Securitization of Senior Life Settlements: *Managing Extension Risk*

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In January 2004, the first securitization of senior life insurance policies was issued in the market. It was a securitization consisting of $63 million of class A senior life settlements backed by $195 million in face value of life insurance policies, issued by Tarrytown Second, LLC. The second such securitization, for an amount of $70 million, was issued in April 2004 by Legacy Benefits as a private placement. The securitization of life insurance policies is not new. In the early 1990s those with terminal diseases and a life expectancy of no more than 2-3 years could sell their life insurance policies at a discount from face value to different companies, which in turn would securitize them (viaticals). Viaticals lost their popularity when the lives of viators, particularly those affected with AIDS, were extended by the development of new drugs. Companies had to convert from buying life policies from terminally ill viators to buying life policies from senior life settlers. The valuation of this latter type of securitization remains tricky because of the underlying asset, which can generate negative cash flows early on, and its unusual form of risk: life extension risk. We develop a model that incorporates life extension risk, develop a new security (the targeted termination class) to protect investors from this risk, and propose an innovative approach to measuring the sensitivity of the value of senior life settlement-backed securities to changes in the number of years lived beyond settlers' life expectancy, the le-duration. The le-duration will be a necessary measurement for investors in senior life settlement-backed securities.

The idea of securitizing life insurance policies is not new in itself. Viatical settlements started in the late 1980s, when companies such as Legacy Benefits and Dignity Partners purchased life insurance policies from people with terminal diseases (e.g., AIDS) when no treatment was available.

People with terminal diseases have a hard time paying premia on their life insurance policies and often have high expenses in the form of medical bills and the costs of additional medical assistance. When approached by companies such as Dignity Partners, those with terminal diseases had the opportunity to sell their life insurance policies at a discount on the face value to be received by the beneficiaries and were at the same time able to shift the responsibility of paying the life insurance premia to the companies buying their policies by making them the new beneficiaries of the policy. The companies contacted only those with a life expectancy of perhaps two to three years.

In July 1996, papers presented at the International AIDS Conference in Vancouver documented strong clinical evidence that a new class of drugs known as protease inhibitors, used in combination with AZT, would reduce substantially, even perhaps to zero, the level of human immunodeficiency virus (HIV) detectable in the blood of people previously diagnosed with AIDS. The research presented at the Vancouver conference came as a shock, which was reflected in the collapse of Dignity Partner's value and the significant

EXHIBIT 1
Disease Diversity

Disease or Category	Examples	Limits
Cardiovascular	Coronary Artery Disease, Arrthymia, Other (e.g. Heart Valve Disease)	30%
Cerebrovascular	Stroke, Carotid Artery, Transient Ischemic Attack	10%
Dementia	Alzheimer's, Multi-Infarcts	15%
Cancer	Lung, Prostate, Breast, Hematological, All Other Cancers	15%
Diabetes		10%
Respiratory Diseases	Emphysema,Asthma,Sleep Apnea Chronic Obstructive Pulmonary Diseases	10%
Neurological Disorders (Excluding Alzheimer's)	Parkinson's Disease, Lou Gherig's Disease (ALS)	15%
Other/No Disease	Renal Failure, Peripatetic Vascular, etc.	20%
Multiple		20%
HIV/AIDS		0%

EXHIBIT 2
Typical Distribution of Available Life Expectancies

Life Expectancy (LE)	% of Insured in LE Category
LE<= 36 months	1
36 months<LE<=72 months	12
72 months<LE<=108 months	30
108 months<LE<=144 months*	30
144 months<LE<=180 months	17
180 months<LE<=216 months	8
LE>=216 months	2

*As a practical matter, the life expectancies that are found most commonly in life settlement transactions are normally 12 years or less. Source: A.M. Best, October 2004.

increase in the discount on face value paid to viators for their policies. From a high of $14.50 in 1996, the price per share of Dignity Partners fell to $1. Policies that before the Vancouver conference had been selling at between 50 and 80 cents on the dollar fell to as low as 30 cents.

Life settlements are similar to viaticals in the sense that both viators (insured with a terminal disease) and life settlers (insured with a life expectancy of 10 years or less because of age) sell their life insurance policies at a discount on the face value of the benefit.

Longevity risk (or extension risk) is the key to the cash flow valuation of securitized pools of life settlements. Similar to mortgage-backed securities, whose value is affected mainly by prepayment rates, the value of securities backed by life settlements is fundamentally affected by death rates. Many proprietary models have been developed to value mortgage-backed securities, but few have been developed to value those backed by life settlement.

We develop a model that can accurately value life-settlement-backed securities. Mortality risk rather than prepayment risk is the determining parameter in the model. Just as with mortgage-backed securities, credit risk, interest rate risk, and prepayment risk can be redistributed to some investors and away from others; extension risk in life settlement securitization can be allocated to one group of investors, away from those not willing to absorb it. We develop new structures for this innovative type of securitization.

THE UNDERLYING ASSET: SENIOR LIFE SETTLEMENTS

In order to diversify the pool and reduce the life expectancy correlation among life settlers, A.M. Best (an international insurance rating and information agency founded in 1899 by Alfred M. Best) recommends that the statistical distribution of diseases be limited as shown in Exhibit 1 before securitizing such a pool. In the event of the development of new drugs to treat a specific disease, life settlers with the same disease would experience an increase in life expectancies, so correlation must be minimized.

Other requirements from A.M. Best for a pool of senior life settlement to be securitized are that

1. the pool should have a minimum of 200 settlers;
2. no single life benefit should exceed 3.33% in face value of the entire pool's face value;
3. insurance companies providing life insurance must have financial strength ratings (FSRs) of B+ or higher;
4. the aggregate face value of the policies issued by any one insurance company should not exceed 15%;
5. each senior life settler must have had an evaluation by at least two independent medical examiners in the past 12 months before entering the pool, to obtain an estimate of life expectancy.

Exhibit 2 shows the typical distribution of life expectancies of senior life settlers, which we will use as a base case for our simulated underlying pool of life settlers

Exhibit 3

Number of Settlers Dying at Each Point in Time

$$d_1, \ldots, d_{36} = 1/36 = .02778$$
$$d_{37}, \ldots, d_{72} = 12/(72\text{-}36) = .3333$$
$$d_{73}, \ldots, d_{108} = 30/(108\text{-}72) = .83333$$
$$d_{109}, \ldots, d_{144} = 30/(144\text{-}108) = .83333$$
$$d_{145}, \ldots, d_{180} = 17/(180\text{-}144) = .47222$$
$$d_{181}, \ldots, d_{216} = 8/(216\text{-}180) = .22222$$
$$d_{217}, \ldots, d_{225} = 2/(225\text{-}216) = .22222$$

Exhibit 4

Death Rate over Time Based on Typical Distribution of Life Expectancies

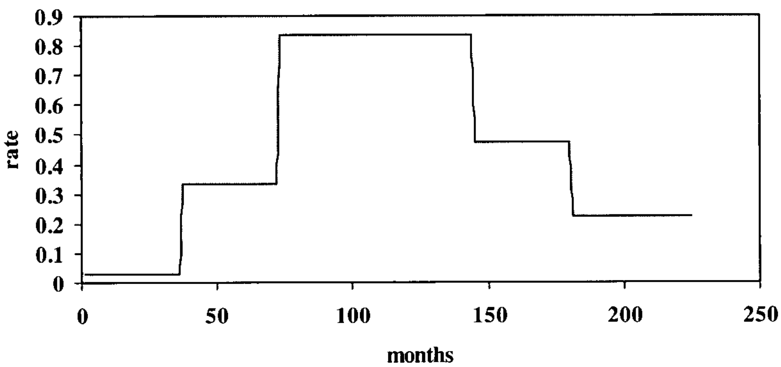
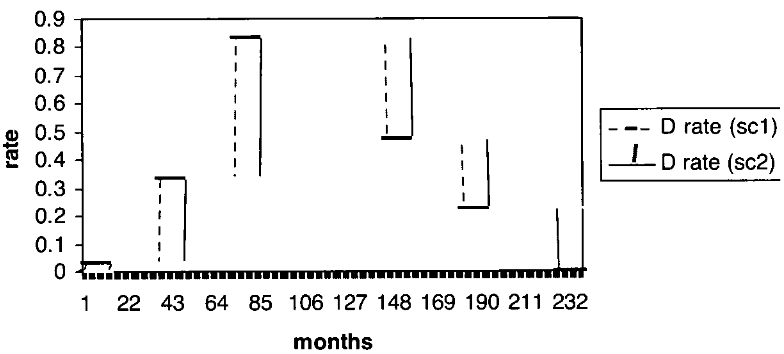


Exhibit 5

Death Rate over Time Based on Two Different Scenarios



being securitized. Following the typical distribution of life expectancies from Exhibit 2 and assuming we securitize a pool of 100 life settlers (m_0), the number of settlers from the pool dying at each point in time (d_t) is computed over a total of n periods (n = 225) as shown in Exhibit 3. The rate of death based on the typical distribution of life expectancies (which we call scenario 1) is graphed in Exhibit 4.

Exhibit 5 graphs the death rate over time under different scenarios. Scenario 1 is the base case; scenario 2 shifts the distribution of the death rate in scenario 1 by 12 months (life extension by 12 months relative to the base case).

Note that most insurance companies use as a reference the life expectancy as a function of mortality rating, based on the 2001 Valuation Basic Table (VBT). For example, a 75-year-old male non-smoker with a 100% mortality rating is expected to live 14 years. With a mortality rating of between 150% and 300%, he would be expected to live between 8.5 and 12 years based on the 2001 VBT. Life expectancy is defined as the time in which 50% of the people in the age category become deceased (A.M. Best [2005]).

$$m_t = m_0 - \sum_{j=1}^{t} d_j \quad (1)$$

Before an asset can be securitized, it is important to understand and be able to estimate the cash flow generated by the asset for the issuer to successfully place the asset-backed security in the market. We next estimate the cash flows of the senior life settlements under different simulated scenarios and develop a valuation approach.

VALUATION OF SENIOR LIFE-SETTLEMENTS-BACKED SECURITIES

The number of settlers remaining in the pool decreases over time as some members die. Equation (1) illustrates the number (m_t) of settlers left in the pool at time t, computed by deducting the cumulative number of deaths up to time t from the original number (m_0) of settlers.

In Exhibit 6 we graph the number of life settlers remaining in the pool under two

EXHIBIT 6

Number of Life Settlers Left in the Pool

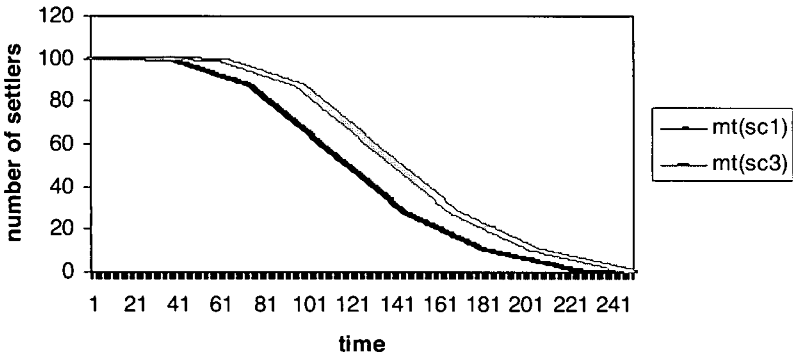
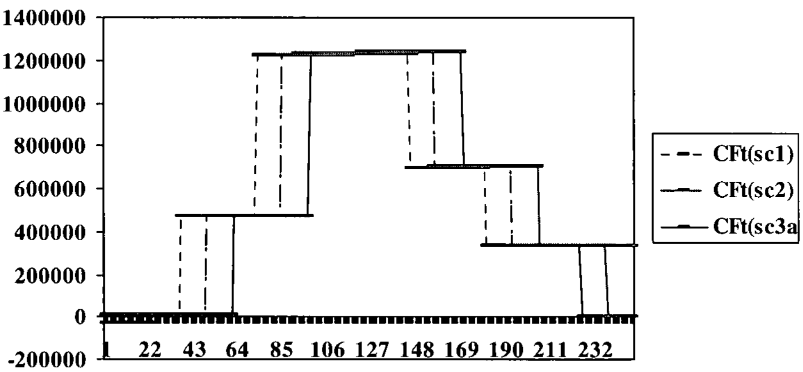


EXHIBIT 7

Cash Flows over Time under Three Scenarios



different death scenarios, with scenario 3 showing the greater life extension.

We define premium paid at the end of each month as P and the life benefit received by the beneficiary at the time of the senior life settler's death as B. The number of premia paid to life insurance companies is a function of the number of life settlers left in the pool at each point in time (m_t); the number of life benefits paid by life insurance companies at each point in time is a function of the number of settlers dying during that period (d_t). For simplicity, we assume that P and B are the same for each of the policies in the pool.

$$
\begin{aligned}
CF_1 &= -m_0 P + d_1 B \\
CF_2 &= -m_1 P + d_2 B \\
&\cdots \\
CF_t &= -m_{t-1} P + d_t B
\end{aligned}
\tag{2}
$$

Under scenario 1 the cash flows are positive from the very beginning; under scenario 2 the cash flows are negative for the first 12 months and then, as life settlers start to die, the life benefits create positive cash flows by outweighing the negative premia; under scenario 3 it is only after 24 months that cash flows become positive (Exhibit 7).

Because of the nature of the pool of life settlements, with only a few deaths occurring early on, and therefore negative cash flows early on, a liquidity facility must be provided to the issuer of the securities backed by senior life settlements. If there are life settlements outstanding in the pool when the asset-backed security matures, the issuer has to sell/liquidate them in order to pay the investors fully.

The value of a securitized pool of senior life settlements, V(SLS), is then computed by summing the discounted cash flows to the present at the appropriate rate r:

$$
V(\text{SLS}) = \sum_{t=1}^{n} CF_t / (1+r)^t \tag{3}
$$

Exhibit 8 graphs the value of a pool of 100 life settlements under 10 different death rate scenarios. As above, scenario 1 is the base case, and each subsequent scenario shifts death rate by 12 months.

Note that we have not taken into account the cost of credit enhancement or other fees because it is not the focus of this article. The model can, however, be easily readjusted by deducting these costs from the cash flows to be received by investors.

PROTECTING INVESTORS FROM LIFE EXTENTION RISK: THE TARGETED TERMINATION CLASS (TTC)

Just as investors in mortgage-backed securities can be protected from prepayment risk by creating planned amortization classes (PACs) with corresponding companion classes, we propose a new type of security, the targeted termination class (TTC), also with its corresponding companion class.

Investors in securitized senior life settlement may be informed that the valuation of the security and its projected cash flows are based on "scenario 2-death rate."

EXHIBIT 8

Values of 100 Life Settlements with Difference Death Rates

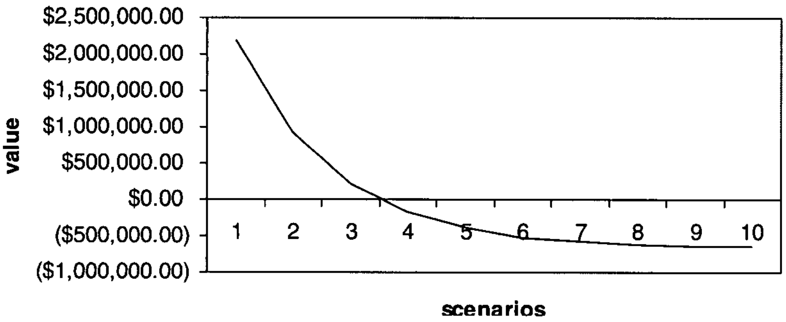
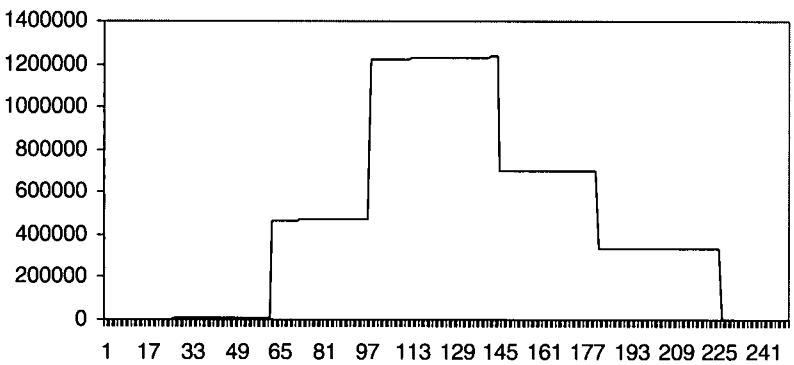


EXHIBIT 9

The Targeted Termination Class:
Scenario 1 < TTC Band < Scenario 3



Investors understand that they could be confronted with different death rate scenarios, and some may want to invest in a security that is minimally affected by changes in death rate scenario. It is possible to create a security backed by senior life settlement with no uncertainty in cash flows to be received by taking the common area of two different scenarios. For example, going back to Exhibit 7, we can carve out the area common to scenario 1 and scenario 3 and create a separate security, the TTC, shown in Exhibit 9. As long as the realized death rate is between these two scenarios, we can guarantee that investors in the TTC will receive known cash flows at each point in time. Of course, if death rates are lower than those in scenario 1 or higher than those in scenario 3, the common area is not realized. When issuing the TTC, a specified band of death rates must be provided to investors with the understanding that the cash flows to be received on the security cannot be met when death rates are below or above that predefined band. Just as with PACs, a companion class must be created simultaneously to shift the extension risk to a group of investors willing to absorb it in exchange for a premiumcompensation: Exhibit 10 displays the cash flows of scenarios 1 and 3 that do not share common areas.

LIFE EXTENSION DURATION: A NEW MEASUREMENT

We introduce a new type of duration, which we call *le-duration* for life extension duration. The Macauley and modified durations are measures of the price sensitivity of fixed-income securities to changes in yield. These durations are still valid for securities backed by senior life settlements but do not capture the life extension risk. As shown in Exhibit 8, the value of a securitized portfolio of senior life settlements decreases as life settlers live beyond life expectancy. How sensitive the value of these securities is can be determined by *le-duration*, which we first derive for an individual senior life settlement as follows:

$$le\text{-}duration = [\%\ \Delta V(\text{sls})]/[\%\Delta t] \tag{4}$$

or

$$le\text{-}duration = [\Delta V(\text{sls})/\Delta t]\ [t/V(\text{sls})]$$

which is the first derivative of the value of a senior life settlement relative to changes in t, subsequently multiplied by t and divided by the value of the life settlement.

The value of an individual senior life settlement is

$$V(\text{sls}) = -P[1/(1+r)^1 + 1/(1+r)^2 + \ldots + 1/(1+r)^n] + B/(1+r)^n \tag{5}$$

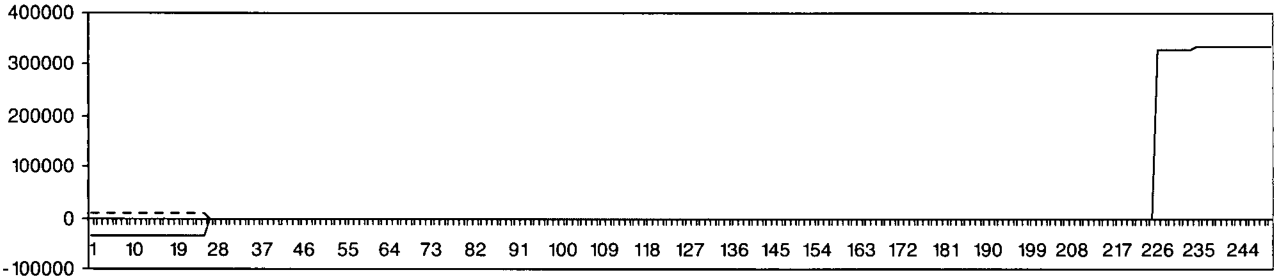
Letting $a = 1/(1+r)$, Equation (5) can be rewritten as

$$V(\text{sls}) = -P[a^1 + a^2 + \cdots + a^n] + Ba^n \tag{6}$$

Invoking the geometric series identity $[1+a^1+a^2+\cdots+a^n = (1+a^{n+1})/(1-a)]$ and rearranging, we obtain

$$V(\text{sls}) = \{[P/(1-a)] + B\}\ a^t \tag{7}$$

EXHIBIT 10
Companion Class sc1 < TTC Band > sc3



We can now take the first derivative relative to changes in t:

$$V(\text{sls})/\Delta t = [B + P/(1-a)]\, a^t \ln(a) \quad (8)$$

and, after multiplying the first derivative by t, dividing it by the value of the life settlement, and substituting $1/(1 + r)$ for a, we obtain the *le-duration*:

$$\textit{le-duration} = t\ln[1/(1 + r)] \quad (9)$$

The result of the *le-duration* is negative, as we expected. The longer a life settler lives beyond life expectancy, the less valuable is the senior life settlement.

Investors are interested in finding the percentage change in value of a life settlement relative to changes in time, rather than relative to percentage changes in time, so for practicality we can derive *modified le-duration* by dividing the *le-duration* by t:

$$\textit{modified le-duration} = \ln[1/(1 + r)] \quad (10)$$

Investors in pools of senior life settlements can evaluate a pool's sensitivity to life extension Δt using the *modified le-duration* of the pool:

$$[\%\ \Delta V(\text{SLS})] = \Delta t\ln[1/(1 + r)] \quad (11)$$

The percentage change in value of the pool $[\%\Delta V(\text{SLS})]$ given a change in time due to life extension or reduction (Δt) is equal to the pool's *modified le-duration* $\ln[1/(1 + r)]$ multiplied by the life extension/reduction Δt.

For example, if we use a discount rate r of 10% per year (0.833% per month) and a life extension of two months ($\Delta t = 2$), the percentage change in the value of the pool $[\%\Delta V(\text{SLS})]$ will be equal to -1.66%:

$$\begin{aligned}[\%\Delta V(\text{SLS})] &= 2 \times \ln[1/(10.1)] \\ &= 2 \times (-0.0083) = -0.0166\end{aligned}$$

For a discount rate of 5% per year (0.4166% per month), the percentage change in the pool's value is $2 \times (-0.00416) = -0.008316$ or -0.8316%.

In order to compute the *le-convexity* we take the second derivative of the value of senior life settlement and obtain:

$$\textit{le-convexity} = \Delta^2 V(\text{sls})/\Delta t^2 = [B + P/(1-a)]a^t \ln(a^2) \quad (12)$$

We have a positive convexity, which means that as a life settler lives for less time than life expectancy, the value of the settlement increases at an increasing rate.

CONCLUSION

As of December 2005 only 3 pools of senior life settlements had been securitized publicly. A few private securitization transactions have been placed, mainly in Germany and Australia for tax purposes. The first public transaction, in January 2004, issued by Tarrytown Second LLC, was $63 million of class A 7% annual coupon asset-backed bonds, maturing in December 2011 (7-year bond), collateralized by $195 million in face value of life insurance policies, and was assigned an AA− rating by A.M. Best. The life settlers in the underlying pool had life expectancies ranging from 4 to 7 years.

The second public life-settlement-backed security was issued on April 30, 2004, by Legacy Benefits Life Insurance Settlements 2004-1 LLC, for a total amount of $70 million. The issue included two tranches, a class A note ($61,500,000 with a 5.35% coupon) and a class B note ($8,500,000 with a 6.05% coupon) rated A1 and Baa2, respectively, by Moody's, both maturing in 2039. Typically, asset-backed securities have an embedded cleanup option; when the underlying pool has less than 10% of the initial balance, the issuer has the option to pay the remaining principal to security holders at once. This avoids unnecessary transaction costs and management fees, for the few life settlements remaining in the pool at some point. The underlying pool had senior life settlers with an average age of 77. Most of the insurance companies providing life insurance to the senior life settlers had an Aa3 or better rating.

The third public life settlement securitization transaction was launched by Tempo Financial in March 2005.

As of December 2004, the statistics showed that each year $1.5 trillion in life insurance lapses or is surrendered. It is estimated that $150 billion in face value is eligible for life insurance settlement, with a projected eligible face value of more than $800 billion by 2010. Currently, only $2 billion in face amount is sold through the senior life insurance process each year. Securitization is a financing approach for companies investing in life settlements with which it will be possible to reallocate the different risks associated with life settlements (mainly life extension risk) to different groups of investors, just as has been done with mortgage-backed securities. Finally, securitized pools of senior life settlements can be used by life insurance companies to hedge their portfolios of life insurances provided to individuals against the risk of premature death.

ENDNOTE

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