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# Achieving Retirement Income Security:

## A Comparison of Guaranteed Lifetime Withdrawal Benefit, Systematic Withdrawal and Partial Variable Annuity Strategies

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### Abstract

Many retirement income products attempt to satisfy multiple and sometimes conflicting objectives because retirees desire products that provide retirement security, inflation protection, liquidity, asset growth and the potential for an estate. In this paper, we used historical data over the past 90 years to conduct simulations and analyze how a Guaranteed Lifetime Withdrawal Benefit (GLWB), systematic withdrawal, and partial Variable Immediate Annuity (VIA) strategies performed in meeting these multiple objectives. With the exception of retirement income starting dates at the beginning of the Great Depression, all three strategies performed well in providing income throughout retired life. The partial VIA and GLWB strategies provided better "peace of mind" retirement income products, while the systematic withdrawal strategy offered the greatest flexibility in managing retirement assets. Overall, we conclude that a partial VIA income strategy comprised of a VIA and supplemental liquid asset account would have provided the best mixture of income generation, risk management, and estate potential for the majority of cohorts.

## Introduction

As the baby boom generation continues to transition into retirement, income drawdown strategies and managing retirement income risk have become topics of increased interest. Research indicates many retirees desire products that ensure they will not outlive income, offer some inflation protection and, at the same time, allow them to retain some flexibility and control.[1] In light of these sometimes conflicting desires, there is a need for a framework that benefit consultants, financial advisors and plan sponsors and participants can use to compare various retirement plan distribution products. Using historical monthly returns data, we analyze and compare three different retirement income strategies:

- A Guaranteed Lifetime Withdrawal Benefit (GLWB) product strategy designed to provide a guaranteed minimum amount of lifetime income, asset liquidity, and the potential for receiving additional income from portfolio gains.
- A hybrid income strategy, combining a Variable Immediate Annuity (VIA) with discretionary supplemental withdrawals from a separate liquid asset account, that protects against longevity risk, provides limited asset liquidity, and offers the potential to receive additional income from portfolio gains.
- A simple systematic withdrawal strategy where the retiree bears all retirement related risks.

Conventional wisdom is that a GLWB product strategy outperforms the two alternative strategies in providing what many retirees want—lifetime income that can capture upside market returns (with no downside losses), liquidity for cash emergencies, and the potential for providing an estate. Our analysis indicates, however, that the insurance value of GLWB may be overstated relative to the typical cost of purchasing the GLWB guarantee. Using historical asset return and inflation data over the past 90 years, we find that most cohorts of retirees would have achieved similar or better outcomes by simply avoiding annual GLWB fees. Compared to a systematic withdrawal strategy, most cohorts of retirees would have received the same level of annual income, had greater liquidity, and left a larger estate relative to purchasing GLWB protection. However, retirees using the systematic withdrawal strategy would have borne substantial retirement risks. If a partial VIA strategy was utilized as part of an alternative income strategy, then most cohorts of retirees would have had guaranteed lifetime income protection, limited but increasingly greater liquidity and potential estate, and had better inflation protection relative to a comparable GLWB strategy. However, early in retirement, the variable annuity strategy provides relatively less liquidity for covering unexpected or catastrophic expenses.

Overall, we conclude that a hybrid income strategy comprised of a VIA and supplemental liquid asset account would have provided the best mixture of income generation and risk management for the majority of cohorts. This is particularly true for cohorts starting income after 1980. Given total investment returns over the past 30 years, we feel this point is important enough that it bears repeating. *Over the past three decades, the cost of GLWB protection was high relative to the insurance value provided.* Of course, past performance is no guarantee of future results. And, a GLWB can be purchased before retirement to allow for a lock-in of a minimum income floor, with liquidity and potential upside. This paper does not address that feature. Furthermore, we do not run stochastic (Monte Carlo) simulations, but use actual past historical return performance in running simulations. And we did not address the possibility of lump-sum draw-downs to finance emergency needs during retirement and the impact of these cash withdrawals on future income.[2]

The remainder of the paper is structured as follows. The next section discusses the basics of the three types of strategies: systematic withdrawals, GLWBs, and partial VIAs. We then compare the relative performance of the GLWB and systematic withdrawal strategy using various assumptions. We next conduct similar analysis comparing the relative performance of the GLWB and partial VIA strategies. The final section offers a summary of the results and concluding thoughts.

1. Beshears et al (2013)
2. We hope to address these issues in a future paper.

## Retirement income strategies

Most strategies for drawing down assets to provide for retirement needs start with determining the base of retirement income provided by Social Security and/or Defined Benefit (DB) pensions. Once this amount is determined, remaining needs must be met by drawing down Defined Contribution (DC) plan, Individual Retirement Account (IRA), and/or after-tax brokerage account assets.[3] While numerous income generating strategies exist, we consider three types of strategies for comparison: systematic withdrawals, partial VIAs, and GLWBs. Our metrics for comparison are the ability of a strategy to (1) generate income throughout retirement, (2) provide an income floor in each year, (3) offer adequate retirement risk management, (4) provide some liquidity for unexpected needs, and (5) have the potential for an estate. We note that these metrics can have off-setting effects; a strategy that moves retirees closer to achieving one objective may simultaneously move them further from other goals.

### Systematic withdrawal strategy

Systematic withdrawals provide a retiree with a substantial amount of flexibility and control over how to generate income from assets. However, a systematic withdrawal strategy requires a retiree to bear the burden of a number of risks, including longevity, investment portfolio, and inflation risks. Effectively managing these risks requires a retiree to carefully limit the amount withdrawn, which can result in more volatile and lower annual income.

Many financial advisors use simple "rules of thumb" they claim can mitigate various risks. One of the more well-known heuristics in the financial industry is the "4% draw-down rule." This strategy suggests a retiree can begin drawing income at 4% of the initial asset balance and increase his or her withdrawal to remain on pace with inflation, yet is not likely to run out of money.

There are a number of issues with this strategy. The retiree bears substantial longevity risk because it is only "likely" that the retiree will not outlive income. There is consumption (or standard of living) risk because the 4% rule means only $4,000 of initial annual income on a $100,000 portfolio. This provides less initial income than other strategies and has the potential of being substantially lower if market returns are poor. The retiree bears all asset market risk. Large systemic market shocks (e.g., the 2009 financial crisis) can have a severe impact on the well-being of retirees using a systematic withdrawal strategy. The retiree bears all inflation risk.

In sum, the "cost" of maintaining complete control of his or her retirement portfolio and distribution strategy is the substantial amount of risk a retiree must be willing and capable of managing throughout retired life. With respect to our five standards, a systematic withdrawal strategy can satisfy many objectives early in retirement but will tend to do a poorer job satisfying the metrics later in retirement.

### Partial annuity strategy

Research demonstrating the benefits of purchasing life annuities is well documented.[4] A life annuity provides the opportunity to maximize lifetime income with low risk for the retiree, particularly when compared to systematic withdrawals. A life annuity strategy protects a retiree from substantial risks, including the risk of outliving income (longevity risk), equity market and interest rate risk (portfolio risk), inflation risk, and the risk of cognitive decline (mental ability to manage the other risks).[5] Critics of the annuity strategy typically claim there are major disadvantages to purchasing a life annuity. First, there is the risk of loss in estate value due to early death. However, that risk can be mitigated with the purchase of a guarantee period that eliminates estate loss risk over the desired coverage period.[6] Second, there is the loss of asset liquidity to cover the risk of catastrophic need. This risk can be managed by adopting a partial annuity strategy that provides guaranteed income for covering life's necessities and maintaining a reserve account to provide for supplemental needs. Third, a fixed annuity is designed to pay a specific nominal amount of money for life. Because inflation can erode the value of a fixed nominal payment over time, some issuers include an inflation rider to their fixed annuities. However, in today's low interest-rate environment, that protection typically comes at a large upfront cost that may take years to recover. An

3. We do not consider other less liquid sources, such as housing equity, in this paper.
4. See, for example, Goodman and Richardson (2014), Mauer, et al. (2012), Richardson and Spence (2010), Brown (2008) and Goodman and Heller (2006).
5. Agarwal, et al (2009)
6. Purchasing a guaranteed period is equivalent to purchasing a single premium, declining face value term life insurance policy.

annuity strategy for protecting against the effects of inflation is to purchase a variable immediate annuity. The initial payment from a variable immediate annuity is based on an Assumed Investment Return (AIR) that, when combined with an assumed mortality assumption, yields the initial income payment.

For example, the VIA variable annuity uses a 4% annual AIR that, when combined with the current VIA mortality table, yields an initial annual payment of approximately $6,550 per $100,000 of settled accumulation at age 65 for a single life annuity. In contrast to a fixed annuity, future variable annuity payments will vary based on how the actual net return of the underlying investments compares to the AIR. With a 4% AIR, the nominal payment will increase (decrease) if the underlying funds earn more (less) than 4% annually. Because an appropriate asset allocation can yield a nominal return of greater than 4%, the variable annuity payout has a good likelihood of keeping pace with inflation. Assume a variable annuity portfolio return averages 7.5% per year. Then the payment will increase, on average, approximately 3.5% a year. And as long as average annual inflation is 3.5% or less, the growth rate of this payment stream will tend to outpace inflation. Since 1985. the U.S. inflation rate has averaged 2.8% and has never been higher than 5.4%, whereas, a 60/40 portfolio of VIA equity and fixed income has averaged 9.1%, providing lifetime income protection and an excellent inflation hedge.[7]

Because the variable annuity payments are dependent on the performance of the underlying investments, the risk to retirement security is clear: downside market volatility increases the likelihood that not only will the payment be unable to outpace inflation, but it will also be reduced in nominal dollars. While some variable annuities may offer a guaranteed minimum floor (the VIA annuity does not), this may not satisfy participant concerns about downside market risk.[8] With respect to our five standards, the partial variable annuity strategy does a good job of providing income throughout retired life with adequate retirement risk protection. When coupled with a supplemental asset account, it provides liquidity for emergencies and the potential for an estate. However, it does not provide a guaranteed income floor.

## GLWB strategy

The risks associated with systematic withdrawals (e.g., outliving income) and variable annuities (e.g., estate loss, the possibility of very low income) led to the creation of an insurance product known as the Guaranteed Lifetime Withdrawal Benefit (GLWB). When purchasing an immediate GLWB product, a policyholder invests funds at retirement with the insurance issuer. First-year income is determined by the amount settled and a withdrawal factor established by the contract. Over the course of the year, the account is credited with portfolio returns based on the mix of underlying investments. If, over the next year, the account balance increases above the initial amount, then the following year's payment will increase and a higher income floor is established.[9] Otherwise, the account payment and floor remain the same.

As an example, consider a retiree age 65 who settles $100,000 in a single-life GLWB contract with end-of-month valuation. Under current interest rates and standard withdrawal factors, this settlement will pay out $5,000 (5%) in the first year.[10] At all times, the insurer tracks the account balance (the underlying initial settlement amount, less payments, plus or minus the returns of the portfolio).

Over the next year, if at the end of any month the account balance has grown to more than $100,000, then the following year's payment will increase to 5% of that high point, and a new income floor is established.[11] If the account balance is $100,000 or less, then the payment remains at its current floor of $5,000. This continues each year for the life of the purchaser—*the current year payment will be the greater of* 5% *of the highest end-of-month balance over the past 12 months, or the prior year's payment.* Upon death of the policyholder, any remaining account balance becomes part of the decedent's estate.

7. Inflation numbers calculated from Bureau of Labor Statistics CPI-U historical chained data. Fixed income (TIAA) and VIA results are based on author calculations of a contribution made on December 31, 1984 accumulated through December 31, 2014.
8. See Goodman and Tanenbaum (2008) for a discussion on the relative value of Guaranteed Minimum Withdrawal Benefits.
9. The new account value can be measured at the end of year or at the end of the highest month's value, depending on the contract.
10. Note this income level will be based on age; 5% is the typical rule at age 65. The amount will be higher if the retiree is older, and lower if the benefit includes two lives. These nuances will be addressed later in the paper.
11. Some products only offer this "high point" based on year-end balance.

A GLWB strategy can satisfy our five standards. It provides lifetime income and a minimum annual nominal floor because the policyholder is guaranteed to receive *at least* $5,000 (per $100,000 of investment) in nominal income per year for life. The GLWB has the potential for increases in nominal income if the underlying portfolio performs strongly. There is also the potential for an estate. And the GLWB can provide liquidity of assets in case of an emergency.

Providing these features comes at a cost, and, the insurer must charge a fee for assuming the risks covered by the GLWB protection. We assume that the GLWB fee to be 100 basis points (1.00%). An additional 40 basis points (0.40%) is charged for administration and investment fees for the underlying assets of all three strategies. Our primary research question is whether the additional 1.0% GLWB fee, which reduces net returns on an annual and cumulative basis, provides value relative to the alternative strategies.

## Comparison of alternative income strategies

The standard rationale for purchasing a GLWB product is that it provides insurance value by protecting a retiree from downside investment risk and longevity risk while also providing liquidity and the potential for an estate. For example, if the GLWB investment portfolio has a 0% nominal annual return for a policy holder still alive after 40 years, then the $5,000 nominal income guarantee has done a good job protecting against market and longevity risks. Had the retiree not purchased the GLWB product, the account balance would have been depleted and income payments would cease; however, the GLWB continues to make annual nominal payments of $5,000 for life.

GLWB products do have issues that reduce the value of some design features. First, the likelihood of receiving additional amounts is "starting point" sensitive. If a retiree purchases and starts GLWB protection in years with low or negative investment returns, then the likelihood of receiving additional income in later years is very low, regardless of the strength of investment returns in later years. Second, unless returns are positive and moderately strong, then the liquidity and estate features of the GLWB diminish substantially over time. Third, the GLWB minimum income payment, when coupled with investment returns and fees, may make it unlikely that the income payment will keep pace with inflation.

In what follows, we will use historical data to analyze how the various income strategies would have performed along the following dimensions: (1) generate income throughout retirement, (2) provide an income floor in each year, (3) offer adequate retirement risk management, (4) provide some liquidity for unexpected needs, and (5) have the potential for an estate. Overall, we are interested in whether the additional costs of the GLWB strategy provide value compared to a partial VIA or simple systematic withdrawal strategy.

## Comparison of GLWB and systematic withdrawal strategies

We start by comparing the historical relative performance of a GLWB strategy to a systematic withdrawal strategy, with the only difference being the latter does not include any of the insurance protections in the GLWB contract. To facilitate comparison, we assume the systematic withdrawal amount is set equal to the GLWB annual amount. We then analyze how the systematic withdrawal strategy compares to the GLWB strategy with respect to protecting against market and longevity risk while providing liquidity and the possibility of an estate.

We conduct the analysis by running portfolio simulations using historical returns for a hypothetical investment portfolio with portfolio weights of 50% allocated to an S&P 500 Index fund, 35% to a Government Bond fund and 15% to a Corporate Bond fund.[12] Assuming 40 basis points for annual administration charges, we run this portfolio for successive 30-year periods beginning January 1926 (ending December 1955), with the last 30-year run beginning January 1985 (ending December 2014).[13] This provides us with simulated portfolio results for 709 distinct 30-year periods.[14] For each simulation run, we pick the starting month and year and calculate the actual net-of-fee monthly returns. Using a withdrawal amount *as determined by a comparable GLWB*

12. This is a moderately conservative 50% equity/ 50% bond portfolio and has slightly lower equity exposure than most lifecycle funds at a similar age.
13. Using 40 basis points as the expense ratio underweights the portfolio cost for most of the studied period but does not impact the relative analysis across draw-down options.
14. We use a 30-year horizon because this substantially exceeds the life expectancy of the vast majority of 65-year old retirees, which is approximately 20 years. Note that there is quite a bit of overlap in these runs, since some months are included in 360 of the runs! This should not be considered a Monte Carlo simulation.

*product with a 5% rule*, we calculate annual income and year-end balances over each 30-year period for the GLWB and alternative strategies. This measure allows us to compare (1) annual income, (2) the value of the income floor, (3) inflation protection, (4) the stock of liquid assets to cover emergencies, and (5) the potential for an estate.

## GLWB versus systematic withdrawals: strong starting point returns

Consider whether GLWB protection has value relative to systematic withdrawals for retirees whose starting point returns were strong and who experienced generally good market returns over their retired lives. Exhibit 1 (page 14) shows results for an individual who began receiving benefits in 1982.[15] The first column shows the gross return to the 50%/50% equity/bond portfolio for each year. The average gross return for this portfolio over the 30-year period was 11.9%. There were four years with negative returns but only one year where the loss was more than 3.5%. By contrast, this portfolio period had 23 years with returns of at least 5% and 16 years of returns in excess of 10%, including eight out of the first 10 years. The next two sets of columns show nominal income and residual assets under the GLWB contract, and the comparable values for the systematic withdrawal strategy that replicates the GLWB income path.

Exhibit 1 shows that while these two income strategies received the same gross return and provided the same annual income, the higher net returns (by 1% per year) to the systematic withdrawal strategy would have provided, by the end of the 30-year period, a residual estate balance of approximately $625,000, almost *double* the residual GLWB estate balance. Figure 1 (page 22) shows that at any year, the systematic withdrawal strategy provided a larger estate relative to the GLWB strategy.[16] So as the retiree aged, there were significantly less GLWB resources available to provide liquidity for potential end-of-life needs. Another way to view the residual asset balance is to consider the amount needed to generate the original $5,000 minimum guaranteed income level. Any residual assets above this amount could be liquidated to meet emergency or catastrophic need. The systematic withdrawal strategy provided greater liquidity in every period. The final column of Exhibit 1 shows real income in 1982 dollars and highlights the advantage of a starting point during years of strong asset returns. Both strategies not only provide inflation protection, but also substantial real income increases over most of the 30-year period.

Under these strong starting point scenarios, the cost of the GLWB guarantee is large relative to the foregone estate value and asset liquidity. Indeed, the value of the GLWB protection worsens over time because the annual cost of the insurance rises substantially. That is, *the insurance cost of the GLWB guarantee rises as the need for continuing the guarantee falls*. Thus, for this 30-year period, the total cost of the GLWB guarantee was over $300,000 on an initial investment of $100,000! Overall, this example highlights that when the stock and bond markets perform well, the insurance value of the GLWB floor is small relative to the cost of other retirement and estate goals.

## GLWB versus systematic withdrawal: poor starting date returns

Consider the relative value of GLWB protections when the investment portfolio underperforms. Exhibit 2 (page 15) provides an example of this scenario by showing the outcomes of the two strategies for a person who started receiving benefits in 1965, a starting date that had a series of poor market returns.

The first column shows annual gross returns to a 50%/50% equity/bond portfolio. This scenario had 20 years of returns greater than 5%, with 14 years experiencing double-digit portfolio returns. However, the portfolio also had 7 years of negative returns, including 4 of the first 10 years. The average gross return for this portfolio was 9.4%. The early portfolio losses had a significant impact on income and asset accumulation. Figure 2 (page 22) shows the stock of liquid assets fell for both the GLWB and systematic strategy for the first 10 years. As a result, nominal income remained constant from year 2 through year 27, and real income declined dramatically over the entire 30-year period, with particularly strong declines in purchasing power during the high inflation years of the 1970s and early 1980s. In real terms, the GLWB floor fell to less than 25 cents on the dollar at the end of the 30-year period. The GLWB floor did provide protection as available assets declined, but the systematic withdrawal strategy was able to replicate the income path while providing progressively greater liquidity.

15. Note that all results are per $100,000 invested.

16. The residual estate from the systematic withdrawal strategy is larger in every year of every scenario. By definition, paying excess fees results in lower estate value.

This occurred because, with the extra 1% GLWB fee, assets declined more sharply and rebounded more slowly with the GLWB strategy relative to the systematic withdrawal strategy. Both strategies also had a residual estate in every year. At the end of this 30-year period, the pure withdrawal strategy provided residual estate assets of more than $200,000, more than double the account value using the GLWB strategy. This difference is solely attributable to the GLWB annual fee.

## GLWB versus systematic withdrawals: historical simulation results

Did the GLWB protections ever provide insurance value to an individual? The short answer is a qualified "yes." Table 1 (page 13) shows that out of the 709 portfolio periods, the 50%/50% equity/bond allocation results in 28 (about 4.0%) starting dates when the systematic withdrawal account would have been depleted before 30 years elapsed. Each of these depletions occurred for starting dates immediately preceding the 1929 market crash and the Great Depression. Since November 1929, there was not a single starting date when a systematic withdrawal stream equal to the 5% GLWB rule would have resulted in outliving income over a 30-year period.

To better understand the downside tail-risk on retirement income outcomes, Exhibit 3 (page 16) shows portfolio performance and retirement income paid with a starting date of September 1929, the worst starting date in the entire simulation series. This example highlights the importance of the starting date. There were only 8 years with negative returns but this included 5 of the first 10 years; with the first 3 years losing at least 10% per year. The average gross return for this 30-year period was 6.8%. In this worst case scenario, a retiree using a systematic withdrawal strategy would have received the same payment as the GLWB for 25 years and a substantially smaller payment in the 26th year. The GLWB in this worst case provided good nominal income protection throughout the 30-year period and good inflation protection for the first 14 years. Both strategies provided very limited liquidity and a rapidly diminishing estate, with the GLWB strategy exhausting estate assets six years before the systematic withdrawal strategy. This worst case example highlights that for a GLWB contract to produce value relative to a systematic withdrawal strategy, two things must happen: (1) markets must perform extremely poorly for a prolonged period and (2) the retiree must be long-lived.

Could GLWB strategy have ever offered more value? The short answer is an unqualified "yes." All else equal, the GLWB protection increases with the riskiness of the underlying investment portfolio. By allowing the purchaser to select a portfolio with a *higher* percentage for the equity allocation, the retiree has the potential for more upside portfolio returns while still truncating downside income risk. This tilts the distribution of expected income in favor of the retiree, creating better insurance value from the GLWB strategy.

Table 1 shows the results of changing the portfolio weights to a 60%/40% equity/bond portfolio allocation. In most of the 709 cases we examined the systematic withdrawal strategy still provided as much annual and total nominal income, the same inflation protection, and progressively greater liquidity and a larger estate. However, the additional portfolio risk means there were 16 (for a total of 7.6%) more starting dates when the GLWB protection provided income protection relative to a systematic withdrawal strategy.[17] As with the prior analysis, the GLWB protection is most valuable for retirees with longer life expectancy. Exhibit 3b (page 17) shows that for the worst case scenario of a September 1929 starting date, a retiree with 60%/40% equity/bond portfolio weights and using the systematic withdrawal strategy would not run out of money for 20 years. Again, we found that all the cases of asset depletion occurred with starting dates before or during the Great Depression. For any starting date after July 1930, there were no historical simulations where the systematic withdrawal strategy would exhaust the account, even when assuming a higher equity allocation.

Another way to increase GLWB value is by reducing the fee. Sensitivity analysis shows that reducing the GLWB fee to 75 basis points (which increases the value of the GLWB balance, resulting in larger GLWB payments and equally larger systematic withdrawals) did not change the 30-year results, but did result in six more cases of systematic withdrawal asset depletion in the 25-year runs. Decreasing the fee also resulted in higher estate values under the GLWB, albeit still below the assets available with the systematic withdrawal strategy.

Overall, increasing the value to GLWB protections requires the insurer to assume substantially more risk, either through the portfolio or through the fee structure. While this may

17. And in 41 (5.3%) of the 25-year periods.

seem desirable to an individual participant, greater portfolio risk may be offset by the need to charge higher fees, while lower fees may result in restrictions on portfolio allocations. Otherwise, the entire insurance pool may be at higher risk of a default through moral hazard and adverse selection.

### GLWB versus systematic withdrawals: sensitivity of results

The 5% draw-down rate is relevant for a single person beginning retirement income at age 65. Changing either the starting age or the number of lives covered changed the income draw rate. For example, if a couple both age 65 purchased a GLWB, they would likely receive a 4.5% initial income rate. Intuitively, if a 50%/50% equity/bond asset allocation and 5% systematic withdrawal rate does not deplete assets over 30 years, then neither will a 4.5% withdrawal rate. However, given that the joint life expectancy of this couple is longer than the single life expectancy, we ran the simulation analysis over 35-year periods.[18] Because there are fewer possible 35-year periods, we compared results using 649 starting points, covering dates from 1926 through 1979.

Table 1 shows the results of the historical simulation runs. Even with the added five years of returns and payments, the systematic withdrawal strategy provided as much income protection as the GLWB strategy when using the base case 50%/50% equity/bond portfolio. Assuming a 60%/40% equity/bond allocation, Table 1 shows that the GLWB strategy provided income protection value because the systematic withdrawal strategy exhausted assets before the end of 44 (6.7%) 35-year periods. However, the systematic withdrawal strategy never provided income for fewer than 26 years, and there was not a single 35-year period after November 1929 when the account was depleted. Consistent with the prior results, Table 2 (page 13) shows the systematic withdrawal strategy provided a larger median estate compared to the GLWB strategy. The systematic withdrawal strategy also provided progressively greater liquidity and a larger estate in all cases.

Conversely, if a retiree is older than age 65, then the initial income rate will be higher than 5%. For example, at age 70, the initial income rate would likely be set to equal 5.5% of the initial balance. Given that remaining life expectancy is lower at age 70, we analyzed results over 25-year periods to provide parity with our assumption of age 95 single-life mortality. As shown in Table 1, shortening the income horizon resulted in 769 possible starting dates. Running the historical simulations resulted in 39 (5%) cases of account depletion; each case occurred for retirement starting dates before or during the Great Depression. Increasing the starting age to 70 and the equity allocation to 60%, results in 54 (7%) depletions when using the systematic withdrawal strategy; all of the depletions had starting dates before July 1930.

Table 2 shows that over the remaining 721 periods for the base case portfolio, the median estate balance of the systematic withdrawal strategy was at least double that of the GLWB strategy. In 17 cases, the GLWB purchaser left no estate while the pure withdrawal strategy still had assets, averaging about $9,000 in residual estate assets.

Sensitivity analysis shows it would have taken withdrawal rates of at least 6.5%, or equity allocations of 70% or more, for the GLWB product to have provided substantial protection over 20 or more years, relative to a systematic withdrawal strategy. If these combinations of withdrawal rates and equity allocations are available in a GLWB product, then it would be a good alternative to the comparable systematic withdrawal strategy. However, given that GLWB withdrawal rates are in the 4.5% to 5.5% and equity allocations are limited to the 50% to 60% ranges, it seems unlikely that any GLWB product would have provided substantial insurance value compared to a systematic withdrawal strategy. Overall, the historical results are mixed. A GLWB strategy worked well for risk-averse retirees with low estate planning needs. A systematic withdrawal strategy would be favored by retirees willing to bear some income risk and desiring greater asset liquidity and estate potential.

## Comparison of GLWB and variable annuity strategies

An alternative strategy to a GLWB or systematic withdrawal is to annuitize a portion of retirement wealth. A fixed annuity provides lifetime income protection with an automatic income floor, but does not offer the ability to receive upside investment returns. A pure Variable Immediate Annuity (VIA) provides the potential of upside investment returns and lifetime income, but does not offer an income floor. While a combination of the two strategies could provide an income floor and potential for upside income gain, in this section

18. The joint life expectancy of a couple ages 65 is approximately 24 years.

we focus on whether GLWB protections had value relative to a partial VIA strategy, specifically examining the historical performance of a 50%/50% equity/bond portfolio for the VIA compared to a standard GLWB product.

Given multiple objectives, there are trade-offs between VIA and GLWB strategies. A VIA strategy will typically generate higher initial income compared to a 5% GLWB contract. But while the VIA provides lifetime income protection, it does not provide income floor protection like the GLWB. Another limitation of the VIA is that if retirement wealth is fully annuitized, then there is a loss of liquidity and no possibility of residual estate assets. For this reason, we compare a GLWB strategy to a partial annuitization strategy that combines a VIA with supplemental systematic withdrawals. The partial VIA strategy, where supplemental income is utilized only if it is needed to provide parity of annual nominal income with the GLWB, provides both lifetime income, liquidity in case of emergencies, and the possibility of leaving an estate. In summary, the partial VIA strategy offers features similar to the GLWB protections, with the primary differences being sources of income and underlying cost of protection.

Consider an age 65 retiree who purchases a single-life VIA with a 20-year income guarantee provision. Under current actuarial and interest rate assumptions, the retiree can expect an initial payment of $6,263 per $100,000 settled.[19] The payment would be higher without the 20-year guarantee, but we include it to address a major concern of annuity purchase – the potential loss of most of the settled annuity assets in the event of an early death.[20] The 20-year guarantee protects the estate and provides peace-of-mind to the retiree by effectively providing a declining face-value term life insurance policy. If the retiree dies at any time during the first 20 years, then the estate receives the present value of the remaining payments of the 20-year guarantee.

The use of a partial VIA strategy addresses another major concern – the loss of asset liquidity in case of short-term unexpected need. For simplicity, we assume the retiree annuitized *half* the initial $100,000 resulting in an initial annuity payment of $3,132. Because this payment is lower than the 5% GLWB, we assume the retiree also adopted a supplemental systematic withdrawal strategy from the remaining (non-annuitized) balance that generates sufficient initial income for the combined payments to equal the $5,000 GLWB payment. For every subsequent year, we calculate the new GLWB payment, new VIA annuity payment, and if the VIA payment is smaller than the GLWB, the supplemental systematic withdrawal payment required to bring total income to parity with the GLWB. We then calculate the size of the remaining asset balance for each strategy.

There are important differences in how the two strategies generate changes to annual income. A first-year GLWB payment will increase *only if* the first year net portfolio return (i.e., after all fees except the GLWB fee) is greater than 6.26%. If the return is lower than this threshold the first year, then the threshold GLWB net return required to increase income in each subsequent year continues to rise. Consider the example of a retiree with $100,000 in a GLWB product and an initial payment of $5,000. The new balance is $95,000. If the underlying portfolio return, net of administrative fees, is 6.25%, then after taking the 100 basis point GLWB protection fee, the relevant net return is only 5.25%. Applying that return to the balance of $95,000, the balance will increase to $99,988 and the payment will remain at $5,000. Only if the first-year return is greater than 6.26% will the next year's income be greater than $5,000.

For each year that the net return is insufficient to increase the nominal GLWB payment, then the portfolio return required to increase next year's income rises. For example, suppose the first year GLWB return was 6%, which after the GLWB fee is only 5%, the account balance at year end will be $99,750. Given the second year withdrawal of $5,000, the account will now have to earn over 6.53% in year 2 for the GLWB payment to increase above the $5,000 minimum.

By contrast, a VIA uses a 4% Assumed Interest Rate (AIR) and the payment will increase as long as the net portfolio return is greater than 4%. So while a 6.25% net return will keep the GLWB payment at $5,000, the annuity payment will increase by over 2% from $3,132 to $3,199. Even if portfolio returns are consistently in the 4% to 6% range, the VIA annuity payment will increase over time (while the GLWB payment remains constant), resulting in smaller supplemental systematic withdrawals from the remaining balance and greater asset liquidity and residual estate potential. Importantly, if returns are strong and consistently greater than 6%, the VIA payment will still increase relative to the GLWB payment

19. The current settlement parameters include a 4% AIR.

20. That is, a death at any age before average remaining life expectancy at settlement.

Our analysis shows that for some of the simulated historical runs, the VIA payment alone eventually exceeded the GLWB payment, despite beginning at a substantially lower income base. For simplicity, and to avoid discussing estate tax strategies, we assume any VIA payment in excess of the GLWB payment was consumed by the retiree and not reinvested. Alternatively, if we had assumed the excess income was saved, then the estate values for the partial annuity strategy would be substantially larger than what we report. Of course in an asset market environment with low or negative portfolio returns, the VIA payment will be reduced, and will require larger systematic withdrawals, resulting in less liquidity and a smaller estate.

## GLWB versus partial VIA strategy: simulated historical results

We begin the analysis by examining how the partial VIA strategy would have performed relative to the GLWB strategy for a single retiree over 709 30-year periods. For comparison with the systematic withdrawal strategy, we first examine the same three benchmark periods of a strong, weak, and worst starting dates. Exhibit 4 (page 18) and Exhibit 5 (page 19) use 1982 and 1965, respectively, as the starting points for benchmarking the strong and weak starting dates, while Exhibit 6 (page 20) uses September 1929, which was the worst starting date.

The 1982 results (Exhibit 4) indicate the partial VIA strategy would have generated as much annual income as the GLWB strategy and never ran out of assets. Figure 1 shows this strategy would have resulted in a substantially larger late-life estate when compared to the GLWB strategy. Of the three strategies considered, the partial VIA strategy would have resulted in the largest estate in the last six years of the period. However, the systematic withdrawal strategy provided greater liquidity and the largest estate for the first 20 years.

Figure 3 (page 23) shows that, over the first 20 years, the residual estate from using the partial VIA strategy was composed of two parts—the supplemental asset value and the present value of the partial annuity guarantee provision. The combined parts provided approximately the same annual estate value as the GLWB strategy in each of the first 10 years, with a progressively larger estate thereafter. This occurred because the income draw on supplemental asset was low and falling. Figure 4 shows the weights of the two income components. In the first 10 years, the supplemental asset contributed an average of 30% to annual income. Over the last 20 years, the supplemental asset contributed only about 15% to annual income. Both strategies resulted in substantial real income gains due the optimal starting period.

Exhibit 5 shows the results of a retiree using either the partial VIA or GLWB strategy given the bad starting date of 1965. Two aspects stand out. The partial VIA strategy generated at least as much income as the GLWB over the entire period, and more income over the last ten years. This has important consequences for real income – which rose over those years for the partial VIA strategy but not the GLWB strategy. Importantly, these real income gains did not occur at the cost of lost estate value. The partial VIA strategy generated more income and, as shown in Figure 2, an estate value that was about 2.4 times greater than the GLWB estate at the end of the 30-year period.

Figure 5 (page 24) shows that the two components of the partial VIA estate provided approximately the same value as the GLWB over the first 15 years and then grew more rapidly over the next 15 years. Figure 6 shows the reason is that, beginning in the 21st year, the VIA component alone produced more income than the GLWB. This occurs because the 4% AIR allowed annuity income to grow much faster than the GLWB income. Because the remaining supplemental asset balance is not needed to provide income, this component provided more liquidity and the opportunity for faster growth of the estate.

Exhibit 6 shows results from the worst starting date scenario of 1929. Given our assumption of a 50%/50% equity/bond portfolio, the partial VIA and GLWB strategy both performed well in providing lifetime income protection with a $5,000 income floor, Figures 7 and 8 (page 25) show, however, that the mixture of the VIA with the supplemental asset account performed better at providing liquidity and an estate, especially in the last 10 years.

Exhibit 6b (page 21) shows the results of our sensitivity analysis for the worst case scenario assuming a 60%/40% equity/bond allocation. The results indicate that if a retiree had held more equity risk, then the GLWB strategy performed better at providing an income floor in years 15 through 26. But even in this example the annuity alone ended up producing more annual income in the final four years of the 30-year period. As with the previous case, this occurred because the 4% AIR provided the opportunity for greater income growth relative to the 5% GLWB. The partial VIA

strategy performed slightly better at providing liquidity and the possibility of an estate, but neither strategy provided an estate at the end of 30 years because of the greater equity exposure in a prolonged down market. As a result, the GLWB assets were exhausted after 17 years and the partial VIA assets after 19 years.

## GLWB versus partial VIA strategies: sensitivity analysis

Table 1 shows the results of comparing the GLWB and partial VIA strategies for all 30- year periods since 1926. Assuming a 50%/50% equity/bond portfolio and a 5% GLWB withdrawal rate, we find *there were no 30-year periods when the partial VIA strategy would have generated less income than the GLWB.* For couples using a 4.5% GLWB withdrawal rate, we did not find *a single example where the partial VIA strategy produced less income than the GLWB over any 35-year period.* Older retirees using a 5.5% GLWB withdrawal rate experienced 26 (3.4%) periods where the supplemental asset balance of the partial VIA strategy was depleted before the end of 25 years.

Examining the sensitivity of increasing investment risk by using 60%/40% equity/bond portfolio weights resulted in a small number of simulations where the partial VIA strategy underperformed relative to the GLWB. Assuming an age 65 single retiree and 5% GLWB withdrawal rate, the additional equity risk resulted in the partial VIA strategy running out of supplemental assets in 46 (6.5%) 30-year periods. Assuming later retirement and a 5.5% GLWB withdrawal rate, then the partial VIA strategy exhausted supplemental assets in 54 (7.0%) 25- year periods. Interestingly, the joint-life age 65 couple with GLWB income rate of 4.5% only resulted in 11 (1.7%) simulations where the partial VIA strategy ran out of supplemental assets before the end of the 35-year period.

The sensitivity results show that withdrawal rate, combined with greater equity exposure, could impact a retiree's well-being if using a partial VIA strategy. We note, however, two important caveats. First, all cases of partial VIA strategy failures occurred either before or after the Great Depression. Second, even in these worst case simulations the VIA component of the partial annuity strategy continued to produce annual income, although not necessarily as much as the income provided by the GLWB protection.

In many simulations, the partial VIA strategy provided less liquidity (or left a smaller estate) in the first 10 years. However, the difference in the potential estate was never large and the stronger the starting point returns, the shorter the estate "break-even" point. Once the break-even point was reached, the partial VIA strategy always left a larger estate, and in some cases yielded more annual income (and better inflation protection). For all simulated runs over the last eight decades (1935 to 2015), if the 65-year old retiree lived at least 10 years, then the partial VIA strategy produced the same or more annual income, provided better inflation protection, provided greater liquidity, and provided a larger estate relative to the GLWB strategy. Overall, the historical results favor the partial VIA strategy. While the GLWB strategy provided the best income floor protection, it was at a substantial cost to other objectives. We conclude that the partial VIA strategy would be favored by retirees willing to bear minimal income risk and desiring better inflation protection, greater asset liquidity and estate potential.

## Conclusion

Many retirement income products attempt to satisfy multiple and sometimes conflicting objectives because retirees desire products that provide retirement security, inflation protection, liquidity, asset growth and the potential for an estate. In this paper, we analyzed how GLWB, systematic withdrawal, and partial VIA strategies performed in meeting these multiple objectives. The partial VIA and GLWB strategies provided better "peace of mind" retirement income products, while the systematic withdrawal strategy offered the greatest flexibility in managing retirement assets. All three strategies come at a cost, either in terms of loss of liquidity (annuities), retirement income security (systematic withdrawals), or fees (GLWB). Our objective was to examine how these costs impact the ability of the alternative strategies to achieve various retirement income objectives.

Using historical returns and simulated portfolio allocations, we find that, for the overwhelming majority of possible income stating dates, the three strategies generated equivalent income floor protection. The GLWB strategy performed best at providing an income floor and the systematic withdrawal strategy the worst. However, we find not a single income starting date in the past 85 years when the GLWB strategy provided better protection compared to either a systematic withdrawal or partial VIA strategy.

This bears repeating, *over the past 85 years, the probability measure of needing GLWB protection was zero;* that is, the alternative strategies provided as much income protection and performed better at meeting other objectives, all with very minimal risks.[21]

As such, we have difficulty justifying the typical cost of the GLWB product, as the insurance feature was rarely utilized over the entire sample period and not once since July 1930. For the typical GLWB to have generated value compared to alternative strategies would have required the combination of a massive systemic shock (e.g., the Great Depression) *and* a retiree with substantially longer than average life expectancy. Alternatively, sensitivity analysis indicated that if the GLWB fees were significantly lower (or subject to a lifetime maximum), then the performance of the GLWB strategy would improve relative to both the systematic withdrawal and partial VIA strategies.

We conclude that the typical GLWB fee structure leads to sub-optimal outcomes relative to alternative strategies. Our analysis demonstrated that, with the exception of the combination of poor starting date, multi-year poor investment returns, and a long-lived retiree, the systematic withdrawal and partial VIA strategies produced at least the same level of nominal income, and increasingly greater liquidity and estate relative to the GLWB strategy.[22] The systematic withdrawal strategy always provided greater liquidity and a larger estate, regardless of the longevity of the retiree. And the partial VIA strategy performed better in providing inflation protection. These results were due in large part to the additional GLWB fees charged for the income guarantee. These fees were especially punitive in simulations with strong market returns because the chance of needing the income protecting was very small but the fee continued to rise with market returns.

Despite the historical evidence, there may still be a good reason to purchase a GLWB; it can protect a retiree from poor market timing. A major assumption we made in the analysis was that the retiree remained allocated 50%/50% in equity/bonds throughout the withdrawal period. However, if a retiree responds irrationally to poor market returns and sells assets *after* a major downturn, the withdrawal account could do very poorly and exhaust assets faster than any of our simulations indicated.

The GLWB protects the retiree against this market timing behavioral bias by taking the investment decision out of the hands of the retiree. For example, a recent retiree using an alternative strategy, and who would have transferred assets from equity to bonds in late 2008 or early 2009, may have been better served by choosing the GLWB protection. However, this type of protection is not income protection per se; rather, it protects a retiree from making ill-informed, behaviorally-biased investment decisions. And the partial VIA strategy can also be designed to protect the retiree from poor decisions. In this sense, both the GLWB and partial VIA are better than a systematic withdrawal strategy that leaves all risk with the retiree. This is particularly true for long-lived retirees who may suffer from cognitive decline.

Overall, we conclude that the partial VIA strategy would have performed best for a retiree who desired to have lifetime income with inflation protection, maintain some liquidity and have the potential for an estate. Over the past 80 years, the partial VIA strategy would have resulted in the same (or higher) income protection, did a better job at providing real income gains, provided increasing greater liquidity and a larger potential estate. The partial VIA strategy did have a small risk of a relatively smaller estate value upon early death relative to both the GLWB and the systematic withdrawal strategies. And in the rare case of a catastrophic systemic shock (e.g., the Great Depression), the partial VIA produced a smaller income for a number of years than would have been provided by the GLWB. We conclude that the partial VIA strategy provided greater economic and psychological value, compared to both the systematic withdrawal and GLWB strategies.

21. There are other aspects to this comparison we have not yet covered; for example, the value of purchasing a GLWB a few years prior to retirement, Monte Carlo analysis on potential future return series, and results assuming a one-time post-retirement emergency need. These will be covered in future papers.

22. Alternatively, the systematic withdrawal strategy could result in the same estate but provide substantially larger annual nominal and real income payments. We plan on considering this alternative strategy in future research.

The tables below summarize the results of the runs. Table 1 shows the number of times the retiree outlived assets, noting that in the case of partial annuitization, income will continue even after the assets have been depleted. Table 2 shows the median estate value at the end of the period analyzed under the three possible income methods.

**Table 1. Alternative strategy failure rates under varying assumptions**

| Withdrawal Rate | Single or Couple | Years | Simulation Runs | Equity Percent | # of Failures: Withdrawal | # of Failures: Partial VIA |
|---|---|---|---|---|---|---|
| 5.0% | Single | 30 | 709 | 50% | 28 | 0 |
| 4.5% | Couple | 35 | 649 | 50% | 0 | 0 |
| 5.5% | Single | 25 | 769 | 50% | 39 | 26 |
| 5.0% | Single | 30 | 709 | 60% | 54 | 46 |
| 4.5% | Couple | 35 | 649 | 60% | 44 | 11 |
| 5.5% | Single | 25 | 769 | 60% | 41 | 54 |

Source: Author calculations

**Table 2. Simulated median estate values under varying assumptions**

| Withdrawal Rate | Single or Couple | Years | Equity Percent | GLWB Median balance | Withdrawal Median balance | Partial VIA Median balance |
|---|---|---|---|---|---|---|
| 5.0% | Single | 30 | 50% | $99,500 | $216,800 | $253,800 |
| 4.5% | Couple | 35 | 50% | $156,600 | $372,000 | $441,000 |
| 5.5% | Single | 25 | 50% | $85,700 | $153,100 | $170,000 |
| 5.0% | Single | 30 | 60% | $128,000 | $270,100 | $308,100 |
| 4.5% | Couple | 35 | 60% | $197,800 | $455,000 | $528,500 |
| 5.5% | Single | 25 | 60% | $113,200 | $201,900 | $215,900 |

Source: Author calculations

## Exhibit 1: GLWB versus systematic withdrawal, strong starting date returns

| | | GLWB | | Systematic Withdrawal | | |
|---|---|---|---|---|---|---|
| Year | Gross Return | Nominal Income | Ending Balance | Nominal Income | Ending Balance | Real Income (1982 $'s) |
| 1982 | 31.2% | $5,000 | $123,265 | $5,000 | $124,499 | $5,000 |
| 1983 | 12.1% | $6,163 | $129,931 | $6,163 | $132,626 | $5,974 |
| 1984 | 11.3% | $6,763 | $135,140 | $6,763 | $139,501 | $6,281 |
| 1985 | 31.6% | $6,763 | $167,515 | $6,763 | $174,907 | $6,067 |
| 1986 | 21.1% | $8,376 | $191,218 | $8,376 | $202,058 | $7,371 |
| 1987 | 3.2% | $9,836 | $185,225 | $9,836 | $198,259 | $8,357 |
| 1988 | 13.4% | $10,521 | $196,139 | $10,521 | $212,855 | $8,587 |
| 1989 | 24.6% | $10,521 | $229,429 | $10,521 | $252,478 | $8,194 |
| 1990 | 1.7% | $11,471 | $218,157 | $11,471 | $243,735 | $8,475 |
| 1991 | 25.2% | $11,471 | $256,382 | $11,471 | $290,846 | $8,132 |
| 1992 | 8.1% | $12,819 | $259,820 | $12,819 | $299,583 | $8,820 |
| 1993 | 13.4% | $12,991 | $276,901 | $12,991 | $324,606 | $8,680 |
| 1994 | -2.9% | $14,111 | $251,034 | $14,111 | $299,733 | $9,190 |
| 1995 | 33.9% | $14,167 | $315,271 | $14,167 | $383,390 | $8,975 |
| 1996 | 11.0% | $15,764 | $328,118 | $15,764 | $406,762 | $9,701 |
| 1997 | 24.1% | $16,853 | $382,641 | $16,853 | $483,688 | $10,135 |
| 1998 | 21.1% | $19,132 | $435,943 | $19,132 | $562,265 | $11,330 |
| 1999 | 5.5% | $21,797 | $430,913 | $21,797 | $568,031 | $12,631 |
| 2000 | 4.3% | $22,267 | $420,898 | $22,267 | $567,678 | $12,483 |
| 2001 | -2.7% | $22,308 | $381,560 | $22,308 | $527,669 | $12,164 |
| 2002 | -3.3% | $22,308 | $341,776 | $22,308 | $486,051 | $11,973 |
| 2003 | 15.4% | $22,308 | $364,633 | $22,308 | $534,163 | $11,704 |
| 2004 | 9.9% | $22,308 | $371,367 | $22,308 | $560,675 | $11,400 |
| 2005 | 6.3% | $22,308 | $366,234 | $22,308 | $570,359 | $11,028 |
| 2006 | 8.7% | $22,308 | $368,999 | $22,308 | $593,799 | $10,684 |
| 2007 | 6.8% | $22,308 | $365,810 | $22,308 | $608,730 | $10,386 |
| 2008 | -11.7% | $22,308 | $297,425 | $22,308 | $514,145 | $10,004 |
| 2009 | 7.5% | $22,308 | $290,802 | $22,308 | $525,776 | $10,036 |
| 2010 | 14.0% | $22,308 | $302,893 | $22,308 | $572,704 | $9,875 |
| 2011 | 13.8% | $22,308 | $316,078 | $22,308 | $625,256 | $9,574 |

Source: Author calculations

1. Assumptions:

| | | | |
|---|---|---|---|
| Beginning Balance | $100,000 | Retirement Date | January, 1982 |
| Equity Allocation | 50.0% | Age at Retirement | 65 |
| Administration Fee | 0.4% | GLWB Withdrawal Rate | 5.0% |
| GLWB Fees | 1.0% | | |

2. GLWB payments reset annually and are equal to the greater of: (a) the prior year's payment; (b) 5% of the highest end of month balance during the prior year.

3. Systematic withdrawal payment is set to equal the GLWB payment.

## Exhibit 2: GLWB versus systematic withdrawal, weak starting date returns

| | | GLWB | | Systematic Withdrawal | | |
|---|---|---|---|---|---|---|
| Year | Gross Return | Nominal Income | Ending Balance | Nominal Income | Ending Balance | Real Income (1965 $'s) |
| 1965 | 6.3% | $5,000 | $99,758 | $5,000 | $100,775 | $5,000 |
| 1966 | -3.8% | $5,077 | $89,594 | $5,077 | $91,492 | $4,930 |
| 1967 | 7.1% | $5,077 | $89,505 | $5,077 | $92,444 | $4,796 |
| 1968 | 6.0% | $5,077 | $88,432 | $5,077 | $92,440 | $4,601 |
| 1969 | -7.0% | $5,077 | $76,284 | $5,077 | $80,786 | $4,364 |
| 1970 | 9.2% | $5,077 | $76,551 | $5,077 | $82,238 | $4,121 |
| 1971 | 13.7% | $5,077 | $80,482 | $5,077 | $87,745 | $3,954 |
| 1972 | 12.4% | $5,077 | $83,856 | $5,077 | $92,846 | $3,829 |
| 1973 | -7.5% | $5,077 | $71,609 | $5,077 | $80,636 | $3,603 |
| 1974 | -12.8% | $5,077 | $56,731 | $5,077 | $65,166 | $3,246 |
| 1975 | 23.7% | $5,077 | $63,784 | $5,077 | $74,830 | $2,974 |
| 1976 | 20.8% | $5,077 | $70,426 | $5,077 | $84,432 | $2,812 |
| 1977 | -3.6% | $5,077 | $61,921 | $5,077 | $76,018 | $2,641 |
| 1978 | 3.1% | $5,077 | $57,798 | $5,077 | $72,868 | $2,453 |
| 1979 | 7.8% | $5,077 | $56,291 | $5,077 | $73,056 | $2,205 |
| 1980 | 14.0% | $5,077 | $57,742 | $5,077 | $77,374 | $1,943 |
| 1981 | -1.8% | $5,077 | $50,817 | $5,077 | $70,560 | $1,760 |
| 1982 | 31.2% | $5,077 | $59,514 | $5,077 | $85,927 | $1,658 |
| 1983 | 12.1% | $5,077 | $60,564 | $5,077 | $90,682 | $1,607 |
| 1984 | 11.3% | $5,077 | $60,878 | $5,077 | $94,883 | $1,540 |
| 1985 | 31.6% | $5,077 | $73,083 | $5,077 | $118,403 | $1,488 |
| 1986 | 21.1% | $5,077 | $81,918 | $5,077 | $137,414 | $1,459 |
| 1987 | 3.2% | $5,077 | $78,532 | $5,077 | $136,369 | $1,409 |
| 1988 | 13.4% | $5,077 | $82,512 | $5,077 | $148,689 | $1,353 |
| 1989 | 24.6% | $5,077 | $95,799 | $5,077 | $178,887 | $1,291 |
| 1990 | 1.7% | $5,077 | $90,796 | $5,077 | $175,866 | $1,225 |
| 1991 | 25.2% | $5,077 | $106,364 | $5,077 | $213,486 | $1,176 |
| 1992 | 8.1% | $5,318 | $107,790 | $5,318 | $224,259 | $1,195 |
| 1993 | 13.4% | $5,390 | $114,877 | $5,390 | $247,556 | $1,176 |
| 1994 | -2.9% | $5,854 | $104,145 | $5,854 | $233,474 | $1,245 |

Source: Author calculations

1. Assumptions:

| | | | |
|---|---|---|---|
| Beginning Balance | $100,000 | Retirement Date | January, 1965 |
| Equity Allocation | 50.0% | Age at Retirement | 65 |
| Administration Fee | 0.4% | GLWB Withdrawal Rate | 5.0% |
| GLWB Fees | 1.0% | | |

2. GLWB payments reset annually and are equal to the greater of: (a) the prior year's payment; (b) 5% of the highest end of month balance during the prior year.

3. Systematic withdrawal payment is set to equal the GLWB payment.

## Exhibit 3: GLWB versus systematic withdrawal, worst starting date returns

| | | GLWB | | Systematic Withdrawal | | |
|---|---|---|---|---|---|---|
| Year | Gross Return | Nominal Income | Ending Balance | Nominal Income | Ending Balance | Real Income (1929 $'s) |
| 1929 | -10.6% | $5,000 | $83,269 | $5,000 | $84,135 | $5,000 |
| 1930 | -14.0% | $5,000 | $65,850 | $5,000 | $67,283 | $5,120 |
| 1931 | -12.8% | $5,000 | $50,831 | $5,000 | $52,623 | $5,625 |
| 1932 | 27.2% | $5,000 | $57,427 | $5,000 | $60,290 | $6,241 |
| 1933 | -3.2% | $5,000 | $49,871 | $5,000 | $53,154 | $6,577 |
| 1934 | 18.3% | $5,000 | $52,567 | $5,000 | $56,981 | $6,381 |
| 1935 | 25.9% | $5,000 | $59,711 | $5,000 | $65,857 | $6,241 |
| 1936 | 3.2% | $5,000 | $55,828 | $5,000 | $62,722 | $6,151 |
| 1937 | -5.6% | $5,000 | $46,591 | $5,000 | $53,569 | $5,938 |
| 1938 | 1.6% | $5,000 | $41,777 | $5,000 | $49,279 | $6,064 |
| 1939 | 3.7% | $5,000 | $37,826 | $5,000 | $45,978 | $6,151 |
| 1940 | 5.3% | $5,000 | $34,108 | $5,000 | $43,020 | $6,107 |
| 1941 | -4.0% | $5,000 | $27,234 | $5,000 | $36,055 | $5,816 |
| 1942 | 22.1% | $5,000 | $27,396 | $5,000 | $38,418 | $5,245 |
| 1943 | 8.5% | $5,000 | $24,054 | $5,000 | $36,225 | $4,942 |
| 1944 | 16.1% | $5,000 | $22,104 | $5,000 | $36,418 | $4,858 |
| 1945 | 7.6% | $5,000 | $18,565 | $5,000 | $34,113 | $4,750 |
| 1946 | 0.1% | $5,000 | $13,218 | $5,000 | $28,873 | $4,385 |
| 1947 | 4.0% | $5,000 | $8,415 | $5,000 | $24,743 | $3,829 |
| 1948 | 4.9% | $5,000 | $3,504 | $5,000 | $20,619 | $3,556 |
| 1949 | 15.3% | $5,000 | $0 | $5,000 | $18,331 | $3,591 |
| 1950 | 16.0% | $5,000 | $0 | $5,000 | $15,779 | $3,553 |
| 1951 | 7.0% | $5,000 | $0 | $5,000 | $11,581 | $3,292 |
| 1952 | -1.7% | $5,000 | $0 | $5,000 | $6,467 | $3,218 |
| 1953 | 23.1% | $5,000 | $0 | $5,000 | $2,402 | $3,194 |
| 1954 | 22.1% | $5,000 | $0 | $2,552 | $0 | $3,183 |
| 1955 | 6.6% | $5,000 | $0 | $0 | $0 | $3,191 |
| 1956 | -2.4% | $5,000 | $0 | $0 | $0 | $3,144 |
| 1957 | 7.5% | $5,000 | $0 | $0 | $0 | $3,041 |
| 1958 | 13.1% | $5,000 | $0 | $0 | $0 | $2,960 |

Source: Author calculations

1. Assumptions:

| | | | |
|---|---|---|---|
| Beginning Balance | $100,000 | Retirement Date | January, 1929 |
| Equity Allocation | 50.0% | Age at Retirement | 65 |
| Administration Fee | 0.4% | GLWB Withdrawal Rate | 5.0% |
| GLWB Fees | 1.0% | | |

2. GLWB payments reset annually and are equal to the greater of: (a) the prior year's payment; (b) 5% of the highest end of month balance during the prior year.

3. Systematic withdrawal payment is set to equal the GLWB payment.

## Exhibit 3b: GLWB versus systematic withdrawal, worst starting date returns

| | | GLWB | | Systematic Withdrawal | | |
|---|---|---|---|---|---|---|
| Year | Gross Return | Nominal Income | Ending Balance | Nominal Income | Ending Balance | Real Income (1929 $'s) |
| 1929 | -14.5% | $5,000 | $79,446 | $5,000 | $80,276 | $5,000 |
| 1930 | -17.6% | $5,000 | $59,852 | $5,000 | $61,166 | $5,120 |
| 1931 | -16.8% | $5,000 | $43,253 | $5,000 | $44,816 | $5,625 |
| 1932 | 30.3% | $5,000 | $49,012 | $5,000 | $51,553 | $6,241 |
| 1933 | -5.3% | $5,000 | $40,907 | $5,000 | $43,738 | $6,577 |
| 1934 | 20.6% | $5,000 | $42,932 | $5,000 | $46,782 | $6,381 |
| 1935 | 30.0% | $5,000 | $49,410 | $5,000 | $54,905 | $6,241 |
| 1936 | 3.6% | $5,000 | $45,570 | $5,000 | $51,716 | $6,151 |
| 1937 | -8.3% | $5,000 | $35,782 | $5,000 | $41,783 | $5,938 |
| 1938 | 0.8% | $5,000 | $30,690 | $5,000 | $37,044 | $6,064 |
| 1939 | 3.3% | $5,000 | $26,377 | $5,000 | $33,199 | $6,151 |
| 1940 | 5.2% | $5,000 | $22,175 | $5,000 | $29,567 | $6,107 |
| 1941 | -5.2% | $5,000 | $15,669 | $5,000 | $22,831 | $5,816 |
| 1942 | 26.4% | $5,000 | $14,047 | $5,000 | $23,223 | $5,245 |
| 1943 | 9.7% | $5,000 | $9,901 | $5,000 | $20,049 | $4,942 |
| 1944 | 18.2% | $5,000 | $6,043 | $5,000 | $18,071 | $4,858 |
| 1945 | 8.5% | $5,000 | $1,582 | $5,000 | $14,612 | $4,750 |
| 1946 | -0.5% | $5,000 | $0 | $5,000 | $9,336 | $4,385 |
| 1947 | 5.3% | $5,000 | $0 | $5,000 | $4,579 | $3,829 |
| 1948 | 4.4% | $5,000 | $0 | $4,538 | $0 | $3,556 |
| 1949 | 18.2% | $5,000 | $0 | $0 | $0 | $3,591 |
| 1950 | 19.7% | $5,000 | $0 | $0 | $0 | $3,553 |
| 1951 | 8.4% | $5,000 | $0 | $0 | $0 | $3,292 |
| 1952 | -1.7% | $5,000 | $0 | $0 | $0 | $3,218 |
| 1953 | 25.4% | $5,000 | $0 | $0 | $0 | $3,194 |
| 1954 | 27.5% | $5,000 | $0 | $0 | $0 | $3,183 |
| 1955 | 8.2% | $5,000 | $0 | $0 | $0 | $3,191 |
| 1956 | -2.1% | $5,000 | $0 | $0 | $0 | $3,144 |
| 1957 | 8.0% | $5,000 | $0 | $0 | $0 | $3,041 |
| 1958 | 16.2% | $5,000 | $0 | $0 | $0 | $2,960 |

Source: Author calculations

1. Assumptions:

| | | | |
|---|---|---|---|
| Beginning Balance | $100,000 | Retirement Date | January, 1929 |
| Equity Allocation | 60.0% | Age at Retirement | 65 |
| Administration Fee | 0.4% | GLWB Withdrawal Rate | 5.0% |
| GLWB Fees | 1.0% | | |

2. GLWB payments reset annually and are equal to the greater of: (a) the prior year's payment; (b) 5% of the highest end of month balance during the prior year.

3. Systematic withdrawal payment is set to equal the GLWB payment.

## Exhibit 4: GLWB versus partial annuity, strong starting date returns

| | | GLWB | | Partial Annuity | | |
|---|---|---|---|---|---|---|
| Year | Gross Return | Nominal Income | Ending Balance | Nominal Income | Ending Balance | Real Income (1982 $'s) |
| 1982 | 31.2% | $5,000 | $123,265 | $5,000 | $115,971 | $5,000 |
| 1983 | 12.1% | $6,163 | $129,931 | $6,163 | $123,103 | $5,974 |
| 1984 | 11.3% | $6,763 | $135,140 | $6,763 | $128,948 | $6,281 |
| 1985 | 31.6% | $6,763 | $167,515 | $6,763 | $161,073 | $6,067 |
| 1986 | 21.1% | $8,376 | $191,218 | $8,376 | $185,372 | $7,371 |
| 1987 | 3.2% | $9,836 | $185,225 | $9,836 | $181,111 | $8,357 |
| 1988 | 13.4% | $10,521 | $196,139 | $10,521 | $193,484 | $8,587 |
| 1989 | 24.6% | $10,521 | $229,429 | $10,521 | $228,440 | $8,194 |
| 1990 | 1.7% | $11,471 | $218,157 | $11,471 | $219,393 | $8,475 |
| 1991 | 25.2% | $11,471 | $256,382 | $11,471 | $260,500 | $8,132 |
| 1992 | 8.1% | $12,819 | $259,820 | $12,819 | $266,900 | $8,820 |
| 1993 | 13.4% | $12,991 | $276,901 | $12,991 | $287,701 | $8,680 |
| 1994 | -2.9% | $14,111 | $251,034 | $14,111 | $264,058 | $9,190 |
| 1995 | 33.9% | $14,167 | $315,271 | $14,167 | $335,797 | $8,975 |
| 1996 | 11.0% | $15,764 | $328,118 | $15,764 | $354,145 | $9,701 |
| 1997 | 24.1% | $16,853 | $382,641 | $16,853 | $418,655 | $10,135 |
| 1998 | 21.1% | $19,132 | $435,943 | $19,132 | $483,792 | $11,330 |
| 1999 | 5.5% | $21,797 | $430,913 | $21,797 | $485,584 | $12,631 |
| 2000 | 4.3% | $22,267 | $420,898 | $22,267 | $482,009 | $12,483 |
| 2001 | -2.7% | $22,308 | $381,560 | $22,308 | $444,687 | $12,164 |
| 2002 | -3.3% | $22,308 | $341,776 | $22,308 | $423,315 | $11,973 |
| 2003 | 15.4% | $22,308 | $364,633 | $22,308 | $481,064 | $11,704 |
| 2004 | 9.9% | $22,308 | $371,367 | $22,308 | $522,566 | $11,400 |
| 2005 | 6.3% | $22,308 | $366,234 | $22,308 | $550,372 | $11,028 |
| 2006 | 8.7% | $22,308 | $368,999 | $22,308 | $593,344 | $10,684 |
| 2007 | 6.8% | $22,308 | $365,810 | $22,308 | $629,921 | $10,386 |
| 2008 | -11.7% | $22,308 | $297,425 | $22,308 | $551,105 | $10,004 |
| 2009 | 7.5% | $22,308 | $290,802 | $22,308 | $584,196 | $10,036 |
| 2010 | 14.0% | $22,308 | $302,893 | $22,308 | $659,598 | $9,875 |
| 2011 | 13.8% | $22,308 | $316,078 | $22,308 | $746,229 | $9,574 |

Source: Author calculations

1. Assumptions:

| | | | |
|---|---|---|---|
| Beginning Balance | $100,000 | Retirement Date | January, 1982 |
| Equity Allocation | 50.0% | Age at Retirement | 65 |
| Administration Fee | 0.4% | GLWB Withdrawal Rate | 5.0% |
| GLWB Fees | 1.0% | | |

2. GLWB payments reset annually and are equal to the greater of: (a) the prior year's payment; (b) 5% of the highest end of month balance during the prior year.

3. Annuity payment is variable and changes monthly. If needed, supplemental withdrawals to bring total payment to parity with GLWB.

## Exhibit 5: GLWB versus partial annuity, weak starting date returns

| | | GLWB | | Partial Annuity | | Real Income (1965 $'s) | |
|---|---|---|---|---|---|---|---|
| Year | Gross Return | Nominal Income | Ending Balance | Nominal Income | Ending Balance | GLWB | Partial Annuity |
| 1965 | 6.3% | $5,000 | **$99,758** | $5,000 | $93,864 | $5,000 | $5,000 |
| 1966 | -3.8% | $5,077 | **$89,594** | $5,077 | $84,869 | $4,930 | $4,930 |
| 1967 | 7.1% | $5,077 | **$89,505** | $5,077 | $85,381 | $4,796 | $4,796 |
| 1968 | 6.0% | $5,077 | **$88,432** | $5,077 | $84,982 | $4,601 | $4,601 |
| 1969 | -7.0% | $5,077 | $76,284 | $5,077 | $73,879 | $4,364 | $4,364 |
| 1970 | 9.2% | $5,077 | $76,551 | $5,077 | $74,722 | $4,121 | $4,121 |
| 1971 | 13.7% | $5,077 | $80,482 | $5,077 | $79,232 | $3,954 | $3,954 |
| 1972 | 12.4% | $5,077 | $83,856 | $5,077 | $83,312 | $3,829 | $3,829 |
| 1973 | -7.5% | $5,077 | $71,609 | $5,077 | $71,852 | $3,603 | $3,603 |
| 1974 | -12.8% | $5,077 | $56,731 | $5,077 | $57,540 | $3,246 | $3,246 |
| 1975 | 23.7% | $5,077 | $63,784 | $5,077 | $65,433 | $2,974 | $2,974 |
| 1976 | 20.8% | $5,077 | $70,426 | $5,077 | $73,128 | $2,812 | $2,812 |
| 1977 | -3.6% | $5,077 | $61,921 | $5,077 | $65,162 | $2,641 | $2,641 |
| 1978 | 3.1% | $5,077 | $57,798 | $5,077 | $61,725 | $2,453 | $2,453 |
| 1979 | 7.8% | $5,077 | $56,291 | $5,077 | $61,091 | $2,205 | $2,205 |
| 1980 | 14.0% | $5,077 | $57,742 | $5,077 | $63,789 | $1,943 | $1,943 |
| 1981 | -1.8% | $5,077 | $50,817 | $5,077 | $57,267 | $1,760 | $1,760 |
| 1982 | 31.2% | $5,077 | $59,514 | $5,077 | $68,554 | $1,658 | $1,658 |
| 1983 | 12.1% | $5,077 | $60,564 | $5,077 | $71,283 | $1,607 | $1,607 |
| 1984 | 11.3% | $5,077 | $60,878 | $5,077 | $73,386 | $1,540 | $1,540 |
| 1985 | 31.6% | $5,077 | $73,083 | $5,243 | $96,099 | $1,488 | $1,536 |
| 1986 | 21.1% | $5,077 | $81,918 | $6,632 | $115,914 | $1,459 | $1,906 |
| 1987 | 3.2% | $5,077 | $78,532 | $7,297 | $119,119 | $1,409 | $2,025 |
| 1988 | 13.4% | $5,077 | $82,512 | $7,155 | $134,562 | $1,353 | $1,907 |
| 1989 | 24.6% | $5,077 | $95,799 | $8,160 | $166,984 | $1,291 | $2,076 |
| 1990 | 1.7% | $5,077 | $90,796 | $8,436 | $169,094 | $1,225 | $2,036 |
| 1991 | 25.2% | $5,077 | $106,364 | $9,288 | $210,799 | $1,176 | $2,151 |
| 1992 | 8.1% | $5,318 | $107,790 | $10,221 | $227,031 | $1,195 | $2,297 |
| 1993 | 13.4% | $5,390 | $114,877 | $11,236 | $256,362 | $1,176 | $2,452 |
| 1994 | -2.9% | $5,854 | $104,145 | $11,040 | $247,816 | $1,245 | $2,348 |

Source: Author calculations

1. Assumptions:

| | | | |
|---|---|---|---|
| Beginning Balance | $100,000 | Retirement Date | January, 1965 |
| Equity Allocation | 50.0% | Age at Retirement | 65 |
| Administration Fee | 0.4% | GLWB Withdrawal Rate | 5.0% |
| GLWB Fees | 1.0% | | |

2. GLWB payments reset annually and are equal to the greater of: (a) the prior year's payment; (b) 5% of the highest end of month balance during the prior year.

3. Annuity payment is variable and changes monthly. If needed, supplemental withdrawals to bring total payment to parity with GLWB.

## Exhibit 6: GLWB versus partial annuity, worst starting date returns

| | | GLWB | | Partial Annuity | | Real Income (1929 $'s) | |
|---|---|---|---|---|---|---|---|
| Year | Gross Return | Nominal Income | Ending Balance | Nominal Income | Ending Balance | GLWB | Partial Annuity |
| 1929 | -10.6% | **$5,000** | $83,269 | $5,000 | $78,325 | $5,000 | $5,000 |
| 1930 | -14.0% | **$5,000** | $65,850 | $5,000 | $62,306 | $5,120 | $5,120 |
| 1931 | -12.8% | **$5,000** | $50,831 | $5,000 | $48,301 | $5,625 | $5,625 |
| 1932 | 27.2% | **$5,000** | $57,427 | $5,000 | $54,814 | $6,241 | $6,241 |
| 1933 | -3.2% | $5,000 | $49,871 | $5,000 | $47,877 | $6,577 | $6,577 |
| 1934 | 18.3% | $5,000 | $52,567 | $5,000 | $50,761 | $6,381 | $6,381 |
| 1935 | 25.9% | $5,000 | $59,711 | $5,000 | $58,057 | $6,241 | $6,241 |
| 1936 | 3.2% | $5,000 | $55,828 | $5,000 | $54,709 | $6,151 | $6,151 |
| 1937 | -5.6% | $5,000 | $46,591 | $5,000 | $46,034 | $5,938 | $5,938 |
| 1938 | 1.6% | $5,000 | $41,777 | $5,000 | $41,654 | $6,064 | $6,064 |
| 1939 | 3.7% | $5,000 | $37,826 | $5,000 | $38,099 | $6,151 | $6,151 |
| 1940 | 5.3% | $5,000 | $34,108 | $5,000 | $34,758 | $6,107 | $6,107 |
| 1941 | -4.0% | $5,000 | $27,234 | $5,000 | $28,153 | $5,816 | $5,816 |
| 1942 | 22.1% | $5,000 | $27,396 | $5,000 | $28,807 | $5,245 | $5,245 |
| 1943 | 8.5% | $5,000 | $24,054 | $5,000 | $25,842 | $4,942 | $4,942 |
| 1944 | 16.1% | $5,000 | $22,104 | $5,000 | $24,414 | $4,858 | $4,858 |
| 1945 | 7.6% | $5,000 | $18,565 | $5,000 | $21,247 | $4,750 | $4,750 |
| 1946 | 0.1% | $5,000 | $13,218 | $5,000 | $16,048 | $4,385 | $4,385 |
| 1947 | 4.0% | $5,000 | $8,415 | $5,000 | $11,454 | $3,829 | $3,829 |
| 1948 | 4.9% | $5,000 | $3,504 | $5,000 | $6,737 | $3,556 | $3,556 |
| 1949 | 15.3% | $5,000 | $0 | $5,000 | $5,817 | $3,591 | $3,591 |
| 1950 | 16.0% | $5,000 | $0 | $5,000 | $5,134 | $3,553 | $3,553 |
| 1951 | 7.0% | $5,000 | $0 | $5,000 | $4,142 | $3,292 | $3,292 |
| 1952 | -1.7% | $5,000 | $0 | $5,000 | $2,859 | $3,218 | $3,218 |
| 1953 | 23.1% | $5,000 | $0 | $5,000 | $2,309 | $3,194 | $3,194 |
| 1954 | 22.1% | $5,000 | $0 | $5,000 | $2,366 | $3,183 | $3,183 |
| 1955 | 6.6% | $5,000 | $0 | $5,098 | $2,502 | $3,191 | $3,253 |
| 1956 | -2.4% | $5,000 | $0 | $5,005 | $2,326 | $3,144 | $3,148 |
| 1957 | 7.5% | $5,000 | $0 | $5,000 | $2,207 | $3,041 | $3,041 |
| 1958 | 13.1% | $5,000 | $0 | $5,162 | $2,470 | $2,960 | $3,056 |

Source: Author calculations

1. Assumptions:

| | | | |
|---|---|---|---|
| Beginning Balance | $100,000 | Retirement Date | January, 1929 |
| Equity Allocation | 60.0% | Age at Retirement | 65 |
| Administration Fee | 0.4% | GLWB Withdrawal Rate | 5.0% |
| GLWB Fees | 1.0% | | |

2. GLWB payments reset annually and are equal to the greater of: (a) the prior year's payment; (b) 5% of the highest end of month balance during the prior year.

3. Annuity payment is variable and changes monthly. If needed, supplemental withdrawals to bring total payment to parity with GLWB.

## Exhibit 6b: GLWB versus partial annuity, worst starting date returns

| | | GLWB | | Partial Annuity | | Real Income (1929 $'s) | |
|---|---|---|---|---|---|---|---|
| Year | Gross Return | Nominal Income | Ending Balance | Nominal Income | Ending Balance | GLWB | Partial Annuity |
| 1929 | -14.5% | $5,000 | $79,446 | $5,000 | $74,722 | $5,000 | $5,000 |
| 1930 | -17.6% | $5,000 | $59,852 | $5,000 | $56,607 | $5,120 | $5,120 |
| 1931 | -16.8% | $5,000 | $43,253 | $5,000 | $41,039 | $5,625 | $5,625 |
| 1932 | 30.3% | $5,000 | $49,012 | $5,000 | $46,649 | $6,241 | $6,241 |
| 1933 | -5.3% | $5,000 | $40,907 | $5,000 | $39,112 | $6,577 | $6,577 |
| 1934 | 20.6% | $5,000 | $42,932 | $5,000 | $41,224 | $6,381 | $6,381 |
| 1935 | 30.0% | $5,000 | $49,410 | $5,000 | $47,706 | $6,241 | $6,241 |
| 1936 | 3.6% | $5,000 | $45,570 | $5,000 | $44,290 | $6,151 | $6,151 |
| 1937 | -8.3% | $5,000 | $35,782 | $5,000 | $35,001 | $5,938 | $5,938 |
| 1938 | 0.8% | $5,000 | $30,690 | $5,000 | $30,236 | $6,064 | $6,064 |
| 1939 | 3.3% | $5,000 | $26,377 | $5,000 | $26,196 | $6,151 | $6,151 |
| 1940 | 5.2% | $5,000 | $22,175 | $5,000 | $22,231 | $6,107 | $6,107 |
| 1941 | -5.2% | $5,000 | $15,669 | $5,000 | $15,903 | $5,816 | $5,816 |
| 1942 | 26.4% | $5,000 | $14,047 | $5,000 | $14,503 | $5,245 | $5,245 |
| 1943 | 9.7% | $5,000 | $9,901 | $4,008 | $11,546 | $4,942 | $3,962 |
| 1944 | 18.2% | $5,000 | $6,043 | $2,661 | $10,654 | $4,858 | $2,585 |
| 1945 | 8.5% | $5,000 | $1,582 | $3,111 | $8,460 | $4,750 | $2,955 |
| 1946 | -0.5% | $5,000 | $0 | $2,826 | $5,478 | $4,385 | $2,478 |
| 1947 | 5.3% | $5,000 | $0 | $2,813 | $2,816 | $3,829 | $2,154 |
| 1948 | 4.4% | $5,000 | $0 | $2,799 | $0 | $3,556 | $1,991 |
| 1949 | 18.2% | $5,000 | $0 | $3,067 | $0 | $3,591 | $2,203 |
| 1950 | 19.7% | $5,000 | $0 | $3,476 | $0 | $3,553 | $2,470 |
| 1951 | 8.4% | $5,000 | $0 | $3,747 | $0 | $3,292 | $2,467 |
| 1952 | -1.7% | $5,000 | $0 | $3,835 | $0 | $3,218 | $2,468 |
| 1953 | 25.4% | $5,000 | $0 | $4,015 | $0 | $3,194 | $2,565 |
| 1954 | 27.5% | $5,000 | $0 | $4,861 | $0 | $3,183 | $3,094 |
| 1955 | 8.2% | $5,000 | $0 | $5,512 | $0 | $3,191 | $3,518 |
| 1956 | -2.1% | $5,000 | $0 | $5,351 | $0 | $3,144 | $3,365 |
| 1957 | 8.0% | $5,000 | $0 | $5,138 | $0 | $3,041 | $3,125 |
| 1958 | 16.2% | $5,000 | $0 | $5,763 | $0 | $2,960 | $3,412 |

Source: Author calculations

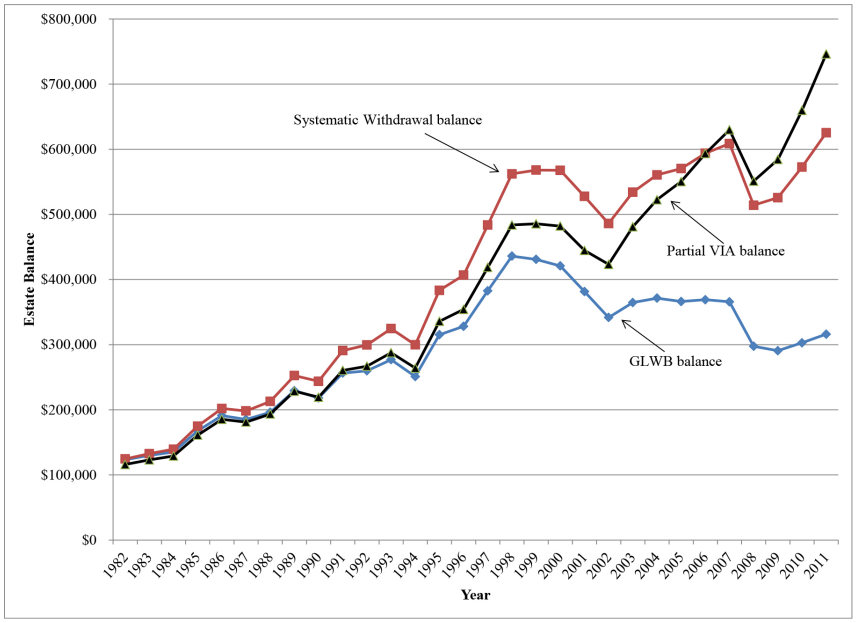
1. Assumptions:

| | | | |
|---|---|---|---|
| Beginning Balance | $100,000 | Retirement Date | January, 1929 |
| Equity Allocation | 60.0% | Age at Retirement | 65 |
| Administration Fee | 0.4% G | LWB Withdrawal Rate | 5.0% |
| GLWB Fees | 1.0% | | |

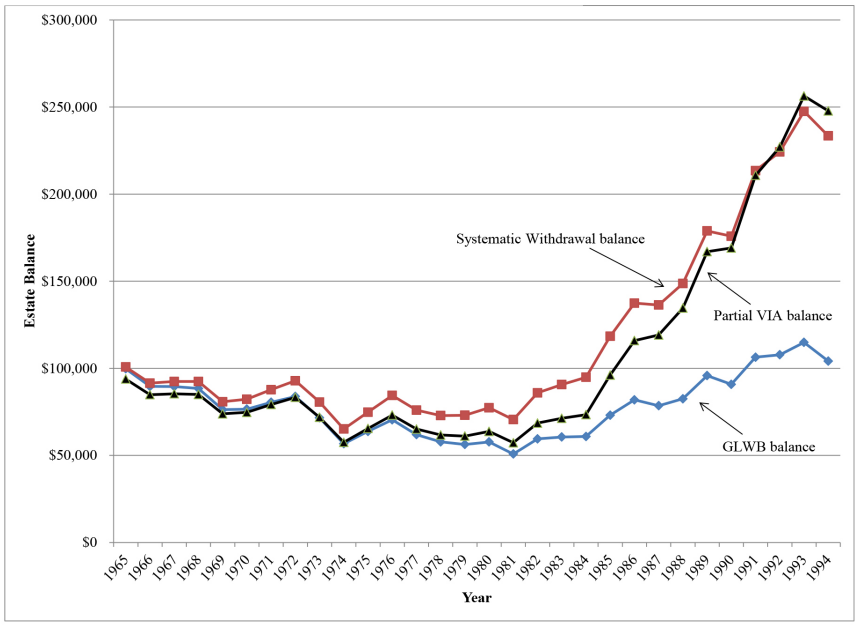
2. GLWB payments reset annually and are equal to the greater of: (a) the prior year's payment; (b) 5% of the highest end of month balance during the prior year.

3. Annuity payment is variable and changes monthly. If needed, supplemental withdrawals to bring total payment to parity with GLWB.

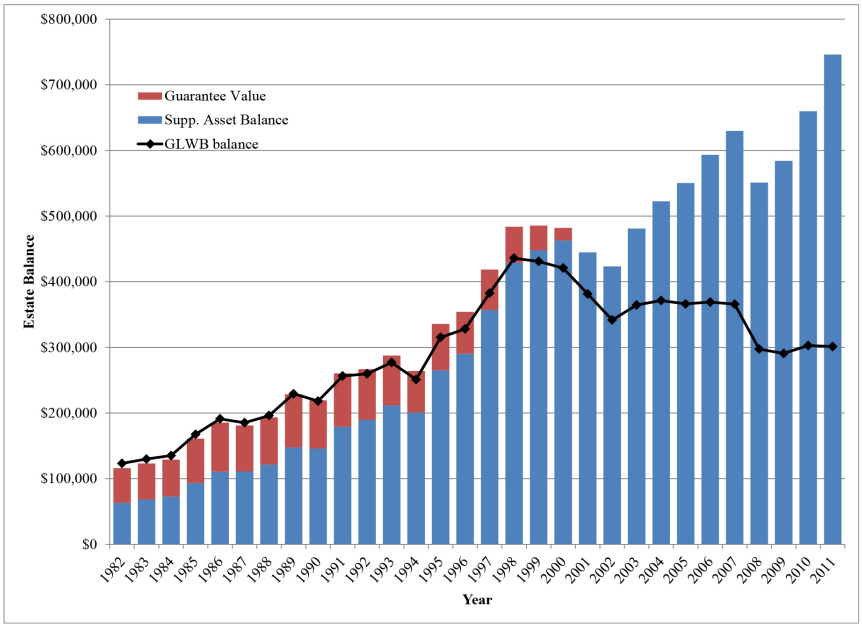
## Figure 1. Yearly estate values: strong starting date returns



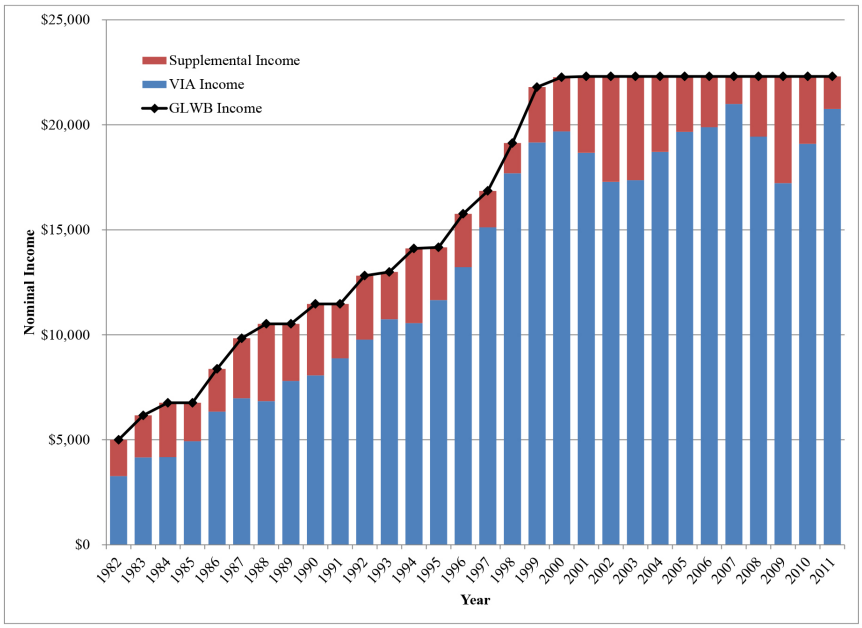

## Figure 2. Estate value of GLWB vs. systematic withdrawal, weak starting date returns



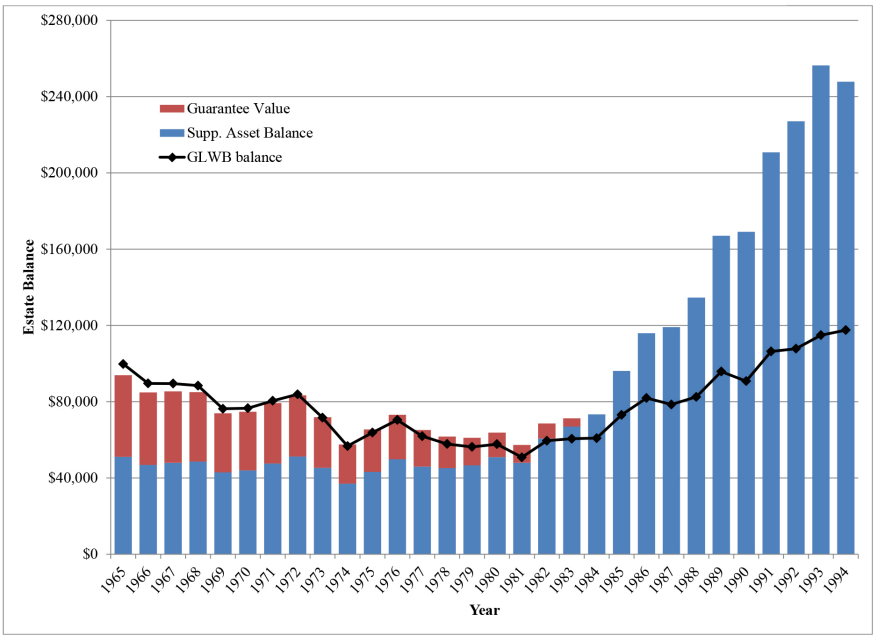
## Figure 3. Partial VIA estate value components: strong starting date returns



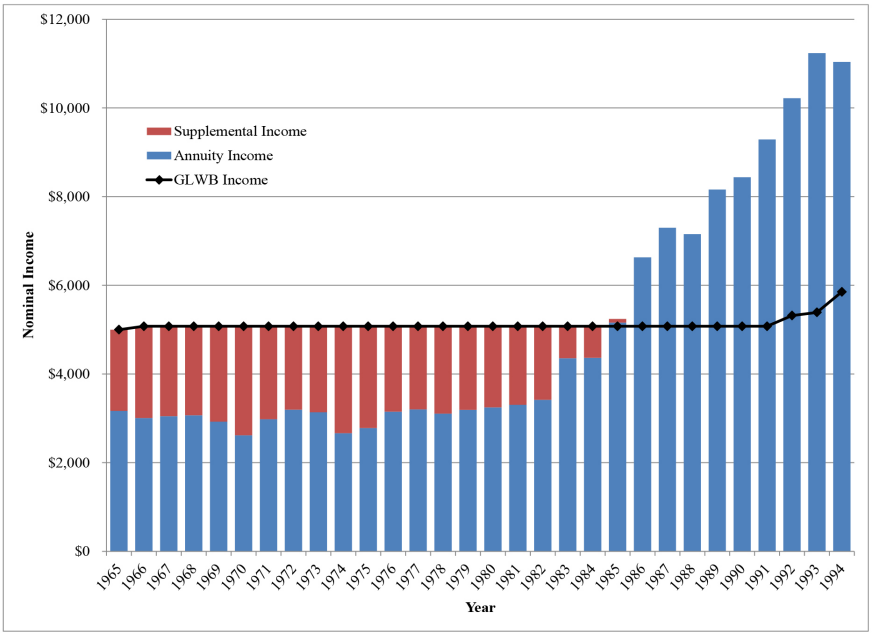

## Figure 4. Partial VIA income components: strong starting date returns



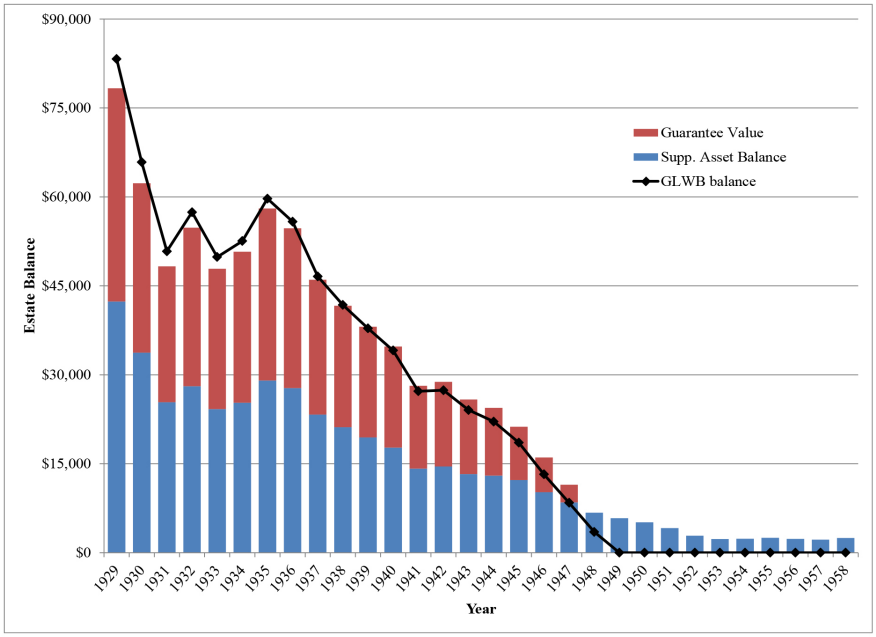
## Figure 5. Partial VIA estate value components: weak starting date returns



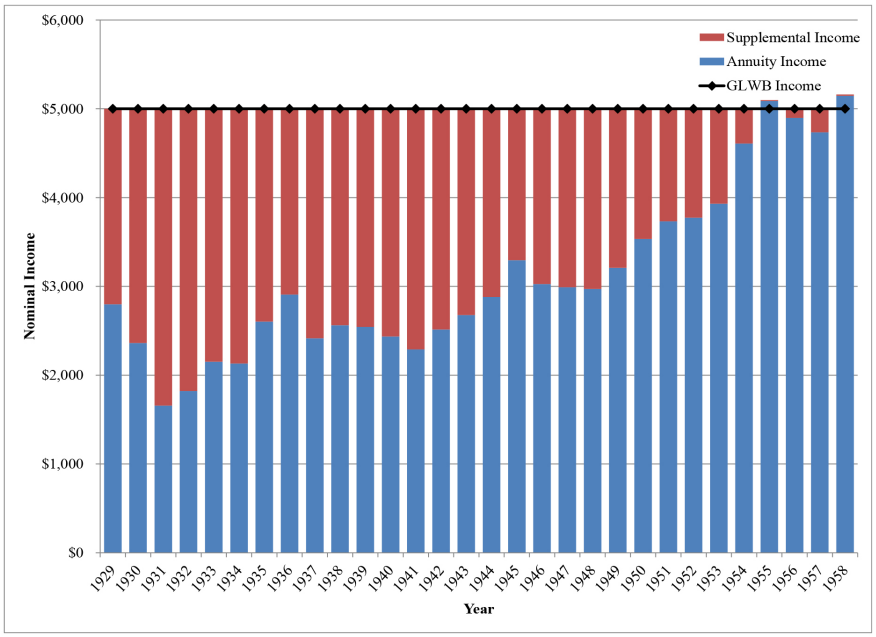

## Figure 6. Partial VIA income components: weak starting date returns



## Figure 7. Partial VIA estate value components: worst starting date returns




## Figure 8. Partial VIA income components: worst starting date returns



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