White Paper

VIX® for Variable Annuities

A study considering the advantages of tying a Variable Annuity fee to VIX

March 2013
Executive Summary

This paper explores the use of the CBOE Volatility Index® (VIX®) in setting the risk charge (“fee”) for a variable annuity (VA) product guarantee, and will demonstrate the potential advantages – both to variable annuity carriers and to policy holders – of calculating the fee as a function of VIX\(^1\).

This paper will analyze the use of a dynamic fee that more closely matches the guarantee and hedging costs in different market environments, to address some of the difficulties faced by variable annuity carriers.

We first discuss the problems typically faced by carriers in matching fees and costs on typical VA products, even with a hedging program in place.

We then explain how using a fee linked to VIX can help resolve these problems. Finally, we provide an illustrative example where we apply this approach to a simple guaranteed minimum withdrawal benefit (“GMWB”) product.

We demonstrate how carriers may have improved ability to manage cash flow for hedging purposes, and more stable reserve and capital outcomes under certain regulatory regimes. We also show that this may allow policyholders to benefit by having more money exposed to equities in low volatility, rising markets.

Weaknesses in Existing Variable Annuity Product Designs

An ongoing challenge for variable annuity writers is that future costs\(^2\) as well as regulatory capital and reserve requirements for the product are highly scenario-dependent, and thus essentially unknown at the time of issue. These requirements can vary significantly based on a number of economic variables such as actual future changes in equity markets and interest rates.

At the same time, the fees on a typical variable annuity product – which are intended to fund the cost of providing the guarantee – are essentially fixed\(^3\).

This mismatch between fee income and costs can put carriers under painful financial constraints, especially during periods of market turmoil, as was observed during the recent financial crisis.

Hedging Costs

Common hedging programs employed by carriers, while significantly reducing the market risk exposure, cannot adequately address this mismatch between fee income and costs. Even after implementing a hedging program, significant uncertainty remains around the future outcomes for variable product guarantees.

Dynamic Hedging

During periods of market turmoil, dynamic hedging solutions generally become much more expensive. Dynamic replication strategies become more costly because the larger market movements both up and down mean greater losses are incurred. Using short dated options rather than futures can provide some protection for the negative gamma from the guarantees, but new options will need to be repurchased regularly and the future cost of these purchases is uncertain – these options become much more costly when implied volatility is higher.

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\(^1\) Fee-determination systems and methods relating to insurance products that are designed to incorporate a measure of volatility into the fees are subject to a pending patent application filed with the U.S. Patent and Trademark Office (Application number: 12/817,788 Publication number: US 2010/0325063 A1).

\(^2\) These costs include both claim payouts on the guarantee and costs of hedging during the life of the product.

\(^3\) Actual fee income received can also depend on underlying fund performance, sales compensation structures and realized rates of policyholder withdrawals or deaths; however, analysis of these is beyond the scope of this paper.
Static Hedging

Static or semi-static hedges using long-dated instruments such as over-the-counter equity put options are very costly to put in place. And even if they are implemented, they can leave the carrier exposed over time to mismatches with the liabilities due to policyholder behavior, and also to basis risk between hedging instruments and the underlying funds.

No “Natural Suppliers” of Long-Dated Volatility

While significant demand exists for long-term equity market downside protection, the “natural production” of long dated options needed to adequately meet this demand does not presently exist. In addition, the prices of long dated options have historically reflected a substantial premium for liquidity and cost of capital. This premium is likely to persist or even increase due to pressure from regulators for liquidity providers to post more collateral against those obligations. This means that carriers are usually forced to pay a high premium in order to obtain long-dated hedges, making this solution prohibitively expensive.

Reserve and Capital Costs

In addition to the expected increased capital constraints for hedging instruments, regulatory reserve and capital calculations in Europe and North America are moving toward more market-consistent treatment of their obligations. Requirements for carriers to calculate the value of the obligations based on current market conditions can create balance sheet risk that traditionally has not been there. This can have negative consequences for insurers during times of market turmoil, even if hedging programs are in place.

Because variable annuity guarantees can be considered a put option on the policyholder’s portfolio, an increase in the implied volatility in the market place will likely increase the value of the guarantee. Therefore, regulatory requirements for liabilities to be calculated on a market-consistent basis using implied volatility can have a significant impact on an insurer’s balance sheet.

Unless the carrier has found a long dated static hedge for the liabilities, the actual ongoing hedging costs are changing, and yet the fee income is fixed; therefore the insurer can be forced into heavy cash outlays precisely at the time reserve and/or capital pressures are intensifying.

“Perfect Storm”

Dramatic increases in implied volatility often occur precisely at the same time the market has fallen dramatically. When this happens, it means that not only is the liability increased due to increased volatility, but also the guarantee itself has more intrinsic value (i.e., it is more “in-the-money”). Add to this the increased cost of hedging activities during these same periods, and this can become a perfect storm for variable annuity carriers.

How Utilizing a VIX-linked Fee Can Help

If fee revenues could better correspond to hedging costs period-by-period, carriers could have more stable cash flow, more stable reserve and capital requirements, and thus more stable financial positions.

If fees paid by policyholders could be lowered when the market is doing well, they could benefit by having more of their money working in the market.

We will show that linking the variable annuity fee to VIX is a risk-sharing mechanism with potential benefits for both carriers and policyholders, and can achieve both of the above objectives.

What is VIX?

VIX is a published index which measures implied volatility on short-dated options. It is considered an indicator of expected market turbulence.
More precisely, VIX is a normalized sum of option prices across multiple strike prices and time weighted across tenors to reflect a 30 day outlook. As implied volatility increases for the particular options used in the calculation, VIX will increase. It is not our intention to cover the many technical aspects of VIX – for purposes of this paper, a general understanding of VIX will suffice.

**Illustrative Example – A Simple GMWB**

*Product Features*

We now look at a 25-year variable annuity with a GMWB rider. For this product, no withdrawals occur during the first five years, then for the remaining 20 years guaranteed withdrawals are taken, equal to 5% per annum of the higher of the initial deposit and the account value at year 5.

A block of business with $1 billion total initial account value is assumed. The S&P 500 index is used as a proxy for an equity mutual fund. A 100% equity asset mix is used. For simplicity, no additional impacts from policyholder behavior or decrements are modeled. The product is tested over a historical period from 1990 to 2012.

*Fee Structure*

Using the above product, two fee structures are compared:

(i) fixed fee of 100 bps of account value per annum, and

(ii) variable fee equal to VIX times 4.8 per annum

The above VIX multiplier of 4.8 was derived so as to make the total dollar fees approximately equal, to give a fairer comparison between the two approaches over the time period being studied.

In practice, not only is it quite possible to have large differences in total fees between the two approaches depending on the scenario, this is in fact the advantage of the variable fee structure: to have higher fees in those periods and scenarios where the guarantee and hedging costs are higher.

*Key Observations and Results*

The following table summarizes final values for the product under both fee structures:

<table>
<thead>
<tr>
<th>Fee</th>
<th>Fixed Fee</th>
<th>Variable Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 bps</td>
<td>4.80597 * VIX</td>
</tr>
<tr>
<td>Final Account balance after withdrawals and fees</td>
<td>$1,970,679,967</td>
<td>$1,979,637,460</td>
</tr>
<tr>
<td>Average Daily Fee</td>
<td>$52,671.39</td>
<td>$52,671.39</td>
</tr>
</tbody>
</table>

We again underline that for this example, the variable fee was chosen to closely align total fees received with the fixed fee approach, as exhibited by the matching average fees and very close ending account balances. (The slight difference results from a very small sequence-of-returns impact related to cash flow timing under the variable fee approach.)

We want to focus on how present value of fee revenue compared to a “market-consistent” liability calculated using implied volatility. The chart below shows how much the expected liability on new business can vary when calculated using a market consistent approach:

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4 More complex fee structures using VIX are possible and may even be desirable depending on a carrier’s specific pricing or risk management objectives; these are not explored here.
The key observation from this chart is that when fees are tied to VIX, the present value of fees tracks the liability very well. We also note that not only is the flat 100bps fee likely insufficient for a 100% equity position, the potential deficiency is very sensitive to implied volatility and can increase exponentially during periods of market turmoil such as were experienced in the early 2000’s, through the recent 2008 financial crisis and more recently the European debt crisis.

**Implications for Short-Dated Options Hedging Strategies**

Due to the significant risks and costs of hedging with long dated options, many insurers employ a strategy using short dated options and variance swaps for hedging the “Greeks” of the liabilities. One serious risk associated with using shorter dated instruments and rolling them, is that the ongoing cost can vary greatly. During market turmoil, the cost of short dated hedges increases greatly. If fee income is tied to VIX, more cash is available to fund these more expensive hedges, exactly when it is most needed, as shown in the table below:

<table>
<thead>
<tr>
<th>VIX</th>
<th>1 month 90% Put Cost</th>
<th>Fee 4.8 x VIX</th>
<th>1 month of fees</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>10,000</td>
<td>57.6</td>
<td>480,000</td>
</tr>
<tr>
<td>14</td>
<td>51,000</td>
<td>67.2</td>
<td>560,000</td>
</tr>
<tr>
<td>16</td>
<td>161,000</td>
<td>76.8</td>
<td>640,000</td>
</tr>
<tr>
<td>18</td>
<td>371,000</td>
<td>86.4</td>
<td>720,000</td>
</tr>
<tr>
<td>20</td>
<td>706,000</td>
<td>96.0</td>
<td>800,000</td>
</tr>
<tr>
<td>22</td>
<td>1,175,000</td>
<td>105.6</td>
<td>880,000</td>
</tr>
<tr>
<td>24</td>
<td>1,780,000</td>
<td>115.2</td>
<td>960,000</td>
</tr>
<tr>
<td>26</td>
<td>2,516,000</td>
<td>124.8</td>
<td>1,040,000</td>
</tr>
<tr>
<td>28</td>
<td>3,374,000</td>
<td>134.4</td>
<td>1,120,000</td>
</tr>
<tr>
<td>30</td>
<td>4,345,000</td>
<td>144.0</td>
<td>1,200,000</td>
</tr>
<tr>
<td>32</td>
<td>5,418,000</td>
<td>153.6</td>
<td>1,280,000</td>
</tr>
<tr>
<td>34</td>
<td>6,584,000</td>
<td>163.2</td>
<td>1,360,000</td>
</tr>
<tr>
<td>36</td>
<td>7,832,000</td>
<td>172.8</td>
<td>1,440,000</td>
</tr>
</tbody>
</table>
We can see that the increased cost of semi-dynamic hedging is at least partially matched by the increased fee income that results from higher levels of VIX. Clearly, we could derive other formulas for the VIX-linked fee which would align with the cost of a short-dated options hedging strategy even more closely.

**Conclusion**

We explored VIX-linked fees as a powerful risk-sharing mechanism, which addresses many of the constraints faced by variable annuity carriers in their existing product designs and hedging programs.

Tying variable annuity fees to VIX may benefit policyholders through lower fees in quiet rising markets, while providing carriers the needed cash in times of market stress to fund the guarantee and hedging costs or payouts, to mitigate volatility in market-consistent reserve and capital requirements.

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