Delta Hedging an IO securities backed by Senior Life Settlements

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ABSTRACT

Investors in securitized senior life settlements are exposed to longevity risk. The value of their security will decrease if life settlers live above life expectancy because premia will have to be paid for a longer period and the death benefits are not received at life expectancy but at a later date. We examine a block of life settlement and show how it is possible to create an IO (interest only) security, and a PO (principal only) security by stripping apart the premia from death benefits for the pool of life settlements backing a life settlement securitization. We show how it is possible to hedge the value of this IO security.

INTRODUCTION

Senior life settlements are created by the purchase of life policies from policy holders of age 72 and above. The purchaser of the policy becomes the beneficiary and takes over in making the periodic premium payments to the insurance company. The seller of the life insurance, the life settler, has an estimated life expectancy that is determined by his/her health conditions and age at the time of the transaction. The buyer, typically a company, buys many policies, with different life expectancies, different premium and death benefit amounts. When a sufficient amount of policies have been accumulated, they can then be securitized. Investors buy securities backed by the positive death benefit payments and the negative premium payments. The death benefit payments more than outweigh the premium payments, but the difference if a function of the life settlers' life expectancy.

Previous securitized senior life settlements have had the format of a fixed coupon security, of a pass-through security and that of a senior/sub structure. In the senior/sub structure a senior note and a subordinated note are issued to investors. The death benefit cash flow from the underlying pool of life settlements are first paid to the senior note holder, until fully paid, and it is only after the senior note has been fully paid that the subordinated note holder start receiving death benefit payments.

We develop a new structure for securitized senior life settlements that provides more options for investors, by creating an IO security and a PO security.

MODEL

The valuation of a senior life settlement, *V(sls)*, is obtained by discounting the premium paid at the end of each year, -*P*, and the death benefit *B*, collected at the time when the life settler dies. For simplicity a flat yield curve is assumed, with a discount rate of *r*. The valuation is based on a life expectancy of *t* years.

$$V(sls) = -P\left[\frac{1}{(1+r)^1} + \frac{1}{(1+r)^2} \ldots + \frac{1}{(1+r)^t}\right\} + \frac{B}{(1+r)^t} \qquad (1)$$

Equation (1) can be re-written as:

$$V(sls) = -P\left[\frac{1}{r} - \frac{a^t}{r}\right] + Ba^t \ \ where\ a = \frac{1}{(1+r)} \qquad (1')$$

When we look at equation (1') that shows how to value a life settlement, we can observe two components: the first component (let's call it *F*) is the present value of the premia to be paid as long as the life settler lives, and the second component (let's call it *S*) is the present value of the death benefit *B*.

The premia can be interpreted as a negative interest calculated as a percentage of the death benefit *B*:

$$P = \alpha B \qquad (2)$$

For example a life policy with a \$1,000,0000 death benefit and an annual \$10,000 in premium would have an α = 1%. Replacing these numbers in equation (2) we have:

\$10,000 = (1%)(\$1,000,000)

We can re-write equation (1') as:

$$V(sls) = F + S \qquad (3)$$

where *F* is negative and its negative value increases with the number of months/years lived above the settler's life expectancy; and *S*, always positive, increases in value as settler lives below life expectancy, and decreases in value the longer the insured lives.

The value of a pool of securitized senior life settlements *V(SLS)* is the summation of the value of the individual life settlements in that pool:

$$V(SLS) = \sum_{j=1}^{n}\left(F_j + S_j\right) \qquad (4)$$

where n is the number of life settlements in the pool.

The life settlements in the pool have different death benefits, different *α's*, different life expectancies. Life settlers will die at different points in time.

PO SECURITY IN SECURITIZED LIFE SETTLEMENTS

The main risk to investors in Mortgage-Backed Securities (MBS) is the prepayment risk. There have been many different structures developed to redistribute the prepayment risk to different groups of investors to address their specific risk. One structure is that of IOs (Interest Only) and POs (Principal Only), where the interest and principal components of the monthly payments of individual mortgages in the securitized pool, are stripped apart, to create an Interest Only security and a Principal Only security. If prepayment rate is higher than projected, investors in POs receive their principal sooner than expected and can invest it at the current market rate, the value of the PO increases. Investors in IOs are negatively affected by higher prepayment rate because outstanding principal is reduced, and so there is less interest payments paid.

Just like we can strip apart interest from principal and create IOs and POs in mortgage-backed securities, the same possibility is available for securitized senior life settlements.

If we separate in equation (4) F from S we obtain:

$$V(F) = \sum_{j=1}^{n} F_J \qquad (5)$$

$$V(S) = \sum_{j=1}^{n} S_J \qquad (6)$$

Equation (6) is the present value of the *"death benefits only"* security, it is a *Principal Only* security with exactly same characteristics as the ones of a PO backed by mortgages. It goes up in value the sooner it is paid. In the case of senior life settlements, the sooner the life settlers die, the more valuable the PO becomes. The main difference between a PO backed by mortgages and a PO backed by senior life settlements is that the first is affected by prepayment speed and the later by *death speed* or life extension above the initial life expectancy of life settlers (longevity risk).

Equation (5) is unusual as it represents the value of a "*Negative Interest Only*" or NIO. In the case of the PO securities backed respectively by mortgages or by senior life settlements, higher prepayment speed in the first case, and higher death rate, in the second case, increases the value of the POs. POs backed by mortgages benefit from higher prepayment speed because the principal only is received sooner than projected and can be re-invested. POs backed by senior life settlements benefit from higher mortality rates because death benefits are paid faster than projected, and can also be re-invested.

In the case of the IO securities backed respectively by mortgages and senior life settlements, higher prepayment speed in the first case, will decrease the value of the IO security, whilst higher death rate, in the second case, will increase the value of the IO security. In the first case, the value of the IO is reduced because high prepayment rates reduce the outstanding balance of the pool of mortgages, so less interest payments are available. In the second case, higher death rate reduce the amount of premia to be paid. For example, a senior life settlement with a life expectancy of seven years has a value based on the fact that the premia will be paid each year for seven year. If the life settler dies instead in four years, then the premia need to be paid for only four years, increasing therefore the value of the IO backed by life settlements.

APPLICATIONS

We now look at a block of senior life settlements. Due to confidentiality, not all information about the block can be revealed.

The first column (starting from the left) shows the amount of death benefit that will be paid at the time the senior life settler dies. We have labeled this as B in our model.

The second column shows the current age of the life settler at the time of the purchase of the policy.

The third column shows the number of years since the life settler purchased the policy.

The fourth column represents the annual premium, we have labeled it with P in our model.

Finally, the last column is the life expectancy of the senior life settler. It is standard in the industry to label it as *LE*. Just like prepayment rate is the key variable in the valuation of mortgage-backed securities, *LE* is the key variable when valuing securities backed by a pool of senior life settlements. Any change in the actual life of the life settler above or below *LE*, will affect the value of senior-life settlement securities.

Exhibit 1

Face Amount	Age	Years In Force	Annual Premium	LE
10,000,000	88	4	588,753.00	4
2,125,000	85	6	49,392	4
300,000	83	9	20,998	5
100,000	83	9	2,556	5
4,700,000	89	9	477,586	6
1,000,000	70	11	26,923	6
1,351,351	86	2	114,865.00	7
1,148,649	86	2	94,355.00	7
945,946	86	2	80,406.00	7
5,000,000	86	2	408,162.00	7
2,027,027	86	2	165,445.00	7
574,324	86	2	47,497.00	7
804,054	86	2	66,242.00	7
4,250,000	86	2	342,050.00	7
1,500,000	86	2	113,987.00	7
975,000	76	22	17,880	7
1,085,885	71	21	49,812	8
6,500,000	84	1	279,833	8
5,000,000	82	2	356,648	8
2,000,000	82	1.9	163,037	8
2,000,000	82	2	88,262	8
500,000	79	7	18,932	9
350,000	69	10	5,033	9
500,000	75	5	15,878.00	10
5,000,000	75	3	146,025.00	10
1,000,000	75	3	32,004.00	10
1,000,000	77	11	47,000.00	12
1,125,000	77	10	37,580.00	12
750,000	77	10	6,098.00	12
2,000,000	74	6	56,146	12
5,000,000	77	11	152,638.00	12
2,000,000	70	6	30,000	14
700,000	67	1	17,473.00	16
17,500,000	72	2	248,143	17
17,500,000	72	3	296,947	17

Exhibit 2

	Average
Face Amount	3,094,635
Age	80
Years in Force	6
Current Cash Surrender Value	287,517
Annual Premium	133,274
LE	9

This block of senior life settlement has an average death benefit of $3,094,635 with an average premium of $133,274. The average age of the settlers is 80 with an average life expectancy (LE) of 9 years. The average cash surrender value is $287,517.

Exhibit 3

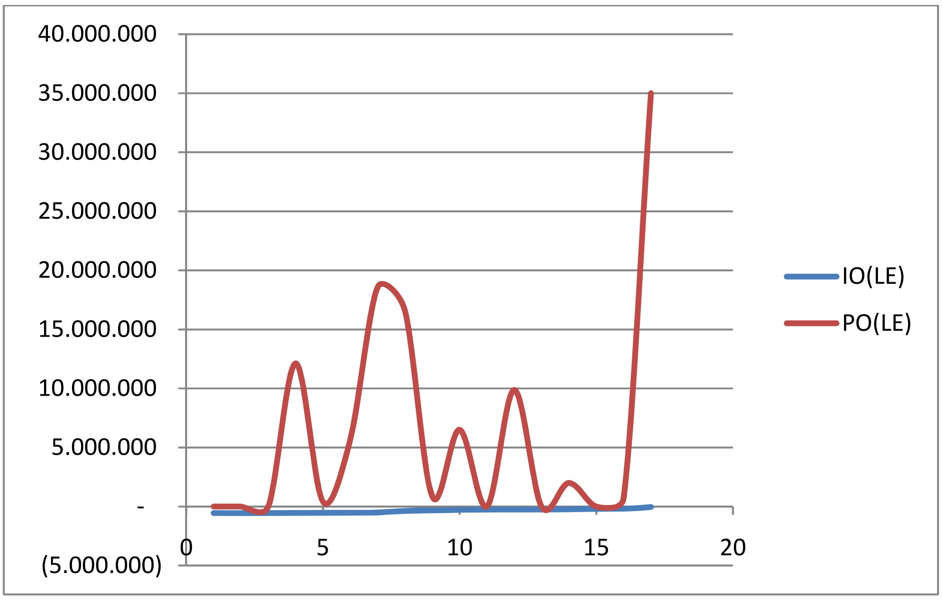


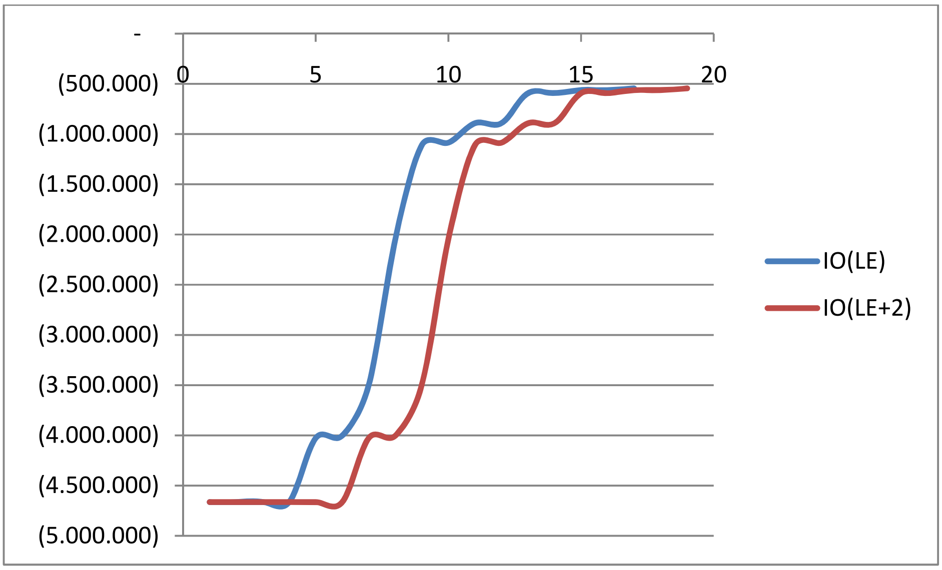
Exhibit 3 graphs the cash flows generated over time for the PO security and the IO security, both backed by the block of senior life settlements in Exhibit 1. The PO has a cash flow that is not continuous, with picks only, because it is only when a settler dies that a death benefit is paid. In between death, the cash flow is zero.

The cash flow of an IO security is negative as it is the cumulative premia payments for the life settlements outstanding at each point in time. Over time, settlers die, so less life settlements remain in the pool and the cumulative premia to be paid over time decreases accordingly.

The cash flow of both PO and IO securities in Exhibit 3 are based on the individual senior life settlement's LE in Exhibit 1.

In exhibit 4 we graph the IO under the same life expectancy of LE from Exhibit 1, and an IO with life expectancy of LE+2, to show the risks associated with a life extension of 2 years. The area between the two curves shows the amount of additional negative cash flows over time.

Exhibit 4



The value of the IO security at LE is -$25,482,220 and increases in negative value by more than 16% at LE+2 to -$29,653,400, when we use a 9% discount rate. What this really means is that at the time of the securitization of the block of senior life settlement, there is a need of $25,482,220 to finance all future premia under the LE of each senior life settlements backing such securitization transaction, and a need of $29,653,400 if the life settlers live an additional two years to LE+2.

Exhibit 5

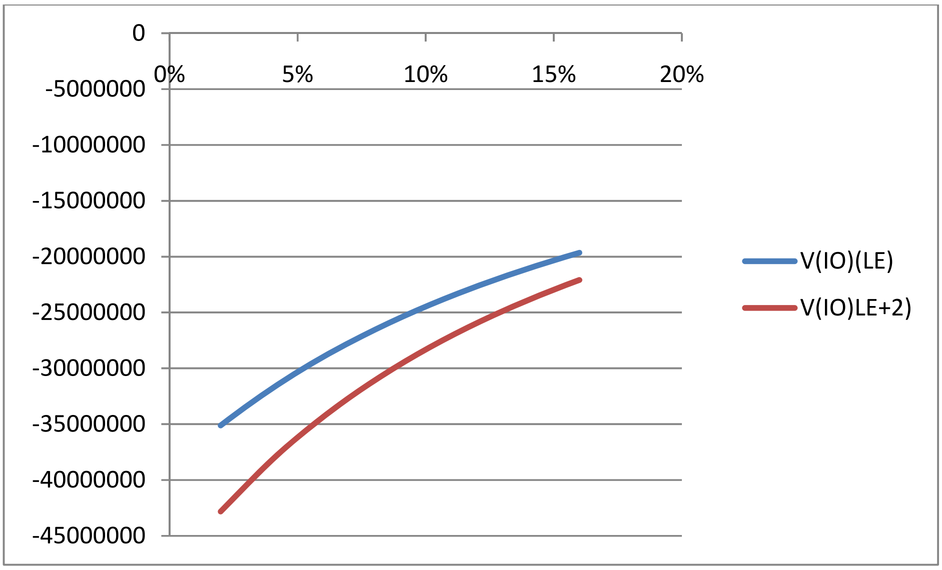
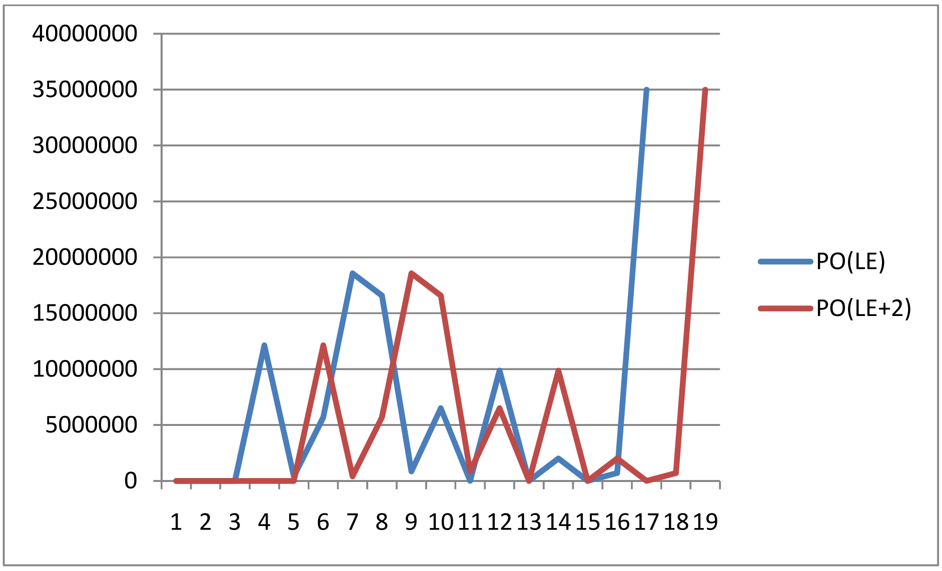


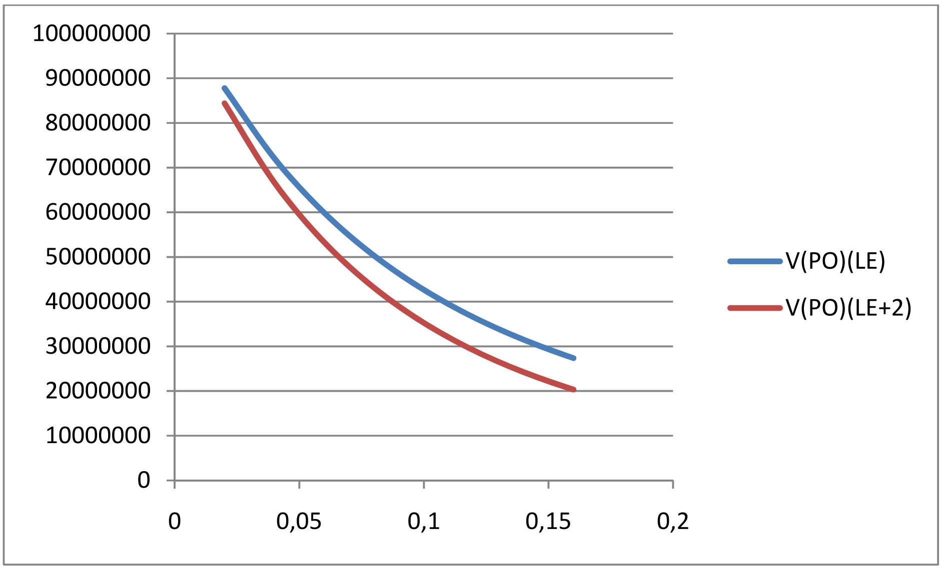
Exhibit 5 shows that the value of the IO increases (the negative value decreases) as market rates increase, and that it increases faster with life extension. We can observe that the value of the IO under LE+2 increases faster that the value of the IO under LE, and that the distance between the two curves is larger under low market rates and narrows as market rates increase.

Exhibit 6



The value of the PO security at LE is $46,244,451 and decreases by almost 16% at LE+2 to $38,923,029, when we use a 9% discount rate.

Exhibit 7



With life extension risk, the opportunity cost for a PO holder becomes stronger as market rates increase. We can see in Exhibit 7 how the PO with LE+2 decreases faster than the PO with LE, as market rates increase.

HEDGING A IO SECURITY BACKED BY SENIOR LIFE SETTLEMENTS

Exhibit 7

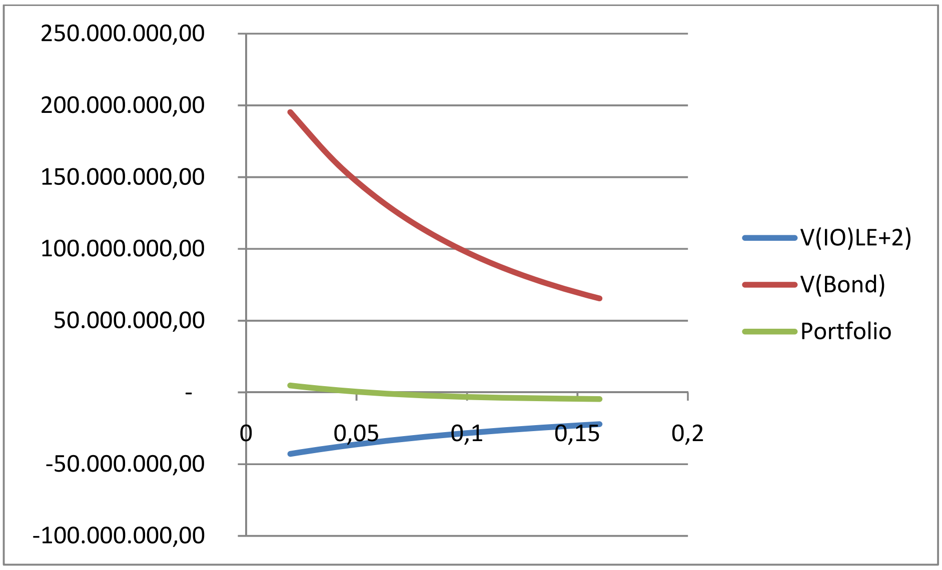


Exhibit 7 graphs, under a range of market rates ranging from 2% to 16%, the value of the IO backed by our initial block of senior life settlements; the value of a bond with an 11.11% coupon rate, 15 year maturity, $90,000,000 Face value; and a portfolio of 50% of the IO backed by the block of senior life settlements and 50% of the $90 million face value bonds.

We can observe that the portfolio is hedged against interest rate risk.

STRATEGIE

- Use the proceeds from securitized senior life settlements towards the difference between the present value of death benefits and the present value of premia.
- This amount should be invested in interest bearing bonds.
- The interest earned on these bonds should be put towards the premium payments.

CONCLUSION

The securitization of senior life settlements is still in its infancy. There have been only a few public deals, since the first in 2004. There is still so much to be done to address the different needs investors have. In this paper we have presented an innovative approach by creating an IO security and a PO security for investors having different expectations about the life expectancy of a securitized pool of senior life settlements. We hope that our paper triggers more discussions on potential new structured securities backed by senior life settlements.

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