the Shortfall Probability has declined from 12% to 4%, significantly increasing the chances that, after payment of estate taxes, funds will be immediately available to distribute to heirs and other beneficiaries. Comparing Figure 7 and Figure 4, incorporating insurance in this manner leads to a better financial outcome for the same investment strategy even when the rate of withdrawal from the private investments portfolio is increased from 5% to 6% (\$532 million versus \$521 million).

Conclusions

Several of the assumptions we made simplify the analysis. The amount of the couple’s annual spending remains constant in real terms over time. Income taxes are paid each year on a mark-to-market basis without distinguishing between ordinary income and capital gain. The allocation to private investments is fully committed at the outset rather than built over time. A fixed percent of the illiquid private portfolio is distributed to the couple every year. Etc. These and other factors can be adjusted in the modeling to fit a client’s particular circumstances.

Despite the simplifications, the analysis (summarized in the table below) yields some useful observations. Recall again that the couple has two primary objectives: (1) maintain assets sufficient to support the life they desire for their remaining years; and (2) at death, maximize the amount transferred to heirs and other beneficiaries.

| Investment Strategy | Expected Nominal Return | Distributions Yield | 40TH YEAR RESULTS | |
|---------------------------------------|-------------------------|---------------------|-------------------|-----------------------|
| | | | Mean Outcome | Shortfall Probability |
| cash portfolio | 2% | N/A | \$16 million | 0% |
| mixed liquid portfolio (A) | 6% | N/A | \$134 million | 0% |
| private investments portfolio (B) | 13.5% | 5% | \$965 million | 99% |
| 70% A + 30% B | 6% / 13.5% | 5% | \$521 million | 80% |
| 70% A + 30% B | 6% / 13.5% | 6% | \$432 million | 23% |
| 70% A + 30% B, \$50 million insurance | 6% / 13.5% | 6% | \$464 million | 12% |
| 70% A + 30% B, varying insurance | 6% / 13.5% | 6% | \$532 million | 4% |

Adding the higher returning investments in the mixed liquid portfolio ensures an outcome superior to that of the all-cash portfolio. The benefit of introducing private investments, however, is not as clear cut given the trade-off between return and liquidity. For a portfolio that includes both liquid and private investments, rebalancing out of the latter and into the former can help to manage the portfolio's overall liquidity profile, but at a cost to return. Pairing life insurance with active rebalancing produces more favorable financial outcomes for heirs and other beneficiaries, and simultaneously minimizes liquidity risk (Shortfall Probability) when estate taxes are due.

More specifically, we offer the following conclusions:

1. *If the couple invests all of their new wealth in a portfolio of cash investments, it offers peace-of-mind, but doesn't serve well the goal of providing as generously as possible for heirs and other beneficiaries. Further, it may present financial challenges, even during the couple's lifetime.*

The return available from an all-cash portfolio is likely to fall short of what the couple needs for spending year-to-year, thus eroding the value of their assets over time.

2. *A diversified mix of publicly traded assets is a better choice than cash.*

A mixed portfolio of stocks and bonds will help the couple compound wealth over time.

3. *Including some amount of private investments in the financial plan can help to compound wealth at a higher rate, assuming the husband and wife have potential to be successful private investors.*

The range of outcomes for private investments is wider than that for a mixed portfolio of liquid assets. Over long periods of time, however, the former should outperform the latter, again assuming the couple has the networks and personal relationships to participate in successful private investment opportunities.

4. *Committing meaningful amounts of capital to private investments introduces illiquidity risk.*

There are two types of illiquidity risk here: (1) insufficient funds to meet annual spending needs if regular withdrawals from the private investments portfolio are challenging; and (2) a shortage of liquid assets to pay estate taxes when they are due at the time of the second death.

5. *If the couple wants to devote a significant portion of their new wealth to potentially higher returning private investments, it will be wise to divide the capital between two portfolios: one that allows them to pursue their interest in private investments, and a second that satisfies their need for liquidity.*

The latter gives the couple access to assets that can easily be reduced to cash to fund annual spending. The preferred choice for it is a mixed portfolio of publicly traded securities. A professional advisor can help the couple evaluate different options for sizing the two portfolios, as well as for constructing the liquid portfolio.

6. *With a significant allocation to private investments, the couple will want to consider adding life insurance to manage the risk of a liquidity shortfall when estate taxes are due.*

Private investments have potential to deliver superior returns but with the risk of creating a liquidity shortfall when important financial obligations, such as estate taxes, are due. The pay-out on life insurance coverage can deliver valuable liquidity at a critical time. Adding insurance can also increase the amount available for the couple's heirs despite incremental spending on the policy premium.

7. *The right amount of life insurance for the couple will be the product of several considerations, including how aggressive they want to be with their allocation to private investments.*

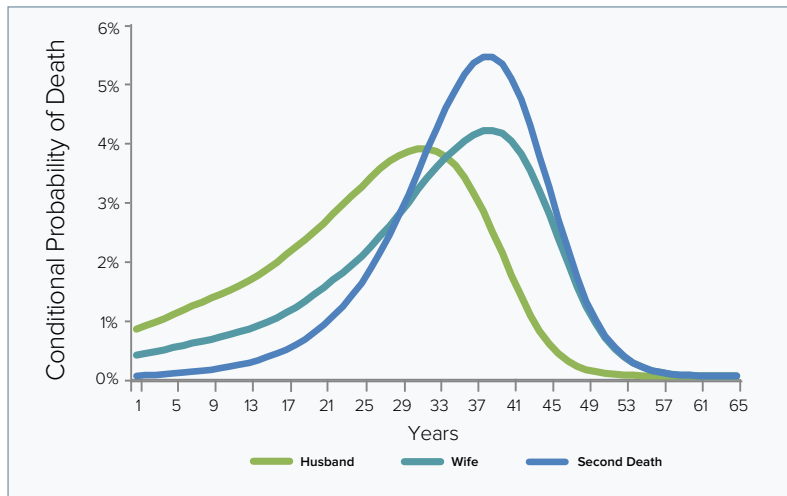
A professional advisor, working with an insurance specialist, can model a variety of scenarios to help the couple choose an initial amount of coverage that aligns with their goals. That level of coverage should be reviewed from time to time as the couple's financial situation evolves, particularly if the private portfolio's performance meets or exceeds original expectations.

Appendix

In order to determine when the couple's wealth might pass to their heirs, we looked at life expectancies for the husband, who begins the simulation at age 54, and for the wife, who begins at age 50. Specifically, we consulted the 2015 mortality tables that are available on the Social Security Administration's website.

Using the data in those tables, we plotted the curves that appear in Figure 8.

FIGURE 8 | DEATH PROBABILITIES



The green line follows the probability of the husband's death through the simulation. That probability peaks in the 32nd year when the husband is 86 years old. The same curve for the wife (aqua) peaks in the 39th year when she is 89 years old. The curves continue until it is highly unlikely that either the husband or the wife remains alive.

The blue line considers the husband and wife as a couple and traces the likelihood of the occurrence of the second death (i.e., when the second member of the couple—husband or wife, but more commonly the wife—passes away following the death of the first). That curve reaches its highest point in the 38th year. The year of second death is significant because we view it as the point when the couple's wealth becomes available to their heirs. For consistency in the body of the paper, we choose to focus on the 40th year as the year of second death. It is close to, but not completely consistent with, the point where the blue curve peaks.

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Jeremy Evnine, PhD

Senior Advisor, Quantitative Research

Jeremy provides guidance to Athena Capital Advisors in the areas of quantitative research and risk management. He is currently CEO of Evnine & Associates, Inc., a consulting and Investment Advisory firm engaged in quantitative strategies since 1992.

From 1991 to 2003, Jeremy was also a partner in Iris Financial Engineering and Systems, a financial software firm specializing in providing high-end trading and risk systems to top-tier investment banks. He sold his interest in Iris in 2003. Jeremy was senior vice president in charge of research at WFIA (subsequently Barclays Global Investors, now BlackRock) from 1984-1990. In this capacity, he worked with such people as Fischer Black and Myron Scholes, Bill Sharpe, Michael Brennan, and Eduardo Schwartz.

From 1980-1984, Jeremy was a consultant at Barra, where he developed the firm's option products.

Jeremy earned his B.Sc. in Mathematics at Manchester University in England, his M.Sc. in Pure Mathematics at the Hebrew University of Jerusalem, and his Ph.D. in Operations Research and Finance at U.C. Berkeley. He has taught courses in finance at U.C. Berkeley, published articles in the financial literature on option pricing and tactical asset allocation, and lectured in the United States and abroad.



William F. McCalpin, JD

Managing Partner, Impact Investments

Bill leads Athena Capital Advisors' impact investing practice. In this role, he coordinates with members of the research, portfolio management, operations, and business development teams to enhance the firm's impact investment services and offer Athena Capital's capabilities to a growing client base.

Prior to joining Athena, he was chief executive officer of Imprint Capital Advisors, an impact investing firm that Goldman Sachs Asset Management acquired in 2015. Through a period of over 20 years, Bill served in several different capacities in two private grantmaking foundations: the Rockefeller Brothers Fund and the John D. and Catherine T. MacArthur Foundation.

Bill is the independent chairman of the board of trustees of the JanusHenderson funds, a family of more than 60 mutual funds with approximately \$135 billion in assets that are offered to retail and institutional investors in the U.S. He is also the independent chairman of the mutual funds, with assets totaling \$3 billion, that are offered by The Investment Fund for Foundations (TIFF) Investment Program.

Bill is also a director of the F.B. Heron Foundation and the Mutual Fund Directors Forum. He received a B.A. in Economics from Williams College and a J.D. from Boston College Law School.



Lisette Cooper, PhD

Managing Partner, Chief Investment Officer

Lisette founded Athena in 1993. Today, she serves as Chief Investment Officer and Managing Partner. In these roles, she sets the firm's overall direction and leads the Investment Committee. Lisette has helped to establish the firm as one of the leaders in the field of impact investing and as a top-ranked RIA on a national scale.

Prior to founding Athena, Lisette served as Manager of Consulting Services for Barra Inc., now MSCI Barra. She and her team specialized in modeling risk and developing investment solutions for institutional investors. She spent five years as a Senior Strategist at Merrill Lynch, where she analyzed, designed, and marketed innovative securities to money managers, banks, and pension funds. Lisette also has extensive experience in the hedge fund industry.

Lisette is a Chartered Financial Analyst (CFA) Charterholder and co-author of "Investing in Gender Equality: A practitioner's perspective on gender lens investing and the construction of gender inclusive investment portfolios" (January 2018) and "Social Finance and the Postmodern Portfolio: Theory & Practice," *Journal of Wealth Management* (Spring 2016). She was named a 2017 "Women to Watch" honoree by *InvestmentNews*. Lisette is a former expert in residence of the Harvard Innovation Lab and serves as a council member of the Harvard Graduate School of Arts and Sciences. She is a board member of Boston Youth Sanctuary, the Mind & Life Institute, and the Garrison Institute.

Lisette received her B.A. from Wesleyan University and a Ph.D. from Harvard University.



John Raus, CFA

Vice President, Quantitative & Risk Analytics

John manages Athena's Quantitative and Risk Analytics team. He oversees quantitative research initiatives, development of proprietary portfolio and risk-management models, and a wide range of analytics across the Research and Portfolio Management groups. He also leads Athena's asset allocation and simulation-based frameworks.

Previously, John was the head trader for Ellington Management Group's long/short equity hedge fund, where his responsibilities included portfolio trading, idea generation, and maintenance of proprietary risk management systems. Prior to this, he worked in Ellington's Quantitative Strategies Group, where he researched and traded various medium and low-frequency systematic strategies.

John received his B.A. in Economics from the College of the Holy Cross and is a member of the Stamford CFA society.

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