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Fixed Indexed Annuities

DISSECTING PERFORMANCE EXPECTATIONS

By Steven P. Clark, PhD, and Mike Dickson, PhD

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ABSTRACT

In today's low interest-rate environment, fixed income securities will not be able to deliver returns of the past. As structured solutions to the principal protection problem, fixed indexed annuities (FIA) can be effective bond replacements in a retirement portfolio through an efficient risk transfer. In this paper, we compare the performance expectations of common FIA structures and present practical comparisons given different market conditions. Simulating the various structures over time, we find that participation rates should be preferred to cap rates except in low and range-bound equity markets, which historically have been less common. We also show that volatility-controlled or "vol-controlled" indexes should be preferred to non-vol-controlled indexes under most conditions. In either case, an FIA should be expected to considerably outperform comparable bond exposures in a range-bound or expected increasing rate environment like we have today. Finally, we show that vol-controlled FIA performance is essentially independent of the vol-control target because increasing option prices offset expected improvements in performance.

INTRODUCTION

FIAs are structured solutions to the principal protection problem for individual investors. The first FIA was sold in 1995 by Keyport Life Insurance Company, and the product category has experienced steady sales growth in the ensuing years. According to the Insured Retirement Institute, global FIA sales reached a record high of $72.5 billion in 2019.[1] In its most basic form, an FIA enables the holder to earn risk premia from an underlying index of publicly traded securities, while eliminating downside risk from declines in index value. At worst, principal is returned at the end of the contract period. Additional returns are contingent on the realized performance of the index.

HOW DO FIXED INDEXED ANNUITIES WORK?

A certain amount of the premium is invested in the insurance company's general account, and the remainder (net of fees) is used to purchase options on the underlying index. The portion in the general account guarantees the return of principal, and the options provide upside exposure to the index. The amount available to purchase options, called the option budget, depends on the expected return of the general account. Because general accounts primarily hold fixed income securities, the option budget will depend, in large part, on the interest-rate environment prevailing when the FIA is written. As interest rates decrease (increase), option budgets become lower (higher) resulting in decreased (increased) upside exposure to the index. The potential share of the index return that the FIA will credit can be specified either as a cap or as a participation rate. In the case of a cap, the structuring agent buys at-the-money (ATM) call options (European exercise style) on the underlying index in a notional amount equal to the FIA premium; however, the option budget may not be sufficient to cover the full cost of these options. So the agent simultaneously sells out-of-the-money call options on the underlying index so that the net option premium exactly equals the option budget (minus fees). Thus, the cap is achieved using a long position in a call spread. In the case of a participation rate, only ATM call options are used, but in a notional amount relative to the FIA premium. The notional value of the call options is set so that the cost of the options exactly equals the option budget (minus fees). The participation rate is then the ratio of the notional value of the call options to the FIA premium. At the end of each crediting period, the index value realized over the term is used to determine the option structure payoff and therefore the interest-credit realized by the contract for this period.

Simulating the various structures over time, we find that participation rates should be preferred to cap rates except in low and range-bound equity markets, which historically have been less common.

A relatively recent innovation is an FIA structure referencing a vol-controlled index, that is, a blend of an index of publicly traded securities and a cash component, dynamically rebalanced to achieve a targeted realized volatility. The addition of the cash component reduces the notional value of call options (written on the non-vol-controlled index) required to produce a given participation rate for the vol-controlled index. The result is that FIAs referencing vol-controlled indexes have higher participation rates than their non-vol-controlled counterparts.

Given historical time-series data on relevant interest rates and credit spreads, along with corresponding prices for options on a given index, it is possible to reconstruct representative FIA structures that could have been offered by insurers and to calculate the returns these FIAs would have realized. In this study, we generate realistic hypothetical FIAs on the S&P 500 Index on each day starting in 1996. We then are able to compare various FIA structures to each other and to traditional fixed income portfolios. Specifically, we present conditional performance studies of FIAs with caps, FIAs with participation rates, FIAs on vol-controlled indexes, and fixed income portfolios. Two main contributions to the FIA literature emerge from this analysis. First, we are able to clearly point out the market conditions that necessitated the introduction of vol-controlled indexes following the Global Financial Crisis of 2007–2008. Second, we assess the value of FIAs as fixed income replacements. Conditional analysis with respect to realized equity returns and interest-rate changes allows us to develop guidelines for choosing optimally, given capital market assumptions, between FIA structures and portfolios of bonds.

METHODOLOGY

Considerable variation in FIA structures is found in the industry. As a standard for comparison, in this study we focus on one of the most common FIA designs: a one-year point-to-point crediting based on either a participation rate (par rate) or a cap, and an annual reset (Pfau 2019a). Modeling the historical performance of an FIA is more complicated than simply observing the historical returns of an underlying index. The simplest approach that is frequently used assumes that the current parameters would have applied in the past. It is useful to know what today's contract terms would look like when simulating payoffs using historical data, but this approach would not generate a realistic representation of historical FIA performance. The evolution of interest rates and index volatility are the main determinants of the FIA parameters, and these parameters vary considerably over time. To gain an accurate view of historical FIA performance, assumptions must be made about both the option budget and the price of the option structure, and then these estimates must be applied to the payoff of the option structure over time.

MODELING HISTORICALLY REALISTIC HYPOTHETICAL FIAs

As VanderPal et al. (2011) point out, participation rates and caps for newly written FIAs change over time. Failing to model this variation is a poor assumption. Ibbotson (2018) accounts for this in a widely cited paper by using simulated participation rates provided by AnnGen Development, LLC, a leading expert in annuity product structuring. Unfortunately, details on how these participation rates were calculated are not publicly available. However, Pfau (2019b) uses the Moody's Seasoned BAA Corporate Bond Yield to approximate the performance of a representative general account and adds a spread to approximate the internal expenses of an insurance carrier. Chang et al. (2020) also discusses the importance of market-linked proxies when modeling the option budget. We follow these recommendations and proxy for the general account return over time using the yield to worst (YTW) of the Bloomberg Barclays U.S. Investment Grade Corporate Bond Index. This index represents both higher credit quality and shorter duration than the index referenced by Pfau (2019b), and we believe it is representative of the yield from a general account, after accounting for operating costs and expenses. The asset allocation of a general account can be found in the 10-K and other associated documents for an insurance company, and it contains riskier assets than just investment-grade bonds.[2] Finally, in table A5 in the appendix, we show a representative sample of crediting rates for fixed annuities offered as of May 2021 by multiple insurance companies rated A- or higher. Fixed annuity rates are often good proxies for the option budget for FIAs because fixed rates are indications of the interest rates insurance companies are willing to guarantee. For reference, the average fixed rate as of May 26, 2021, was 2.39 percent, and the YTW of our proxy index was 2.11 percent on the same date.

Conditional analysis with respect to realized equity returns and interest-rate changes allows us to develop guidelines for choosing optimally, given capital market assumptions, between FIA structures and portfolios of bonds.

We model FIAs on both the S&P 500 Index, as well as a vol-controlled S&P 500 Index, dynamically adjusted to realize 5-percent volatility. To construct historical FIAs on the S&P 500, we obtain historical options data from OptionMetrics, which contains data dating back to 1996, spanning nearly the entire existence of FIAs. Using our estimated option budget and option pricing data, we estimate both a participation rate (S&P Par) and cap rate (S&P Cap), on a rolling one-year term tied to the S&P 500 price index. For the 5-percent vol-controlled S&P 500 Index, the required options are not listed. However, given the constant volatility target of the vol-controlled index, we can estimate the option prices using the Black-Scholes option pricing formula. To simulate the risk-control indexes we follow the procedures used by the S&P series of vol-controlled indexes that are widely used in the industry.[3] Unlike the S&P 500 price index, these indexes include reinvested dividends and typically are presented in excess of a risk-free interest rate. This actually makes the simplifying assumptions (constant volatility and constant risk-free interest rate) of the Black-Scholes formula highly appropriate for pricing these options. Due to this setup, volatility is constant and the forward is completely flat, meaning there is no need to estimate dividends or forward interest rates. Because a risk-control index involves a dynamic cash allocation to meet the volatility target, it is impossible to accurately estimate the index exposure in the future, and in turn it is impossible to accurately estimate the dividend yield and applicable interest rate. By subtracting these parameters from the index in real time, there is no need to estimate them. However, this introduces a difference in the forward price between the two indexes. We will discuss this topic in more detail in the section below titled "Dividends versus No Dividends."

Table 1

SUMMARY STATISTICS FOR UNDERLYING INDEXES

The S&P 500 is the SPX price return index. The S&P risk-control 5 (S&P RC5) was calculated following the S&P daily risk-control methodology. IG Corp Bond references the Bloomberg Barclays U.S. Corporate Bond Index (IG). Excess returns were computed by subtracting the daily rate of the ICE LIBOR USD 3-Month Index.

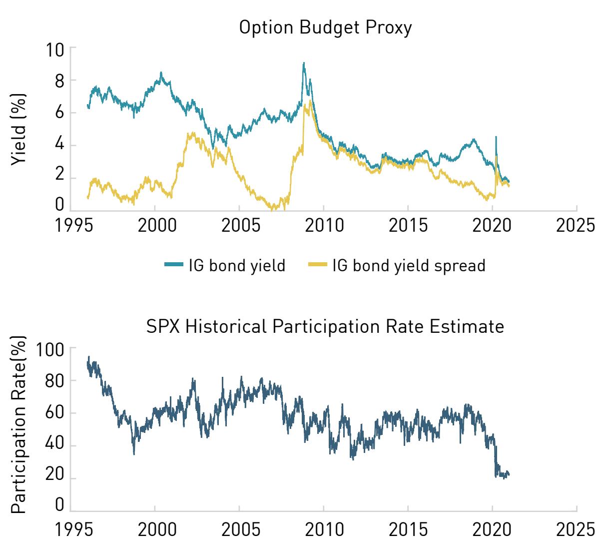
Panel A: January 1996–March 2021			
	S&P 500	S&P RC5	IG
Return	7.7%	5.0%	6.4%
Excess Return	5.0%	2.4%	3.6%
Volatility	19.5%	5.0%	5.3%
Sharpe Ratio	0.25	0.48	0.68
Panel B: January 2009–March 2021			
	S&P 500	S&P RC5	IG
Return	13.0%	5.0%	6.4%
Excess Return	12.1%	4.2%	5.6%
Volatility	18.5%	4.9%	5.3%
Sharpe Ratio	0.65	0.85	1.05

Because a risk-control index involves a dynamic cash allocation to meet the volatility target, it is impossible to accurately estimate the index exposure in the future, and in turn it is impossible to accurately estimate the dividend yield and applicable interest rate.

Figure 1

OPTION BUDGET PROXY OVER TIME

The top panel shows the yield to worst (YTW) of the Bloomberg Barclays U.S. Corporate Bond Index as a proxy for an historical fixed indexed annuity option budget. The IG Bond Yield spread subtracts the ICE LIBOR USD 3-Month Index. The bottom panel uses this option budget proxy and OptionMetrics data to estimate historical participation rates for a fixed indexed annuity. Data is from January 1996 through March 2021.



RESULTS

Table 1 compares summary statistics for the underlying indexes used in our analysis. We compare periods over our full sample, as well as post-2008, to better proxy for the period that coincides with the launch of risk-control indexes. The S&P 500 price index realizes the highest return, followed by investment-grade corporate bonds (IG), and finally the risk-control index. As designed, the S&P RC5 realizes a 5-percent annualized volatility, similar to IG bonds, and the S&P 500 realizes the highest volatility. Because volatility is an important factor in option prices, higher Sharpe ratios, which measure the efficiency of the use of volatility, will be significant determinants in the relative payoff of the FIA.

SUMMARY DATA

Figure 1 shows the estimated option budget for our analysis as the YTW of the Bloomberg Barclays U.S. Corporate Bond Index, as well as the spread above the risk-free rate. Following the Global Financial Crisis, yields collapsed along with the estimated option budgets. This caused standard participation rates to drop, as shown in the bottom panel of figure 1, which coincides with the launch and growth of risk-control indexes. Risk-control indexes increase the standard Sharpe ratios and allow for much higher and consistent participation rates due to their lower and more stable levels of volatility. From an issuer's perspective, higher participation rates may have marketing benefits as well, because they may convey a perception of the potential for stronger performance.

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Figure 2

PAYOFF OF AN FIA WITH AND WITHOUT DIVIDENDS

Estimates for the payoff of an FIA where the underlying index is either a price return only index, i.e., dividends are not included in the payoff of the FIA; or the underlying index is a total return index, i.e., dividends are included in the payoff of the FIA.

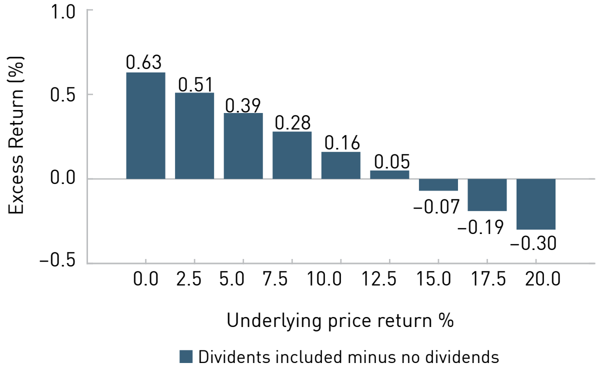


Figure 3

ROLLING ONE-YEAR PAYOFFS OF A PAR RATE FOR THE SPX INDEX (S&P 500) VS. A CAP RATE SPX INDEX (S&P 500)

Figure 3 plots the simulated rolling annual payoffs of both a participation rate and cap rate for the S&P 500. Data is from January 1996 through December 2020.

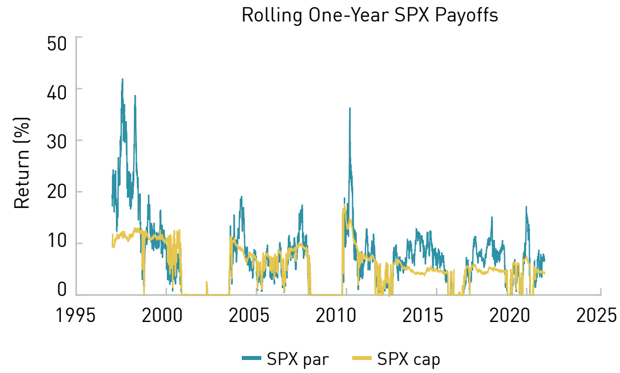


Table 2

SUMMARY STATISTICS OF PAYOFFS FOR A PAR RATE FOR THE S&P 500, A CAP RATE FOR THE S&P 500, AND INVESTMENT GRADE CORPORATE BONDS

Summary statistics for simulated FIA structures based on a participation rate and cap rate. Simulations assume an annual point-to-point reset, and all statistics were computed on rolling one-year annual payoffs. Details on the exact methodology can be found in the Methodology section.

	January 1996–March 2021			January 2009–March 2021		
Statistic	S&P Par	S&P Cap	IG	S&P Par	S&P Cap	IG
Average	6.9%	5.5%	6.3%	6.3%	4.8%	6.5%
Volatility	6.9%	4.1%	5.7%	4.6%	2.7%	5.5%
	Percentiles			Percentiles		
1st	0.0%	0.0%	−7.1%	0.0%	0.0%	−2.8%
10th	0.0%	0.0%	−0.7%	0.0%	0.0%	−0.6%
Median	6.1%	5.1%	6.5%	6.6%	4.7%	6.9%
90th	14.7%	11.2%	12.9%	11.2%	7.3%	13.5%
99th	33.5%	14.3%	24.0%	23.1%	14.1%	22.9%

DIVIDENDS VERSUS NO DIVIDENDS

Figure 2 shows the impact of including dividends versus not including dividends in the underlying index for an FIA. At first glance, it may appear that including dividends is by far the preferred choice, however this is not always the case. Because dividends also impact the forward index price and therefore the option price, participation rates will be different in the case of a total return index compared to an otherwise identical price index. For example, in figure 2 we assume 20-percent volatility, a 2-percent fixed dividend yield, a one-year term, and a 2.5-percent option budget. With dividends included (the total return case), the estimated par rate is 31 percent. But when dividends are excluded, the estimated par rate is 36 percent. This introduces a term known as a "gearing" effect. As shown in figure 2, for approximately a 15-percent return or lower, you would be better off capturing the dividends in the index value. However, as the underlying price return increases, the higher par rate begins to pay off, causing the FIA on the price return index to modestly outperform the FIA on the total return index. In practice, average differences are likely small, however, they are different.

PARTICIPATION VERSUS CAP RATES

Figure 3 plots simulated FIA payoffs over time for both a par rate and a cap rate tied to the S&P 500 price return index. During this period a par rate outperforms a cap rate more than 65 percent of the time. As shown in table 2, the average rolling one-year payoff is 6.9 percent for the participation rate, 1.4 percent higher than the cap rate strategy over the full sample. Since 2009 these results hold with the participation (par) rate FIA averaging 6.3 percent, 1.5 percent higher than the cap rate strategy. Additionally, the percentiles confirm the much greater upside skew of the participation rate strategy. Compared to IG bonds the par rate realizes similar returns over both periods, but again with greater positive skew. In a theoretical option pricing world, an investor should be indifferent

Table 3

CONDITIONAL PERFORMANCE OF PAYOFFS FOR A PAR RATE FOR THE S&P 500, A CAP RATE FOR THE S&P 500, AND INVESTMENT GRADE CORPORATE BONDS

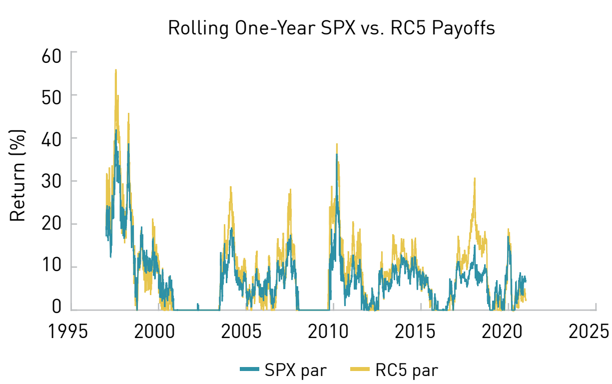
Conditional performance of the candidate strategies based on grouping performance into buckets. Panel A groups rolling annual performance into periods based on the S&P 500 total return. Panel B groups rolling annual performance into periods based on the annual change in the U.S. 10-year yield. Data is from January 1996 through March 2021.

Panel A: Grouped by Rolling Annual S&P 500 Total Return							
Bucket (%)	Frequency	Index	S&P Par	S&P Cap	IG	Par – Cap	Par – IG
X≤–20	6.7%	–29.5%	0.0%	0.0%	2.5%	0.0%	–2.5%
–20<X≤–10	6.9%	–15.4%	0.0%	0.0%	8.8%	0.0%	–8.8%
–10<X≤0	7.0%	–4.5%	0.0%	0.0%	5.4%	0.0%	–5.4%
0<X≤10	20.1%	6.0%	2.4%	3.8%	5.5%	–1.4%	–3.0%
10<X≤20	32.3%	15.1%	7.2%	7.0%	5.9%	0.3%	1.4%
20<X	26.9%	28.3%	15.1%	9.0%	8.0%	6.1%	7.0%
All Periods	**—**	**10.3%**	**6.9%**	**5.5%**	**6.3%**	**1.4%**	**0.6%**
Panel B: Grouped by Rolling Annual Change in U.S. 10-Year Yield							
Bucket (bps)	Frequency	Index	S&P Par	S&P Cap	IG	Par – Cap	Par – IG
X≤–100	16.4%	–1.3%	4.2%	3.3%	10.0%	0.8%	–5.8%
–100<X≤–50	20.8%	–0.8%	6.1%	4.4%	7.4%	1.7%	–1.4%
–50<X≤0	27.0%	–0.3%	6.8%	5.8%	6.7%	1.0%	0.1%
0<X≤50	16.7%	0.2%	8.1%	6.8%	4.9%	1.3%	3.2%
50<X≤100	13.3%	0.7%	9.0%	6.2%	2.8%	2.8%	6.3%
100<X	5.8%	1.3%	9.6%	8.3%	2.0%	1.4%	7.7%
All Periods	**—**	**–0.2%**	**6.9%**	**5.5%**	**6.3%**	**1.4%**	**0.6%**

Figure 4

ROLLING ONE-YEAR PAYOFFS OF A PAR RATE FOR THE SPX INDEX (S&P 500) VS. A PAR RATE FOR THE RISK-CONTROL INDEX

Figure 4 plots the simulated rolling annual payoffs of participation rate applied to the S&P 500 and risk-control strategy applied to the S&P 500 targeting a 5-percent annual volatility. Data is from January 1996 through March 2021.



between a par rate and a cap rate. However, due to the significant positive skew of the equity market, this is not the case in practice.

Table 3, panel A, takes a deeper look and shows the periods in which the performance differences occur. In a slightly positive range-bound equity market, defined by rolling one-year returns between 0 percent and 10 percent, the cap rate outperforms the par rate in excess of 1 percent. Otherwise, the higher the return of the equity market, the greater the outperformance of the par rate. Compared to bonds, only in periods of 10-percent return or greater does the par rate outperform bonds. However, a 10-percent return in the S&P 500 Total Return Index is a common occurrence, happening nearly 60 percent of the time in the historical data. These results suggest that a par rate should be preferred to a cap rate except in situations where equity returns are expected to be low and range-bound with high confidence. Table 3, panel B, shows the same analysis but instead buckets returns based on changes in the U.S. 10-year yield. In these cases, the par rate outperforms the cap rate in every bucket and outperforms IG bonds on average when the rate change is at least –50 basis points (bps), which occurs nearly two-thirds of the time.[4] These results suggest that in a rising rate environment, an FIA should be used to substitute for bond exposure in as large of an allocation as permitted by liquidity needs.

S&P VERSUS S&P RISK CONTROL

Figure 4 plots simulated FIA payoffs over time for a par rate FIA applied to the S&P price index, and a par rate FIA applied to an S&P risk-control index targeting a 5-percent annualized volatility (RC5). Over this period, the risk-control strategy outperforms the S&P par strategy 72 percent of the time. As shown in table 4, the average rolling one-year payoff is 8.4 percent for the risk control (RC5) FIA, 1.5 percent higher than the S&P par FIA over the full sample. Since 2009 these results hold with the

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Table 4

SUMMARY STATISTICS OF PAYOFFS FOR A PAR RATE FOR THE S&P 500, A PAR RATE FOR THE RISK-CONTROL INDEX, AND INVESTMENT GRADE CORPORATE BONDS

Summary statistics for simulated FIAs with participation rates for both the S&P 500 and an S&P 500 risk-control strategy (RC5). Simulations assume an annual point-to-point reset and all statistics were computed on rolling one-year annual payoffs. Details on the exact methodology can be found in the Methodology section.

	January 1996–March 2021			January 2009–March 2021		
Statistic	S&P Par	S&P RC5	Corp	S&P Par	S&P RC5	Corp
Average	6.9%	8.4%	6.3%	6.3%	8.2%	6.5%
Volatility	6.9%	9.2%	5.7%	4.6%	7.1%	5.5%
	Percentiles			Percentiles		
1st	0.0%	0.0%	−7.1%	0.0%	0.0%	-2.8%
10th	0.0%	0.0%	−0.7%	0.0%	0.0%	-0.6%
Median	6.1%	6.6%	6.5%	6.6%	7.8%	6.9%
90th	14.7%	20.4%	12.9%	11.2%	16.5%	13.5%
99th	33.5%	41.6%	24.0%	23.1%	31.9%	22.9%

Table 5

CONDITIONAL PERFORMANCE OF PAYOFFS FOR A PAR RATE FOR THE S&P 500, A PAR RATE FOR THE RISK-CONTROL INDEX, AND INVESTMENT GRADE CORPORATE BONDS

Conditional performance of the candidate strategies based on grouping performance into buckets. Panel A groups rolling annual performance into periods based on the S&P 500 total return. Panel B groups rolling annual performance into periods based on the annual change in the U.S. 10-year yield. Data is from January 1996 through March 2021.

Panel A: Grouped by Rolling Annual S&P 500 Total Return							
Bucket (%)	Frequency	Index	S&P Par	S&P RC5	IG	Par – RC5	RC5 – IG
X≤−20	6.7%	−29.5%	0.0%	0.0%	2.5%	0.0%	−2.5%
−20<X≤−10	6.9%	−15.4%	0.0%	0.1%	8.8%	−0.1%	−8.7%
−10<X≤0	7.0%	−4.5%	0.0%	0.2%	5.4%	−0.2%	−5.2%
0<X≤10	20.1%	6.0%	2.4%	1.5%	5.5%	0.9%	−3.9%
10<X≤20	32.3%	15.1%	7.2%	8.9%	5.9%	−1.7%	3.1%
20<X	26.9%	28.3%	15.1%	19.0%	8.0%	−4.0%	11.0%
All Periods	**—**	**10.3%**	**6.9%**	**8.4%**	**6.3%**	**−1.5%**	**2.1%**
Panel B: Grouped by Rolling Annual Change in U.S. 10-year Yield							
Bucket (bps)	Frequency	Index	S&P Par	S&P RC5	IG	Par – RC5	RC5 – IG
X≤−100	16.4%	−1.3%	4.2%	3.9%	10.0%	0.3%	−6.1%
−100<X≤−50	20.8%	−0.8%	6.1%	6.6%	7.4%	−0.6%	−0.8%
−50<X≤0	27.0%	−0.3%	6.8%	8.4%	6.7%	−1.6%	1.6%
0<X≤50	16.7%	0.2%	8.1%	10.7%	4.9%	−2.6%	5.8%
50<X≤100	13.3%	0.7%	9.0%	12.1%	2.8%	−3.1%	9.4%
100<X	5.8%	1.3%	9.6%	12.4%	2.0%	−2.7%	10.4%
All Periods	**—**	**−0.2%**	**6.9%**	**8.4%**	**6.3%**	**−1.5%**	**2.1%**

RC5 FIA averaging 8.2 percent, 1.9 percent higher than the S&P par FIA. Additionally, the percentiles confirm the much greater upside skew of the RC5 FIA compared to the S&P par FIA. The S&P RC5 FIA also outperforms IG bonds by nearly 2 percent during both time periods.

As shown in table 5, panel A, despite the much stronger performance of the risk-control strategy on average, it underperforms the S&P par rate during a slightly positive range-bound equity market, defined by rolling one-year returns between 0 percent and 10 percent. This appears to be the trade-off of using a vol-controlled index versus straight S&P 500 price return exposure. Thus, for an FIA, a vol-controlled index should be highly preferred to a non-vol-controlled index, except in situations where equity returns are expected to be low and range-bound with high confidence. In table 5, panel B, the S&P RC5 outperforms the S&P par rate on average for U.S. 10-year yield changes greater than −100 bps. The S&P RC5 also outperforms IG bonds on average for changes in the U.S. 10-year yield of −50 bps or higher.[5] Based on these results, an FIA should be used to substitute for bond exposure in as large of an allocation that liquidity needs will allow, in an interest-rate environment that is expected to be range-bound or increasing.

Table 6

SUMMARY STATISTICS OF RETURNS AND PAYOFFS FOR RISK-CONTROL INDEXES

Panel A shows summary statistics for various risk-control targets of the underlying indexes. Panel B shows simulated fixed index annuity strategies based on a participation rate for various S&P 500 risk-control strategies (RC). Simulations assume an annual point-to-point reset and all statistics were computed on rolling one-year annual payoffs and follows the same process and assumptions as outlined in the Methodology section. Data is from January 1996 through March 2021. Panel C shows the participation rates corresponding to each S&P 500 RC strategy consistent with market options prices on March 31, 2021, given the estimated option budget.

Panel A: Volatility Target Index Returns							
Target	5	7	10	12	15	18	20
Excess Return	2.4%	3.3%	4.6%	5.3%	6.3%	7.5%	7.9%
Volatility	5.0%	7.0%	10.0%	11.9%	14.6%	17.0%	18.3%
Sharpe Ratio	48.0%	47.2%	45.7%	44.3%	43.0%	43.9%	43.1%
Panel B: FIA Simulated Statistics							
Average	8.4%	8.4%	8.4%	8.4%	8.2%	8.2%	8.0%
Volatility	9.2%	9.3%	9.4%	9.5%	9.4%	9.3%	9.1%
1st	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10th	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Median	6.6%	6.5%	6.4%	6.3%	6.3%	6.4%	6.2%
90th	20.4%	20.5%	20.7%	20.7%	20.1%	19.9%	19.5%
99th	41.6%	42.2%	43.2%	43.8%	44.1%	43.2%	42.7%
Panel C: Participation Rates and Budget Estimates as of March 31, 2021							
PAR Rate	114.0%	81.7%	57.2%	47.7%	38.2%	31.8%	28.6%
Estimated Budget	2.28%	2.28%	2.28%	2.28%	2.28%	2.28%	2.28%

RISK-CONTROL INDEX COMPARISONS: NOWHERE TO HIDE

In table 6 we present summary statistics for various risk-control targets,[6] along with simulated FIA payoffs tied to these indexes, using the same methodology as previously described. As one might expect, as the target risk level increases so does the return. As found in the S&P methodology guide,[7] risk-control indexes allow leverage up to a point. As the target risk levels increase, this constraint becomes binding during certain periods of low realized volatility, which prevents the process from reaching the desired level of target risk with leverage. As a result, for the 15-percent target volatility and higher, the realized volatility is historically less than the target. This difference in exposure impacts the return slightly as well, causing these strategies to realize modestly lower Sharpe ratios. After accounting for these minor differences, we can state the most interesting result from table 6: Different risk-control targets do not impact the simulated FIA returns or the distribution of these returns. Although expected returns increase as the risk level increases, the options also become more expensive as the volatility of the index rises, resulting in FIAs with lower participation rates. The risk-control process is effective at increasing the Sharpe ratio compared to a price return only index, and therefore increases expected FIA performance. However, the choice of the volatility target should have no impact on the expected return. In practice, it is likely advisable to choose lower levels of target risk because this decreases the chance that the leverage constraints would impact performance.

CONCLUSION

As structured solutions to the principal protection problem, FIAs can be effective bond replacements in retirement portfolios. Given the current environment of historically low interest rates, demand for FIAs, specifically FIAs linked to vol-controlled indexes, is likely to continue to increase. In this paper, we study the historical performance of FIAs referencing the S&P 500 by reproducing structures with realistic contract terms. We estimate historical option budgets using investment-grade corporate bond yields as a proxy for the return on a representative general account. Then we use historical option prices to determine the participation rates and caps that could have been offered using the estimated option budgets. We model historical FIAs on the S&P 500 price index and compare these to FIAs on vol-controlled versions of the S&P 500 total return index. Based on our empirical results, the following points may be useful for FIA investors:

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1. A participation rate should be preferred to a cap rate except in situations where equity returns are expected to be low and range-bound with high confidence.
2. From the perspective of an investor seeking to maximize expected total return, in a range-bound or expected increasing rate environment, an FIA should be used to substitute for bond exposure in as large of an allocation that liquidity needs allow.[8]
3. A vol-controlled index should be preferred to a non-vol-controlled index, except in situations where equity returns are expected to be low and range-bound with high confidence.
4. Realized FIA performance is essentially independent of the vol-control level of the index.

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APPENDIX

Table A1: CONDITIONAL PERFORMANCE OF PAYOFFS FOR A PAR RATE FOR THE S&P 500, A CAP RATE FOR THE S&P 500, AND INVESTMENT GRADE CORPORATE BONDS

Conditional performance of the candidate FIA structures based on grouping performance into buckets. Panel A groups rolling annual performance into periods based on the S&P 500 total return. Panel B groups rolling annual performance into periods based on the annual change in the U.S. 10-year yield. Data is from January 2009 through March 2021.

Panel A: Grouped by Rolling Annual S&P 500 Total Return							
Bucket (%)	Frequency	Index	S&P Par	S&P Cap	IG	Par – Cap	Par – IG
X≤−20	0.0%	—	—	—	—	—	—
−20<X≤−10	0.4%	−13.1%	0.0%	0.0%	1.9%	0.0%	−1.9%
−10<X≤0	5.6%	−3.1%	0.0%	0.0%	1.5%	0.0%	−1.5%
0<X≤10	25.8%	5.3%	1.8%	2.9%	6.7%	−1.2%	−4.9%
10<X≤20	41.4%	15.5%	6.8%	5.4%	6.3%	1.3%	0.5%
20<X	26.8%	26.7%	11.5%	6.5%	7.8%	5.0%	3.7%
All Periods	**—**	**14.8%**	**6.3%**	**4.8%**	**6.5%**	**1.6%**	**−0.2%**
Panel B: Grouped by Rolling Annual Change in U.S. 10-year Yield							
Bucket (bps)	Frequency	Index	S&P Par	S&P Cap	IG	Par – Cap	Par – IG
X≤−100	15.9%	−1.4%	3.3%	3.4%	10.8%	−0.2%	−7.6%
−100<X≤−50	18.4%	−0.8%	5.4%	5.1%	9.4%	0.3%	−4.0%
−50<X≤0	29.7%	−0.3%	5.4%	4.7%	6.0%	0.7%	−0.6%
0<X≤50	12.3%	0.3%	7.0%	4.3%	4.1%	2.6%	2.9%
50<X≤100	18.8%	0.7%	9.5%	5.3%	3.0%	4.1%	6.5%
100<X	4.8%	1.2%	12.0%	6.8%	4.6%	5.2%	7.4%
All Periods	**—**	**−0.2%**	**6.3%**	**4.8%**	**6.5%**	**1.6%**	**−0.2%**

Table A2

CONDITIONAL PERFORMANCE OF A PAR RATE FOR THE S&P 500, A PAR RATE FOR THE RISK-CONTROL INDEX, AND INVESTMENT GRADE CORPORATE BONDS

Conditional performance of the candidate strategies based on grouping performance into buckets. Panel A groups rolling annual performance into periods based on the S&P 500 total return. Panel B groups rolling annual performance into periods based on the annual change in the U.S. 10-year yield. Data is from January 2009 through March 2021.

Panel A: Grouped by Rolling Annual S&P 500 Total Return							
Bucket (%)	Frequency	Index	S&P Par	S&P RC5	IG	Par – RC5	RC5 – IG
X≤–20	0.0%	–	–	–	–	–	–
–20<X≤–10	0.4%	–13.1%	0.0%	0.0%	1.9%	0.0%	–1.8%
–10<X≤0	5.6%	–3.1%	0.0%	0.1%	1.5%	–0.1%	–1.5%
0<X≤10	25.8%	5.3%	1.8%	1.2%	6.7%	0.6%	–5.5%
10<X≤20	41.4%	15.5%	6.8%	8.7%	6.3%	–2.0%	2.4%
20<X	26.8%	26.7%	11.5%	15.7%	7.8%	–4.2%	7.8%
All Periods	**—**	**14.8%**	**6.3%**	**8.2%**	**6.5%**	**–1.9%**	**1.7%**
Panel B: Grouped by Rolling Annual Change in U.S. 10-Year Yield							
Bucket (bps)	Frequency	Index	S&P Par	S&P RC5	IG	Par – RC5	RC5 – IG
X≤–100	15.9%	–1.4%	3.3%	2.4%	10.8%	0.9%	–8.4%
–100<X≤–50	18.4%	–0.8%	5.4%	5.4%	9.4%	0.0%	–4.0%
–50<X≤0	29.7%	–0.3%	5.4%	6.9%	6.0%	–1.5%	0.9%
0<X≤50	12.3%	0.3%	7.0%	10.9%	4.1%	–4.0%	6.9%
50<X≤100	18.8%	0.7%	9.5%	13.8%	3.0%	–4.3%	10.8%
100<X	4.8%	1.2%	12.0%	16.6%	4.6%	–4.7%	12.0%
All Periods	**—**	**–0.2%**	**6.3%**	**8.2%**	**6.5%**	**–1.9%**	**1.7%**

ROBUSTNESS TESTS FOR RISK CONTROL INCLUDING ADDITIONAL COSTS

These robustness tests compare the results shown in the main section of the paper for the risk-control strategy while additionally deducting a 50-bps fee from the option budget, and assuming the options were priced using 50 bps more in volatility. These robustness tests were computed to reflect the possibility of practical costs to real world implementation.

Table A3

SUMMARY STATISTICS OF PAYOOFS FOR A SIMULATED RISK-CONTROL INDEX (NO FEE VS. FEE AND VOLATILITY SHOCK)

Summary statistics for simulated fixed index annuity strategies based on a participation rate and S&P 500 risk-control strategy (RC5). Simulations assume an annual point-to-point reset and all statistics were computed on rolling one-year annual payoffs.

	January 1996–March 2021			January 2009–March 2021		
Statistic	RC5	50-bps Fee	50-bps Vol	RC5	50-bps Fee	50-bps Vol
Average	8.4%	7.5%	7.6%	8.2%	7.1%	7.5%
Volatility	9.2%	8.4%	8.3%	7.1%	6.3%	6.4%
	Percentiles			Percentiles		
1st	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10th	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Median	6.6%	5.8%	6.0%	7.8%	6.6%	7.1%
90th	20.4%	18.7%	18.6%	16.5%	14.2%	15.0%
99th	41.6%	38.7%	37.8%	31.9%	29.8%	29.0%

Table A4

CONDITIONAL PERFORMANCE OF PAYOFFS FOR A SIMULATED RISK-CONTROL INDEX (NO FEE VS. FEE AND VOLATILITY SHOCK)

Conditional performance of the candidate strategies based on grouping performance into buckets. Panel A groups rolling annual performance into periods based on the S&P 500 total return. Panel B groups rolling annual performance into periods based on the annual change in the U.S. 10-year yield. Data is from January 1996 through March 2021.

Panel A: Grouped by Rolling Annual S&P 500 Total Return					
Bucket (%)	Frequency	Index	RC5	50-bps Fee	50-bps Vol
X≤−20	6.7%	−29.5%	0.0%	0.0%	0.0%
−20<X≤−10	6.9%	−15.4%	0.1%	0.1%	0.1%
−10<X≤0	7.0%	−4.5%	0.2%	0.2%	0.2%
0<X≤10	20.1%	6.0%	1.5%	1.4%	1.4%
10<X≤20	32.3%	15.1%	8.9%	7.8%	8.1%
20<X	26.9%	28.3%	19.0%	17.2%	17.3%
All Periods	**—**	**10.3%**	**8.4%**	**6.3%**	**6.3%**
Panel B: Grouped by Rolling Annual Change in U.S. 10-year Yield					
Bucket (bps)	Frequency	10-year Yield	RC5	50-bps Fee	50-bps Vol
X≤−100	16.4%	−1.3%	3.9%	3.6%	3.6%
−100<X≤−50	20.8%	−0.8%	6.6%	6.0%	6.0%
−50<X≤0	27.0%	−0.3%	8.4%	7.5%	7.6%
0<X≤50	16.7%	0.2%	10.7%	9.5%	9.7%
50<X≤100	13.3%	0.7%	12.1%	10.5%	11.0%
100<X	5.8%	1.3%	12.4%	11.0%	11.3%
All Periods	**—**	**−0.2%**	**8.4%**	**6.3%**	**6.3%**

EXAMPLE RATES

Table A5

EXAMPLE FIXED RATES

Example fixed rates accessed from https://www.immediateannuities.com/ as of May 26, 2021. Only one annuity listed for each A– and higher rated companies are shown. The average fixed rate of this list is 2.39 percent. By comparison the YTD of the Bloomberg Barclays U.S. Corporate Bond Index was 2.11 percent as of May 26, 2021.

Company	Annuity	Term	Fixed Rate	Rating
Oceanview	Harbourview 10	10 yrs.	3.10%	A–
Fidelity & Guaranty	FG Guarantee-Platinum 7	7 yrs.	2.80%	A–
Oxford Life	Multi-Select 10	10 yrs.	2.70%	A–
Americo	Platinum Assure 5	5 yrs.	2.70%	A
Delaware Life	Pinnacle MYGA 10	10 yrs.	2.55%	A–
United of Omaha	Ultra-Premier 7	7 yrs.	2.35%	A+
American General	VisionMYG 10 High-Band	10 yrs.	2.25%	A
The US Life Ins. Co.	SolutionsMYG 7 High-Band	7 yrs.	2.25%	A
American Equity	GuaranteeShield 5	5 yrs.	2.25%	A–
North American	Guarantee Choice 10 High-Band	10 yrs.	1.95%	A+
Midland National Life	Guarantee Ultimate 10 High-Band	10 yrs.	1.95%	A+
New York Life	Secure Term MVA II 7 High-Band	7 yrs.	1.80%	A++

ENDNOTES

1. Insured Retirement Institute: Retirement Fact Book 2020. https://www.myirionline.org/docs/default-source/default-document-library/2020_iri_fact_book_2020_final.pdf?sfvrsn=c8394164_2.
2. For example, see https://s23.q4cdn.com/579645270/files/doc_financials/2020/ar/Metlife-AR-web-ready-v1.pdf.
3. See https://www.spglobal.com/spdji/en/documents/additional-material/sp-risk-control-indexes-parameters.pdf.
4. In the appendix we provide additional robustness tests over sub-periods of the data and find these results hold.
5. In the appendix we provide additional robustness tests over sub-periods of the data and find these results hold.
6. These target risk levels are common choices in the FIA space and are managed by S&P Dow Jones Indices.
7. See https://www.spglobal.com/spdji/en/documents/additional-material/sp-risk-control-indexes-parameters.pdf.
8. We emphasize that an allocation to bonds may still provide diversification benefits, which we do not examine in this study.

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