THE IMPACT OF THE SECONDARY MARKET ON LIFE INSURERS' SURRENDER PROFITS

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ABSTRACT

Life insurers often claim that the life settlement industry reduces their surrender profits and leads to an adverse shift in their portfolio of insured risks, i.e., bad risks remain in the portfolio instead of surrendering. In this paper, we aim to quantify the effect of altered surrender behavior—subject to the health status of an insured—in a portfolio of life insurance contracts on the surrender profits of primary insurers. Our model includes mortality heterogeneity by applying a stochastic frailty factor to a mortality table. In the course of our investigation, we additionally analyze the impact of the premium payment method by comparing results for annual and single premium payments.

1. INTRODUCTION

In the life settlement market, life insurance policies of senior citizens with below-average life expectancy are traded.[1] With purchases of about $6.1 billion in face value in 2006, the U.S. life settlement industry is of considerable volume.[2] However, the benefits and detriments of a secondary market for life insurance are controversial.[3] In general, primary insurers have historically profited from lapse or surrender of

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1 See, e.g., Doherty and Singer (2002, p. 4).

2 See Conning & Company (2007). As the population ages, the potential of this secondary market generally increases. See Bhattacharya et al. (2004, p. 643), Doherty and Singer (2002, p. 4), Giacolone (2001, p. 6), and Maple Life Financial (2007, p. 3).

3 From an insured's perspective, see Deloitte Consulting LLP and the University of Connecticut (2005), as well as the corresponding discussion in Singer and Stallard (2005). From an insurer's perspective, see Jenkins (2006).

policies,[4] especially by insureds with impaired health.[5] Adverse selection against insurance companies due to secondary market activity may lead to a decline of those profits, which is particularly true for lapse-supported products, i.e., policies that are priced based on persistency assumptions. This may result in the need to charge higher premiums or could decrease the safety level of life insurance companies.[6] Even though this is a very topical issue in practice, no quantitative analyses have been conducted before. The aim of our paper is to fill this gap and investigate the impact of altered surrender behavior on an insurer's surrender profit. We provide a model framework to quantify the effects of reduced surrender rates subject to the health status of insureds in a mortality heterogeneous universal life insurance portfolio.

To date, the secondary market for life insurance has not received much attention in the academic literature. Giacolone (2001) provides a short overview, describing the development of the life settlement industry, limitations on the market, and sources of competition. Bhattacharya et al. (2004) empirically analyze the impact of state regulation on the viatical settlement market by estimating welfare losses.[7] The benefits of a secondary market for policyholders and life insurance carriers are examined in Doherty and Singer (2002). These authors discuss the effects of modified surrender behavior due to secondary market activity but their aim is not to perform quantitative analyses in this respect from an insurer's perspective (see also Doherty and Singer, 2003). Doherty and Singer (2003) state that more than 20% of all policyholders above age 65 could consider selling their policy to the secondary market as an attractive alternative to lapse or surrender.

Most of the literature dealing with the surrender of life insurance contracts concerns itself with valuation of the surrender option, e.g., Albizzati and Geman (1994), Bacinello (2001, 2003a, 2003b, 2005), Grosen and Jørgensen (1997, 2000), Jensen et al. (2001), Steffensen (2002), and Tanskanen and Lukkarinen (2003). In addition, Bacinello (2005) reveals differences in surrender option value between policies with single or annual premium payments. In Outreville (1990), the emergency fund hypothesis is examined, which claims that surrender values serve as an emergency fund for policyholders in times of personal financial illiquidity. The hypothesis implies that the surrender decision is not primarily triggered by the development of interest rates. Tsai et

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4 When a policy lapses due to insufficient premium payments, the contract is terminated without payout to the policyholder. This understanding of policy lapse is in contrast to exercise of the surrender option, where the cash surrender value of the policy is paid out.

5 See Doherty and Singer (2002, pp. 15–16).

6 See Doherty and Singer (2002, p. 6).

7 In the viatical settlement market, policies of insureds with a considerably reduced life expectancy of less than two years are traded.

al. (2002) simulate the distribution for policy reserves in a pool of policies being considered for early surrender. Their analysis is based on an estimated empirical relation between surrender rates and interest rate. Kim (2005) describes surrender rates, using various explanatory variables based on different surrender rate models, and finds appropriate modeling assumptions for four policy types.

In this paper, we quantitatively examine the effects of modified surrender behavior as implicated by the secondary market from an insurer's perspective for the first time. Mortality heterogeneity in the insurance portfolio is taken into account by employing a continuously distributed frailty factor to a deterministic mortality table. The surrender dates are generated based on constant annual surrender rates. The joint mortality and surrender distribution is implemented using a double-decrement model as presented in Sanders (1968).

In a simulation analysis, we quantify surrender profits for a portfolio of universal life policies using present values. In the base case, constant surrender rates and a surrender charge induce a positive surrender profit for the insurance company. In this setting, a decrease in surrender rates implies a reduction of surrender profits. However, we find that this effect is considerably enhanced when taking into account adverse selection. In this case, only good risks surrender, whereas insureds with reduced life expectancy choose the secondary market alternative and thus remain in the pool of insureds. Our results show that this behavior not only reduces surrender profits, but can even lead to a loss. One main finding is that the premium payment method—single or annual—has a substantial impact on surrender profits reduction. In particular, in the case of the more common annual premiums, surrender profits decline much more compared to the single premium case.

The remainder of the paper is structured as follows. In Section 2, we present our model framework including the life insurance contract, mortality heterogeneity, and the double-decrement model. Numerical analyses and policy implications are discussed in Section 3. Section 4 summarizes the main findings.

2. THE MODEL FRAMEWORK

The model of mortality heterogeneity

Mortality heterogeneity is considered by means of a stochastic frailty factor[8] applied to a given deterministic mortality table. The one-year individual probability of death of a

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[8] See Jones (1998, p. 81) and Vaupel et al. (1979, p. 440).

person age x is thus given by the product of the individual frailty factor $d \in \mathbb{R}_0^+$ and the annual probability of death q'_x from the mortality table:

$$q_x^M(d) = \begin{cases} d \cdot q'_x, & d \cdot q'_x < 1 \\ 1, & x = \min\left\{\tilde{x} \in \{0,\ldots,\omega\} : d \cdot q'_{\tilde{x}} \geq 1\right\} \\ 0, & \text{otherwise} \end{cases} \qquad \text{with } x \in \{0,\ldots,\omega\},$$

where ω is the limiting age of the mortality table. For $d < 1$, we let $q_\omega^M(d) := 1$. The superscript "*M*" stands for mortality probabilities. The parameter d specifies an insured's state of health. When $0 < d < 1$, the individual has an above-average life expectancy. The case of $d = 1$ corresponds to an insured with normal health, and when $d > 1$, the person is impaired.[9] For a given frailty factor d, the random variable $K^M(x,d)$ denotes the individual remaining curtate lifetime. Its distribution function ${}_k q_x^M(d)$ at a point $k \in \mathbb{N}_0$ results in

$${}_k q_x^M(d) = F_{K^M(x,d)}(k) = P\left(K^M(x,d) \leq k\right) = 1 - {}_k p_x^M(d) = 1 - \prod_{l=0}^{k-1}\left(1 - q_{x+l}^M(d)\right),$$

where ${}_k p_x^M(d)$ is the individual k-year survival probability. The frailty factor d is a realization of a random variable D.[10] For its distribution F_D, we follow the assumptions in Hoermann and Ruß (2008): We let F_D be a continuous, right-skewed distribution on $\mathbb{R}_0^+$ with an expected value of 1, such that the mortality table describes an individual with normal health. As probabilities of death approaching zero are not realistic, the probability density function f_D is flat at zero, with $f_D(0) = 0$. The distribution of the stochastic frailty factor D represents the distribution of different states of health and thus of different life expectancies in a portfolio.

Net present value and premiums of the life insurance contract

We consider a portfolio of lifelong universal life insurance contracts purchased by insureds who are all the same age *x* at inception. In case of death, each policy pays a fixed face amount *Y*. Policyholders pay either a single premium B^s or constant annual premiums B^a. From the insurer's perspective, the net present value (NPV^D) of one average policy in the pool can be calculated by the difference of expected premium payments (paid at inception or at the beginning of each year until the stochastic year of death $K^M(x,D)$) and the expected benefit payment (paid at the end of year

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9 See Hoermann and Ruß (2008, pp. 5–6).

10 See Jones (1998, pp. 80–83), Pitacco (2003, p. 14), and Vaupel et al. (1979, p. 440).

$K^M(x,D)$). The constant interest rate is denoted by *i*. Hence, the net present value in the case of annual premiums results to[11]

$$NPV^M = B^a \cdot \mathrm{E}\left(\sum_{t=0}^{K^M(x,D)} (1+i)^{-t}\right) - Y \cdot \mathrm{E}\left((1+i)^{-\left(K^M(x,D)+1\right)}\right). \tag{1}$$

Given the distribution of the frailty factor *D*, we calibrate the annual premium B^a such that the NPV^M of the policy is zero, i.e.,

$$B^a = \frac{Y \cdot \mathrm{E}\left((1+i)^{-\left(K^M(x,D)+1\right)}\right)}{\mathrm{E}\left(\sum_{t=0}^{K^M(x,D)} (1+i)^{-t}\right)}. \tag{2}$$

In the case of a single premium payment B^s, Equation (2) simplifies to

$$B^s = Y \cdot \mathrm{E}\left((1+i)^{-\left(K^M(x,D)+1\right)}\right). \tag{3}$$

Hence, death of the insured before reaching the average life expectancy based on the frailty distribution D causes a negative net present value for the insurer; an insured who survives longer than average generates a positive net present value.

Policy reserves and surrender value of the life insurance contract

In general, policyholders have the right to surrender their life insurance policy. If this right is exercised, a predetermined (cash) surrender value S_t is paid out that depends on the policy reserve V_t (cash value) at the surrender date *t*. In our model, surrender may take place only at the beginning of the year. As done in Tsai et al. (2002), the surrender payout is given by

$$S_t = \left(0.8 + 0.2\frac{t}{T}\right) \cdot V_t, \quad t = 1, \ldots, T, \tag{4}$$

where at $T = \omega - x$ the maximum attainable age is reached. We use this formula, as it accounts for common characteristics of the surrender value. It is, e.g., always higher

[11] As, e.g., in Tsai et al. (2002, p. 436), dividends, expenses, loadings, taxes, and new business are not taken into account.

than 80% of the policy reserve, and the surrender charge decreases with time.[12] According to U.S. law and as set forth in Bacinello (2003a), the cash surrender value of a life insurance policy must be less than the net single premium needed to fund future benefits.[13]

Policy reserves V_t are calculated based on the mortality table according to the following formula:[14]

$$V_t = \frac{\left(V_{t-1} + B_{t-1}\right)\left(1+i\right) - Yq'_{x+t-1}}{1 - q'_{x+t-1}}, t = 1,...,T \, , \tag{5}$$

given $V_0 = 0$. In the case of annual premium payments, $B_t = B^a$ for all t. For a single premium, $B_0 = B^s$ and $B_t = 0$ for $t = 1,\ldots,T$. In year t, the policy reserves V_{t-1} and the premium are assumed to be compounded with the constant interest rate i. In case of survival, from this value, the cost of insurance given by the product of the death benefit Y and the probability of death in year t is deducted, and the new reserve is thus given by V_t. Following the usual practice, we do not consider the surrender option when determining the policy reserves as is done in Bacinello (2003b).[15]

To avoid policy lapses, in our model, premiums and reserves must be calculated based on the same actuarial assumptions, i.e. the same interest rate i and the same mortality table; otherwise, reserves could become negative.[16] Therefore, given the premiums calculated according to Equations (2) and (3), which depend on the frailty factor distribution, we need to adjust the mortality table that is used for calculating the policy reserves in Equation (5). By using a constant multiplier m, this leads to

$$q^M_{x+t}\left(m\right) = m \cdot q'_{x+t}, \; t = 0,...,T\left(m\right) \; ,$$

with $q^M_{x+T(m)}\left(m\right) = 1$. We calibrate m such that the premium calculated under consideration of the stochastic frailty factor equals the expected benefits calculated based on the deterministically shifted mortality table. Thus, in the case of the single premium (Equation (3)), m is adjusted such that

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12 Beyond that, by substituting T by a fixed number τ with $1 \le \tau < T$, the formula allows to consider a restricted surrender charge period.

13 See Bacinello (2003a, p. 466).

14 See Bacinello (2001), Bowers et al. (1997), and Linnemann (2004).

15 See Bacinello (2003b, p. 3).

16 A (universal) life policy lapses if the cash value is insufficient to pay policy costs, see Carson (1996, p. 675).

$$B^s = Y \cdot \mathrm{E}\left(\left(1+i\right)^{-\left(K^M(x,D)+1\right)}\right) \overset{!}{=} Y \cdot \sum_{t=0}^{T(m)} {}_t p_x^M(m) q_{x+t}^M(m)\left(1+i\right)^{-(t+1)} \tag{6}$$

(analogously for annual premium payments). The death and survival probabilities in Equation (5) are then replaced, leading to

$$V_t = \frac{\left(V_{t-1} + B_{t-1}\right)\left(1+i\right) - Y q_{x+t-1}^M(m)}{1 - q_{x+t-1}^M(m)}, \tag{7}$$

for premiums calculated according to Equations (2) and (3), respectively. Based on the policy reserves given by Equation (7), the corresponding surrender value S_t can be computed by Equation (4).

The double-decrement model

The difficulty with double-decrement models lays in identifying the cause of termination, since the dependence structure between surrender and death distribution cannot be observed (one can only observe the minimum of the two causes). In this analysis, we employ the model developed in Sanders (1968). We denote the one-year surrender rate by $q_{x+t}^{(S)}(d)$ for $t = 0,\ldots,T(d)$ with $q_{x+T(d)}^S(d) = 0$ as the corresponding probability of death $q_{x+T(d)}^M(d) = 1$ for a given frailty factor d. The time until decrement $K^{MS}(x,d)$ from either death or surrender has the distribution function

$$F_{K^{MS}(x,d)}(k) = {}_k q_x^{MS}(d) = 1 - \prod_{l=0}^{k-1}\left(1 - q_{x+l}^M(d) - q_{x+l}^S(d)\right).$$

The parameter d still represents a realization of the stochastic frailty factor D. For a generated random number from the uniform distribution ($u \sim U(0,1)$), the contract is terminated in year κ if ${}_\kappa q_x^{MS}(d) \le u < {}_{\kappa+1} q_x^{MS}(d)$. Since the one-year decrement probability consists of the one-year probability of death and the one-year probability of surrender ($q_{x+\kappa}^{MS}(d) = q_{x+\kappa}^M(d) + q_{x+\kappa}^S(d)$), and can be decomposed to

$$\begin{aligned}
{}_{\kappa+1} q_x^{MS}(d) &= {}_\kappa q_x^{MS}(d) + {}_\kappa p_x^{MS}(d) q_{x+\kappa}^{MS}(d) \\
&= {}_\kappa q_x^{MS}(d) + {}_\kappa p_x^{MS}(d)\left(q_{x+\kappa}^M(d) + q_{x+\kappa}^S(d)\right) \\
&= {}_\kappa q_x^{MS}(d) + {}_\kappa p_x^{MS}(d) q_{x+\kappa}^M(d) + {}_\kappa p_x^{MS}(d) q_{x+\kappa}^S(d),
\end{aligned}$$

the interval of the year of termination $\left[{}_\kappa q_x^{MS}(d), {}_{\kappa+1} q_x^{MS}(d)\right)$ can be split into two parts to determine the cause of termination, namely

$$\left[{}_{\kappa}q_x^{MS}(d),\ {}_{\kappa}q_x^{MS}(d)+{}_{\kappa}p_x^{MS}(d)\,q_{x+\kappa}^{M}(d)\right)$$

and

$$\left[{}_{\kappa}q_x^{MS}(d)+{}_{\kappa}p_x^{MS}(d)\,q_{x+\kappa}^{M}(d),\ {}_{\kappa+1}q_x^{MS}(d)\right).$$

If the uniformly distributed random number occurs in the first interval, i.e., $u < {}_{\kappa}q_x^{MS}(d)+{}_{\kappa}p_x^{MS}(d)\,q_{x+\kappa}^{M}(d)$, death occurred; otherwise, the termination is due to surrender.[17]

In the case of annual payments, the net present value NPV^S of the policy including surrender is thus given by

$$NPV^S = B^a \cdot \mathrm{E}\left(\sum_{t=0}^{K^{MS}(x,D)} (1+i)^{-t}\right) - \mathrm{E}\left(L_{K^{MS}(x,D)+1} \cdot (1+i)^{-\left(K^{MS}(x,D)+1\right)}\right), \tag{8}$$

where the benefit L_t paid to the policyholder at the time of termination t depends on the cause of termination. In case of surrender, $L_t = S_t$; in case of death, $L_t = Y$.

Since premiums are calculated such that $NPV^M = 0$ (see Equation (1)), NPV^S is the insurance company's surrender profit. Surrender profits are generated by way of the surrender charge. In our model, for a zero surrender charge (i.e., reserves V_t are fully paid out) $NPV^S = 0$. The same is true for zero surrender probabilities, where $NPV^S = NPV^M = 0$. Thus, lowering positive surrender probabilities, ceteris paribus, reduces surrender profits.

3. Numerical Analyses

We use the U.S. 2001 Commissioners Standard Ordinary (CSO) male ultimate composite[18] mortality table with limiting age $\omega = 120$ as the basis for our numerical analyses. According to the NAIC Standard Nonforfeiture Law for Life Insurance, this table may be used to calculate cash surrender values.[19] We consider a pool of policyholders aged 45 at inception of the contract. For the frailty factor, we let D follow a generalized gamma distribution, $D \sim \Gamma(\alpha, \beta, \gamma)$, with shape parameter $\alpha = 2$, scale parameter $\beta = 0.25$, and shifted by $\gamma = 0.5$, as used in Hoermann and Ruß

[17] See also Glasserman (2004, p. 57).

[18] Composite means that no distinction is made between smokers and nonsmokers.

[19] See Singer and Stallard (2005, p. 13).

(2008).[20] For this parameterization, about 40% of frailty factors lie between 1.0 and 3.5, which for a 65-year-old male leads to life expectancies between about 9 (for $d = 3.5$) to 17 (for $d = 1$) years. For a 75-year-old male, life expectancies lie approximately between 5 (for $d = 3.5$) and 11 (for $d = 1.0$) years.[21]

The interest rate is i = 3%, the death benefit Y = \$100,000, and the constant surrender rate in the portfolio is set to $q_{x+t}^{S}(d) \equiv 4\%,\ \forall d,\ t = 0,\ldots,T$. The latter is a rather conservative assumption, as, e.g., the average surrender rate for all individual U.S. life insurance policies in 2006 was 6.6% according to the *Life Insurers Fact Book 2006*. According to A.M. Best (2007), the lapse ratio of total U.S. life, health, and fraternal insurance was 5.9% in 2006. Surrender occurs independent of the interest rate, meaning that no optimal exercise behavior is assumed. This assumption is supported by Tsai et al. (2002, p. 439), who state that, historically, no dependence between actual surrender behavior and interest rate has been observed.

Numerical results are derived using Monte Carlo simulation with 100,000 sample paths (corresponds to a portfolio of 100,000 policies). To sample from mortality and surrender rates, we use Sanders's (1968) method, as detailed in the previous section.

Base case: Surrender leads to a positive net present value for the insurer

In the base case, as described above, we first calibrate the premium such that the net present value without surrender (NPV^{M}) is zero (see Equations (2) and (3)). This implies a single premium of B^{s} = \$38,126 and an annual premium of B^{a} = \$1,795. Second, the multiplier m is calculated in order to determine the policy reserves. In both cases, it is given by m = 0.9518 (Equation (6)). The surrender profits for single and annual premium payments are set out in Table 1.

[20] The gamma distribution is a common choice for frailty models (see Olivieri, 2006, pp. 29–30). Further analysis revealed that the results are not very sensitive to changes in distributional assumptions of D.

[21] The chosen figures are realistic values for policies traded in the secondary market. See Doherty and Singer (2002, p. 4), Giacolone (2001, p. 2), Modu (2005, p. 1), and SOA Record (2005, p. 3).

Table 1: Base case with 45-year-old male policyholder at inception—premiums and surrender profits NPV^S (results for one average contract)

	Single premium	Annual premium
B^s, B^a	\$38,126	\$1,795
NPV^S, $q_{x+t}^S(d) \equiv 0\% \quad \forall d,t$	\$0	\$0
NPV^S, $q_{x+t}^S(d) \equiv 4\% \quad \forall d,t$	\$4,107	\$1,360

As a surrender charge is applied to the cash value, the surrender profits are positive for $q_{x+t}^S(d) \equiv 4\%$. Table 1 shows that surrender profits are much higher for the single premium payment (\$4,107) than for annual premiums (\$1,360). The reason for this outcome is illustrated in Figure 1. Part a) shows the number of deaths without surrender ($q_{x+t}^S(d) \equiv 0\%$) at each age, starting at 45 (first year of the contract) to the limiting age 120, for the 100,000 policies. Given the premiums in Table 1, the net present value of one contract is zero on average.

When introducing surrender rates as a second type of decrement in the portfolio, the curve showing number of deaths changes, as laid out in Part b) of Figure 1. The graph shows that the number of surrenders at the beginning of the policy duration is substantially higher compared to the number of deaths, which is due to the constant surrender rate of $q_{x+t}^S(d) \equiv 4\% \quad \forall d,t$ and very low annual probabilities of death at early ages. Death probabilities increase with age, which is why the curve of the number of deaths increases until the age of 80. The absolute number of deaths decreases after age 80 since the number of insureds in the portfolio has been substantially reduced due to previous surrenders and deaths. The total number of decrements due to death and surrender over all ages sums up to 100,000.

Part c) of Figure 1 displays deterministic net present values in the case of single and annual premiums. $NPV_t(D)$ is the difference between premium payments and the death benefit if an insured dies at age $x+t$, $t = 0,\ldots,T$ and $NPV_t(S)$ is the corresponding net present value in case of surrender, both discounted to policy inception. $NPV_t(S)$ represents the surrender profit, which depends on the surrender charge and the policy reserves (see Equation (4)).

Figure 1: Base case—number of decrements in simulation; NPV^S for surrender and death at deterministic dates

a) Number of decrements due to death without surrender for $q_{x+t}^S(d) \equiv 0\% \quad \forall d,t$

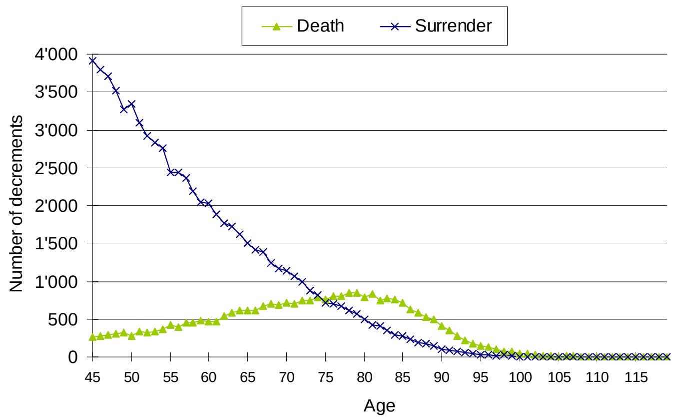
Results for portfolio: number of decrements (death only)

Results for one contract (on average)

Premium	NPV^S
Single	$0
Annual	$0

b) Number of decrements due to death and surrender for $q_{x+t}^S(d) \equiv 4\% \quad \forall d,t$

Results for portfolio: number of decrements

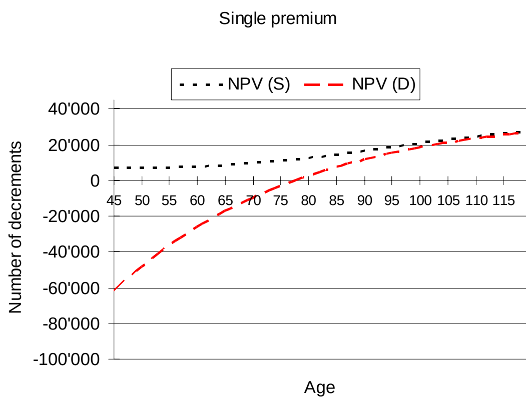


Results for one contract (on average)

Premium	NPV^S
Single	$4,107
Annual	$1,360

c) Deterministic net present values at time *t* for single and annual premium payments

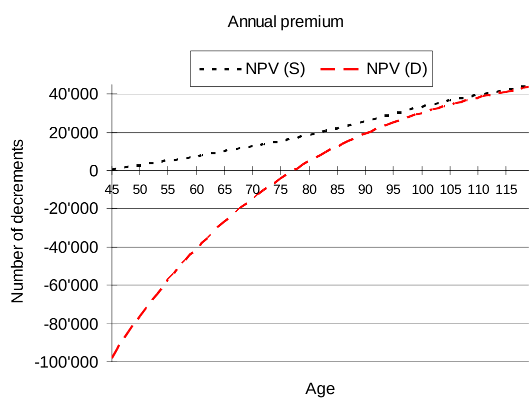
Single premium



$$NPV_t(S) = B^s - S_t(m)(1+i)^{-(t+1)}$$

$$NPV_t(D) = B^s - Y(1+i)^{-(t+1)}$$

Annual premium



$$NPV_t(S) = B^a \cdot \sum_{k=0}^{t}(1+i)^{-k} - S_t(m)(1+i)^{-(t+1)}$$

$$NPV_t(D) = B^a \cdot \sum_{k=0}^{t}(1+i)^{-k} - Y(1+i)^{-(t+1)}$$

To calculate the net present value of an average contract in the portfolio (Equation (8)) for stochastic times of surrender and death, the deterministic values $NPV_t(D)$ and $NPV_t(S)$ are weighted with the number of decrements due to death and surrender, respectively, at the time of the decrement given in Part b) of Figure 1. As shown in Part c) of that figure, $NPV_t(D)$ is much more negative in case of annual premium payments during the first 30 years of the contract than in the case of a single premium. When introducing the possibility of surrender, a substantial portion of negative net present value realizations are replaced by positive surrender profits. During the early years of the contract, $NPV_t(S)$ is higher for a single premium payment than in the annual premium case, which—given the same death and surrender rates—leads to the much higher surrender profit of \$4,107 compared to \$1,360 for the annual premium.

The impact of the secondary market on surrender profits

Surrender behavior depends on the insured's health status.[22] Individuals with above-average health are generally considered more likely to surrender; however, the pattern is not as clear-cut for those with impaired health. On the one hand, their ill health makes it less likely that they will surrender but, on the other hand, the same ill health may make them more in need of money and thus more likely to surrender. The second effect is said to be stronger, but both will have adverse effects on the insurer. To assess the impact of adverse selection on surrender profits, we specifically focus on a change in the surrender behavior of impaired individuals as implicated by the secondary market.

We first assume that surrender rates are set to zero for all policyholders with a reduced life expectancy, i.e., with a frailty factor d greater than some barrier d^*, and that surrender rates remain at 4% for all other policyholders over all ages (i.e., for all t, $q_{x+t}^{S}(d) \equiv 0\%$ if $d > d^*$ and $q_{x+t}^{S}(d) \equiv 4\%$, else). This means that, generally, the average surrender rate in the portfolio decreases. We compare the results in this secondary market scenario with the surrender profits in the base case given in Table 1. Figure 2 displays results for $d^* = 1$ and $d^* = 1.25$ (Part a) and b), respectively), i.e., impaired individuals with below-average life expectancy do not surrender their policies.

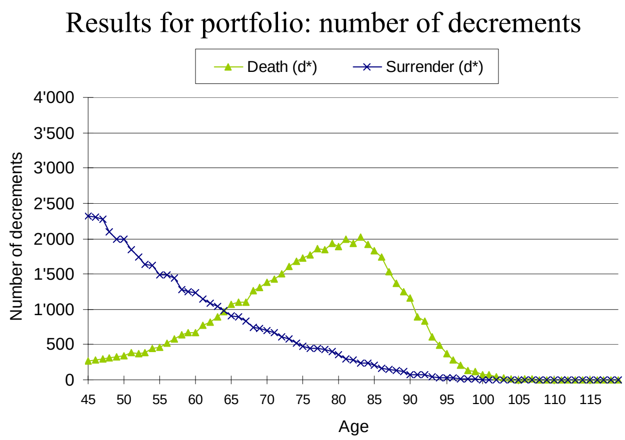
The graphs in Figure 2 show the number of decrements due to death and surrender ("Death (d*)"; "Surrender (d*)") for the case of altered surrender rates. The outcomes show that the secondary market scenario leads to much fewer surrenders compared to the base case (see Part b) in Figure 1). Thus, as we are only considering two causes of

[22] See Doherty and Singer (2002, pp. 16, 21, 2003, pp. 63–73).

decrement, a much higher number of policies is terminated by death than by surrender. In the single premium case (Part a) of Figure 2), the original surrender profit of the base case is considerably reduced from \$4,107 to \$1,781, which means a reduction of 56.6%. In the annual premium payment setting, the net present value even becomes negative, implying a reduction of more than 120%. This effect is explained by the negative selection of insured risks and the adverse interaction of surrender and death probabilities. Due to the highly negative net present value of the death benefit $NPV_t(D)$ during the early years of the contract (see Part c) of Figure 1), the annual premium payment case is considerably more affected.

Figure 2: Secondary market scenario—number of decrements due to surrender and death with $q_{x+t}^S(d) \equiv 0\%$ if $d > d^*$, $q_{x+t}^S(d) \equiv 4\%$, else, for $t = 0,\ldots,T$

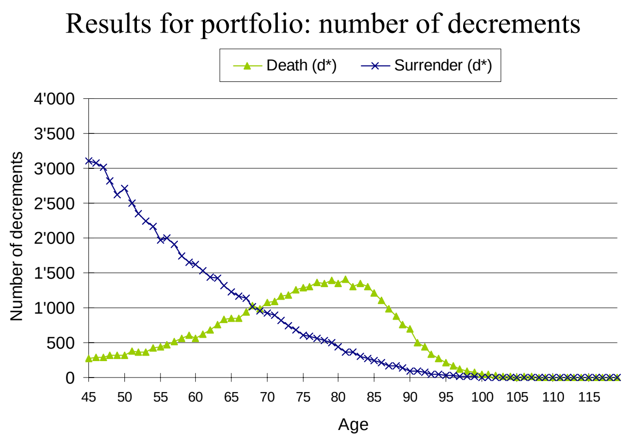
a) $d^* = 1$: Surrender rate $q_{x+t}^S(d) \equiv 0\%$ if $d > 1$; $q_{x+t}^S(d) \equiv 4\%$, else; $t = 0,\ldots,T$



Net present value and reduction with respect to base case (average contract)

Premium	$NPV^S(d^*)$	Reduction
Single	\$1,781	-56.6%
Annual	\$-313	-123.0%

b) $d^* = 1.25$: Surrender rate $q_{x+t}^S(d) \equiv 0\%$ if $d > 1.25$; $q_{x+t}^S(d) \equiv 4\%$, else; $t = 0,\ldots,T$



Net present value and reduction with respect to base case (average contract)

Premium	$NPV^S(d^*)$	Reduction
Single	\$2,786	-32.2%
Annual	\$236	-82.7%

The effects are reduced if we consider only insureds with $d > 1.25$ (Part b) in Figure 2). In this case, surrender profits are still substantially diminished by 32.2% (single premium payment) and 82.7% (annual premium payment). Overall, the results emphasize the impact of the premium payment method, since net present values are much more affected in the case of annual premiums, which, it should be noted, is by far the most common method of payment.

To identify the impact of adverse selection, i.e., of setting $q_{x+t}^{S}(d) \equiv 0\%$ for impaired individuals ($d > d^*$) only, we consider a modified surrender rate in the portfolio taking $d^* = 1.25$ as an example. For this barrier value, in the simulation, 19,911 insureds out of 100,000 have a frailty factor $d > d^*$ and thus do not surrender their policy. The remaining individuals surrender at the usual rate of $q_{x+t}^{S} \equiv 4\% \;\; \forall t$. The new "average" surrender rate in the whole portfolio of insureds (independent of health status) is obtained by

$$q_{x+t}^{s}(d) = (19{,}911 \cdot 0\% + 80{,}089 \cdot 4\%)/100{,}000 \;\approx\; 3.2\% \quad \forall d,t.$$

The surrender profits for this "average" surrender rate are set out in Table 2.

Table 2: Surrender profits NPV^{S} for average surrender rate $q_{x+t}^{S}(d) \equiv 3.2\% \;\; \forall d,t$ (results for one contract on average)

Premium	NPV^{S}	Reduction with respect to base case
Single	\$3,632	-11.6%
Annual	\$1,296	-4.7%

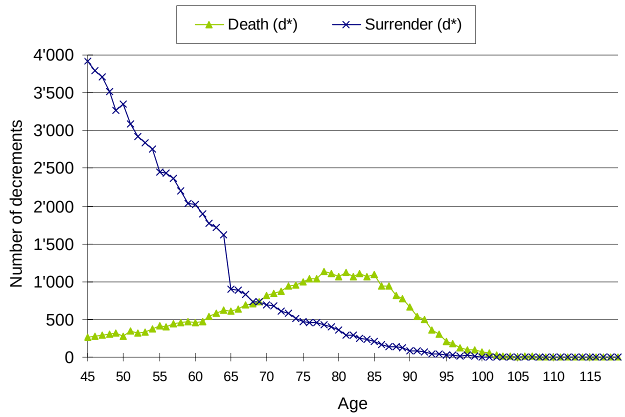
Compared to the tremendous reduction of surrender profits in Figure 2, Part b)—32.2% for a single premium—the decline is reduced to 11.6% when the decrease in surrender rates is distributed over the entire portfolio instead of setting $q_{x+t}^{S}(d) \equiv 0\%$ for impaired individuals ($d > d^*$) only. This effect is even greater for annual premium payments: surrender profits are reduced by 4.7% instead of 82.7%. In contrast to Figure 2, Part b), reducing the overall surrender rate leads to a stronger decline of net present value in the case of a single premium than for annual payments.

We next modify the underlying assumption that all impaired individuals with a frailty factor $d > d^*$ do not surrender during the *whole* policy duration. In fact, it is predominantly policyholders older than 65 who make up the target group for the life settlement market. Hence, we now assume that impaired individuals have an average surrender rate of $q_{x+t}^{S}(d) \equiv 4\%$ until age 64, after which $q_{x+t}^{S}(d) \equiv 0\%,\;\; x+t \geq 65$. As before, all other policyholders continue to surrender at $q_{x+t}^{S}(d) \equiv 4\%,\;\; d \leq d^*, t = 0,\ldots,T$. The resulting decrement curves and surrender profits NPV^{S} are illustrated in Figure 3.

Figure 3: Secondary market scenario—number of decrements due to surrender and death with $q^S_{x+t}(d) \equiv 0\%$ if $d > d^*$ starting at age 65, $q^S_{x+t}(d) \equiv 4\%$, else

a) $d^* = 1$: Surrender rate $q^S_{x+t}(d) \equiv 0\%$ if $d > 1$ and $x+t \geq 65$; $q^S_{x+t}(d) \equiv 4\%$, else

Results for portfolio: number of decrements

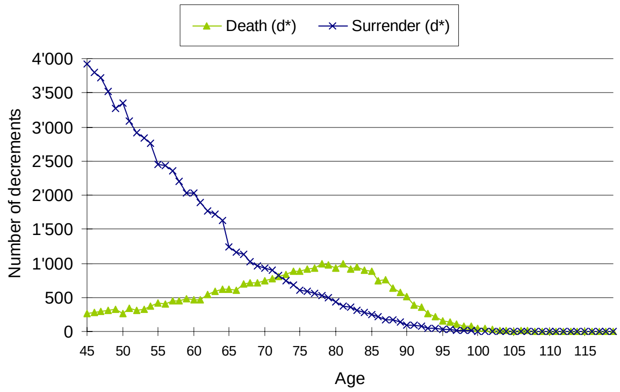


Net present value and reduction with respect to base case (average contract)

Premium	$NPV^S(d^*)$	Reduction
Single	\$3,761	-8.4%
Annual	\$1,025	-24.6%

b) $d^* = 1.25$: Surrender rate $q^S_{x+t}(d) \equiv 0\%$ if $d > 1.25$ and $x+t \geq 65$; $q^S_{x+t}(d) \equiv 4\%$, else

Results for portfolio: number of decrements



Net present value and reduction with respect to base case (average contract)

Premium	$NPV^S(d^*)$	Reduction
Single	\$3,928	-4.4%
Annual	\$1,172	-13.8%

Compared to Figure 2, the reduction of surrender profits shown in Figure 3 is considerably less, but the general trend is very similar. In particular, a change of surrender rates has a much stronger effect on the net present value for the annual premium payments scenario than in the single premium case. Furthermore, surrender profits are still reduced by 8.4% (single) and 24.6% (annual) in Part a) of Figure 3.

An additional cushioning effect occurs when taking into consideration that only a certain percentage of insureds with $d > d^*$ have a zero surrender probability after age 65. Realistically, only a portion of insureds with reduced life expectancy will sell their policy to the secondary market. This further reduces the effect with respect to losses in the surrender profit. However, the key results and central effects remain the same.

Impact of age at inception on surrender profits

We next look at the impact of the insured's age at inception of the contract on surrender profits. In this section, we consider a portfolio of older policyholders where the insureds' initial age is 55 instead of 45. As in the base case, we first need to calibrate the premiums such that the net present value NPV^M is zero. Equation (1) is satisfied for B^s = \$48,915 and B^a = \$2,789. The corresponding multiplier for the policy reserves is given by m = 0.9486. The resulting surrender profits are summarized in Table 3.

Table 3: Base case with 55-year-old male policyholder at inception—premiums and surrender profits NPV^S (results for one contract on average)

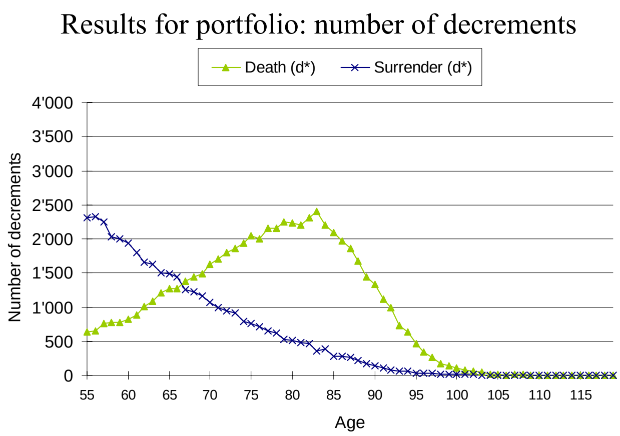
	Single premium	Annual premium
B^s, B^a	\$48,915	\$2,789
NPV^S, $q^S_{x+t}(d) \equiv 0\%\quad \forall d,t$	\$0	\$0
NPV^S, $q^S_{x+t}(d) \equiv 4\%\quad \forall d,t$	\$4,522	\$1,455

Table 3 shows that premiums and surrender profits for an average surrender rate of 4% are higher when the portfolio is comprised of 55-year-old policyholders than when it contains 45-year-olds (see Table 1). Figure 4 illustrates results that are derived under the same scenario as was used in Figure 2 ($q^S_{x+t}(d) \equiv 0\%$ if $d > d^*$; $q^S_{x+t}(d) \equiv 4\%$ else; $t = 0,\ldots,T$).

With a portfolio of 45-year-old insureds, the decline in profits is considerably stronger for the annual premium scenario than for the single payment case. In the portfolio of 55-year-olds, the surrender profit with respect to the corresponding base case is less reduced for the single premium, and more reduced for the annual premium payment method compared to the portfolio of 45-year-olds in Figure 2. Overall, however, the difference between the two portfolios is not very great due to the adjustment in the amount charged for premiums.

Figure 4: Secondary market scenario—number of decrements due to surrender and death in a portfolio with 55-year-old insureds at contract inception with $q_{x+t}^{S}(d) \equiv 0\%$ if $d > d^*$, $q_{x+t}^{S}(d) \equiv 4\%$, else, for $t = 0,\ldots,T$

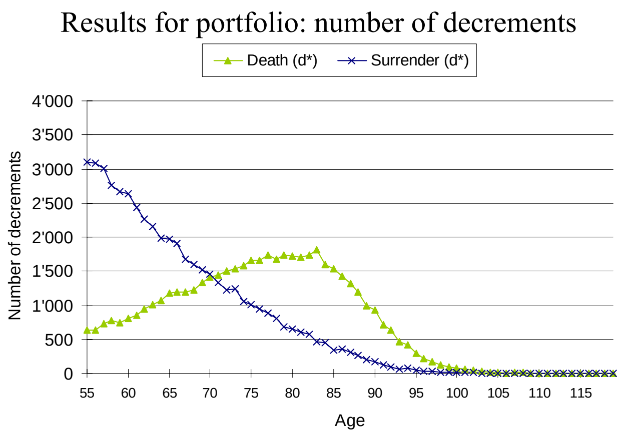
a) $d^* = 1$: Surrender rate $q_{x+t}^{S}(d) \equiv 0\%$ if $d > 1$; $q_{x+t}^{S}(d) \equiv 4\%$, else; $t = 0,\ldots,T$



Net present value and reduction with respect to base case age 55 (average contract)

Premium	$NPV^S(d^*)$	Reduction
Single	\$2,062	-54.4%
Annual	\$-471	-132.4%

b) $d^* = 1.25$: Surrender rate $q_{x+t}^{S}(d) \equiv 0\%$ if $d > 1.25$; $q_{x+t}^{S}(d) \equiv 4\%$, else; $t = 0,\ldots,T$



Net present value and reduction with respect to base case age 55 (average contract)

Premium	$NPV^S(d^*)$	Reduction
Single	\$3,176	-29.8%
Annual	\$203	-86.1%

Selected additional numerical results

Over time, the number of insureds in the portfolio decreases because of decrements due to death or surrender. The former especially concerns impaired insureds with reduced life expectancy. Thus, if we increase the year of age—age 65 in previous analyses—after which all impaired insureds (with $d > d^*$) change their surrender behavior to $q_{x+t}^{S}(d) \equiv 0\%$, the discussed effects will be less distinctive. For example, setting the age to 75, the decline of net present value compared to the base case is about 2.7%, that is, \$1,323 for annual premium payments (single: a 0.9% reduction, or \$4,072); given an age of 65, the net present value was reduced about 13.8% to \$1,172 (single: 4.4% to \$3,928; see Figure 3). Similar effects occur when surrender rates are assumed to decrease over the policy duration.

Furthermore, modifications of the surrender payout have an effect on surrender profits. For example, lowering the surrender charge reduces profits, which also implies less distinct effects of altered surrender behavior. The same is true if the surrender charge is imposed during only the first, e.g., 10 to 15 years. After this period, the surrender payout is equal to the policy reserves, which in our model leads to surrender profits of zero.

When changing the interest rate from $i = 3\%$ to $i = 4\%$, lower premiums are obtained when solving Equations (2) and (3). The single premium B^s goes from 38,126 to 28,651; annual premiums B^a are \$1,545 instead of \$1,795. In the base scenario with a constant surrender rate of 4%, an interest rate of 4% leads to net present values of \$2,966 and \$1,022 for single and annual premiums, respectively. In the secondary market scenario—$q_{x+t}^{S}\left(d\right) \equiv 4\%$ for insureds with $d > d^* = 1.25$ starting at age 65 (see Figure 3)—the corresponding net present value is \$2,829 (single premium) and \$881 (annual premium). Compared to the base scenario, this means a decline of 4.6% and 13.8%, respectively. These values approximately coincide with the 3% interest case (see Figure 3).

Policy implications

Our analyses revealed that reduced surrender rates by insureds with impaired health caused by secondary market activity result in a decline in profits for insurance companies. Not only are the surrender profits reduced, but there are negative effects from adverse selection. In practice, both effects are probably intensified due to the fact that the life settlement market, in order to minimize transaction costs, is mainly interested in policies with large face amounts (see SOA Record, 2005). In the future, life settlements will probably become an alternative for an increasing number of policyholders, i.e., it will not only be the large policies held by seniors that are traded, but also those held by younger adults with below-average life expectancy.

To preserve their surrender profits, U.S. life insurers have looked for ways to compete with the secondary market. The simplest answer would be to pay health-dependent surrender values. Thus, a person surrendering his or her policy would receive the current (net present) value from the insurance company, which should be close to or even higher than (because of less transaction costs) the price in the secondary market. However, according to Doherty and Singer (2002, p. 18), regulatory, actuarial, and administrative difficulties seem to outweigh the benefits gained from offering more competitive surrender values to impaired insureds.

As an answer to the viatical settlement market, the concept of accelerated death benefits (ADBs) was developed by life insurance carriers in the early 1990s.[23] An ADB rider on a policy provides the opportunity of receiving between 25–100% of the death benefit in the case of dread disease, long-term care, or terminal illness accompanied by a remaining life expectancy of (usually) less than 12 months. A further attempt to successfully compete with the life settlement market involves expanding the ADB rider to cover chronic illnesses.[24]

Furthermore, Doherty and Singer (2002, 2003) state that life insurers are lobbying for regulation of the life settlement industry and are refusing to allow their agents to deal with life settlement firms, a situation that is currently changing. Life insurers also attempt to identify so-called premium financed policies—polices purchased for the sole purpose of selling them to the secondary market.[25]

4. SUMMARY

In this paper, we study the impact of modified surrender rates on insurance company profit that occurs due to the opportunity of selling one's policy to the secondary market. This kind of analysis has not been conducted before, even though it is of great interest to insurers. By use of a stochastic frailty factor, we model a mortality heterogeneous pool of life insurance contracts. In the analysis, we first calibrate annual and single premiums such that the actuarial net present value of an average contract without consideration of surrender is zero. Next, surrender profits (generated due to surrender charges) are calculated by means of a double-decrement simulation analysis for different scenarios. In the base case, surrender rates are constant for the entire portfolio. The secondary market scenario assumes an asymmetric surrender behavior, i.e., impaired insureds do not surrender (but, e.g., sell their policies to the life settlement industry instead), while only good risks continue to surrender.

In general, surrender profits are reduced when the portfolio's surrender rate declines. However, our results showed that this effect is intensified by the secondary market scenario. We further found that the single premium payment method results in considerably higher surrender profits and that negative effects from asymmetric surrender behavior are less severe with this type of payment scheme than they are when annual payments are made. Hence, in the case of the more common annual premiums, originally lower surrender profits experience a much stronger decline in the secondary

[23] See Doherty and Singer (2002, pp. 31–33) and Giacolone (2001, p. 5).
[24] See Doherty and Singer (2003, p. 77).
[25] See Dunmore (2006) and Giacolone (2001).

market scenario. This reduction has shown to be even higher in a portfolio comprised of insureds who are older at contract inception. If only impaired insureds above age 65 stop surrendering in the secondary market scenario, the effects are less distinct but still quite evident. Effects are further reduced if only a portion of impaired insureds or decreasing surrender rates are taken into account.

In the long run, both consumers and life insurance carriers will benefit from a competitive secondary market. On the one hand, increasing competition in the life settlement market will allow consumers to obtain higher prices for their policies. On the other hand, primary insurers may benefit if the secondary market causes a stronger demand for life insurance. However, life insurers will need to abandon lapse-supported pricing, which could also aid in reducing the volatility of their profits.

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