

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; that is, high risks remain in the portfolio instead of surrendering. In this article, 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. We additionally analyze the impact of the premium payment method by comparing results for annual and single premium payments.

INTRODUCTION

In the U.S. life settlement market, life insurance policies of senior citizens with below-average life expectancy are traded (see, e.g., Doherty and Singer, 2002, p. 4). With purchases of about \$6.1 billion in face value in 2006, the U.S. life settlement industry is of considerable volume.¹ However, the benefits and detriments of a secondary market for life insurance are controversial.² In general, primary insurers have historically profited from lapse or surrender of policies,³ especially by insureds with impaired

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¹See Conning & Company (2007). As the population ages, the potential of this secondary market generally increases. See Bhattacharya, Goldman, and Sood (2004, p. 643), Doherty and Singer (2002, p. 4), Giacalone (2001, p. 6), and Maple Life Financial (2007, p. 3).

²From 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).

³When 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.

health (see Doherty and Singer, 2002, pp. 15–16). Adverse exercise behavior due to secondary market activity may lead to a decline of those profits, which is particularly true for lapse-supported products, that is, 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 (see Doherty and Singer, 2002, p. 6). Even though this is a very topical issue in practice, no quantitative analyses have been conducted before. The aim of our article 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, Goldman, and Sood (2004) empirically analyze the impact of state regulation on the viatical settlement market by estimating welfare losses.⁴ 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. Doherty and Singer (2003) state that more than 20 percent of all policyholders above age 65 could consider selling their policy to the secondary market as an attractive alternative to lapse or surrender.

A large part of the literature dealing with the surrender of life insurance contracts concerns itself with valuation of the surrender option (see, e.g., Albizzati and Geman, 1994; Bacinello, 2001, 2003a, b, 2005; Grosen and Jørgensen, 1997, 2000; Jensen, Jørgensen, and Grosen, 2001; Steffensen, 2002; Tanskanen and Llukarinen, 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, Kuo, and Chen (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. Kuo, Tsai, and Chen (2003) use the cointegration approach and find that the effect of the interest rate (interest rate hypothesis) on the surrender rate is more economically significant than the effect of the unemployment rate (emergency fund hypothesis). Kim (2005) describes surrender rates, using various explanatory variables based on different surrender rate models, and finds appropriate modeling assumptions for four policy types. By differentiating surrender rates according to test results, Viswanathan et al. (2007) examine potential adverse selection effects in a term life insurance market, when genetic testing is introduced in insurance underwriting. Babbel and Merrill (2005) point out that surrender and lapse rates are a means of influencing the valuation of an insurer's liability value and thus its market value. To examine the relation of

⁴ In the viatical settlement market, policies of insureds with a considerably reduced life expectancy of less than 2 years are traded.

individual mortality and surrender, Jones (1998) develops a four-state model containing the states “healthy,” “impaired,” “withdrawn,” and “dead.” The author applies a gamma distributed frailty factor to the force of mortality and studies effects of different parameterizations on the cohort force of mortality in a heterogeneous population.

In this article, we take the insurer’s perspective and quantitatively examine the effects of modified surrender behavior as influenced by the secondary market. Mortality heterogeneity in the insurance portfolio is taken into account by employing a continuously distributed frailty factor (see Jones, 1998, pp. 83–84) 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 the observed effect is considerably enhanced when taking into account adverse exercise behavior. 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 article is structured as follows. In “The Model Framework” section, we present our model framework including mortality heterogeneity, the life insurance contract, and the double-decrement model. Numerical analyses and policy implications are discussed in the section on “Numerical Analyses.” The last section summarizes the main findings.

THE MODEL FRAMEWORK

The Model of Mortality Heterogeneity

Mortality heterogeneity is considered by means of a stochastic frailty factor (see Jones, 1998, p. 81; Vaupel, Manton, and Stallard, 1979, p. 440) applied to a given deterministic mortality table. The 1-year individual probability of death of a person age x is thus given by the product of the individual frailty factor $d \in \mathbb{R}_0^+$ (i.e., d is a positive real number greater than or equal to zero) and the annual probability of death q'_x from the mortality table. If the product is greater than or equal to 1 for any ages $\tilde{x}$, the individual probability of death is set equal to 1 for the smallest of those ages; for all other ages $\tilde{x}$, it is set to 0. Thus,

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

where ω is the limiting age of the mortality table. For $d < 1$, we let $q_{\omega}^M(d) := 1$. The superscript M indicates the 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 average health, and when $d > 1$, the person is impaired (see Hoermann and Russ, 2008, p. 152). For a given frailty factor d , the random variable $K^M(x, d)$ denotes the individual remaining curtate lifetime. Its distribution function ${}_kq_x^M(d)$ at a point $k \in \mathbb{N}_0$ (i.e., k is a natural number greater than or equal to zero) results in

$${}_kq_x^M(d) = F_{K^M(x,d)}(k) = P(K^M(x, d) \leq k) = 1 - {}_kp_x^M(d) = 1 - \prod_{l=0}^{k-1} (1 - q_{x+l}^M(d)),$$

where ${}_kp_x^M(d)$ is the individual k -year survival probability.

The frailty factor d is a realization of a random variable D (see Jones, 1998, pp. 80–83; Pitacco, 2003, p. 14; Vaupel, Manton, and Stallard, 1979, p. 440). 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 average 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^M) 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 $K^M(x, D)$). The constant riskless interest rate is denoted by i . Hence, the net present value in the case of annual premiums results to⁵

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

⁵ The equation assumes that mortality risk is not priced by the market. As, for example, in Tsai, Kuo, and Chen (2002, p. 436), dividends, expenses, loadings, taxes, and new business are not taken into account.

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,⁶ that is,

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

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

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

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 a policy year. As done in Tsai, Kuo, and Chen (2002), the surrender payout is given by

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

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, for example, always higher than 80 percent of the policy reserve, and the surrender charge decreases with time.⁷ 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 (see Bacinello, 2003a, p. 466). Policy reserves V_t are calculated

⁶ We do not price the policy based on surrender rate assumptions (see, e.g., Bacinello, 2003b, p. 3), meaning that our contract is not lapse supported. If an insurance company's actual lapse experience is less than expected, lapse-supported pricing can substantially reduce the insurer's profitability and even lead to insolvency, as happened in the case of Mid-Continent Life Insurance Company in 1997 (see <http://www.cooperconnect.com/Checklists/LapseSupported.htm>).

⁷ Beyond that, by substituting T with a fixed number τ with $1 \leq \tau < T$, the formula allows us to consider a restricted surrender charge period.

based on the mortality table according to the following formula (see Bacinello, 2001; Bowers et al., 1997; Gatzert and Schmeiser, 2008; Linnemann, 2004):

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

given an initial reserve value of $V_0 = 0$ at policy inception. 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 $t = 1, \dots, T$. 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, p. 3).

To avoid policy lapses, in our model, premiums and reserves must be calculated based on the same actuarial assumptions, that is, the same interest rate i and the same mortality table; otherwise, reserves could become negative.⁸ 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

$$q_{x+t}^M(m) = m \cdot q'_{x+t}, \quad t = 0, \dots, T(m),$$

with $q_{x+T(m)}^M(m) = 1$. 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

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

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

$$V_t = \frac{(V_{t-1} + B_{t-1})(1+i) - Yq_{x+t-1}^M(m)}{1 - q_{x+t-1}^M(m)}, \quad (7)$$

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).

⁸ A (universal) life policy lapses if the cash value is insufficient to pay policy costs (see Carson, 1996, p. 675).

The Double-Decrement Model

In general, modeling individual surrender behavior is very complex as it depends on a number of factors, including, for example, interest rates, age and gender, inflation rates, policy duration, unemployment rates, or seasonal effects (see Kim, 2005). Various surrender rate models focus on describing the surrender probability as a function of the interest rate (see, e.g., Kim, 2005, p. 57). Several studies provide evidence that interest rates can have a considerable impact on policyholder behavior, particularly during times of financial distress.⁹ Other models include different or additional elements. For example, in Kim (2005), two enhanced models are employed that take into account a range of factors influencing surrender activity. Russell (1997) studies the correlation between macroeconomic factors and surrender probabilities, and Cerchiara, Edwards, and Gambini (2008) examine the sensitivity of surrender rates to calendar year of exposure, contract class, and policyholder age.

There is also evidence that surrender behavior depends on the insured's health status (see Doherty and Singer, 2002, pp. 16–21, 2003, pp. 63–73). Generally, individuals with above-average health are more likely to surrender. However, the trend is ambiguous for those with impaired health. On the one hand, their ill health makes surrender less likely because the policy is more valuable to them but, on the other hand, the same ill health may worsen their financial situation and thus make them more likely to surrender. The second effect is believed to be stronger, which is supported by the fact that surrender rates for the risk class of substandard insureds are considerably higher than surrender probabilities of preferred or standard insureds (see LIMRA and SOA, 2008, p. 70). Nevertheless, either type of behavior can have adverse effects on the insurer's profitability, effects not quantitatively assessed to date.

Our study is motivated by the fact that one factor triggering asymmetric surrender decisions is the secondary market for life insurance, where impaired insureds have the opportunity of selling their policy instead of surrendering it. Therefore, in our model, we abstract from the number of different influence factors so as to focus on the pure effect of adverse surrender experience with respect to the insureds' remaining life expectancy. A detailed discussion of resulting limitations is provided below.

We use an exogenous deterministic model for the surrender probability, where the main factors influencing the surrender rate are an insured's health status, represented by the individual frailty factor, as well as his or her age and the policy duration. Thus, for a given frailty factor d we denote the 1-year surrender rate in the t th policy year of an insured aged x at policy inception by $q_{x+t}^{(S)}(d)$ for $t = 0, \dots, T(d)$ with $q_{x+T(d)}^{(S)}(d) = 0$ since the corresponding probability of death is given by $q_{x+T(d)}^M(d) = 1$.

⁹ In 1980/1981 in the U.S. life insurance market, disintermediation problems emerged as interest rates rose and surrender rates increased. However, if there is only modest variation in credited interest rates, as occurred in the mid and end 1980s, a clear relationship between interest rates and surrender rates is not found, which could also be due to data limitations (see Cox et al., 1992). Similar problems occurred in Korea during the financial crisis in 1997/1998, where savings accounts and annuities exhibited higher surrender rates than protection plans (see Kim, 2005). Honegger and Mathis (1993) empirically show that the interest rate has a significant influence on the life insurance policy surrender rate for the period from 1950 to 1989 in Switzerland. Russell (1997), too, finds support for the interest rate hypothesis.

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). The time until decrement $K^{MS}(x, d)$ from either death or surrender has the distribution function

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

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 ${}_{\kappa}q_x^{MS}(d) \leq u < {}_{\kappa+1}q_x^{MS}(d)$. Since the 1-year decrement probability consists of the 1-year probability of death and the 1-year probability of surrender ($q_{x+\kappa}^{MS}(d) = q_{x+\kappa}^M(d) + q_{x+\kappa}^S(d)$), and can be decomposed to

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

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

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

and

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

If the uniformly distributed random number occurs in the first interval, that is, $u < {}_{\kappa}q_x^{MS}(d) + {}_{\kappa}p_x^{MS}(d)q_{x+\kappa}^M(d)$, death occurred; otherwise, the termination is due to surrender (see also Glasserman, 2004, p. 57).

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

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

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, $L_t = Y$.

The effect of the termination of policies by surrender can be determined as the difference between the net present value of the policy including surrender (NPV^S) and the net present value of the policy without surrender (NPV^M) (see Bacinello, 2003a, p. 471). As our pricing is not lapse-supported, annual and single premiums, B^a and B^s , are calibrated such that the latter is equal to zero (see Equations (2) and (3), respectively). Therefore, NPV^S describes the insurance company's surrender profit as generated in the double-decrement framework. Under a different method of calculating premiums, NPV^S could even become negative.

In our fixed interest rate model, surrender profits are generated by way of surrender charges. For a zero surrender charge (i.e., reserves V_t are fully paid out), $NPV^S = 0$. This issue similarly arises when the surrender option is evaluated using option pricing theory. In the case of surrender, accumulated reserves less the surrender charge are paid to the policyholder. Hence, as we do not take any policy fees into consideration in our model, the insurance company earns surrender profits. In practice, however, these profits are reduced if outstanding acquisition costs need to be paid out of the surrender charge (see Eckman, 1990, p. 17). If surrender charges are not large enough to cover the commissions paid to agents during the early contract period, the insurer may face a loss from surrender.¹⁰ In our model, for zero surrender probabilities, $NPV^S = NPV^M = 0$. Thus, lowering positive surrender probabilities, *ceteris paribus*, reduces surrender profits, a point also made by Eckman (1990).

NUMERICAL ANALYSES

We use the U.S. 2001 Commissioners Standard Ordinary (CSO) male ultimate composite¹¹ 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 (see Singer and Stallard, 2005, p. 13). 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 (2008).¹² For this parameterization, about 40 percent 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 $d = 3.5$) and 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.¹³

¹⁰ In general, another reason that surrender profits can occur is that policyholders do not exercise their right rationally or optimally but, instead, for other reasons, financial or personal (see, e.g., Kim, 2006, p. 2).

¹¹ Composite means that no distinction is made between smokers and nonsmokers.

¹² 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 .

¹³ 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; 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

The interest rate is $i = 3\%$, the death benefit $Y = \$100,000$, and the constant surrender rate in the portfolio is set to $q_{x+t}^S(d) \equiv 4\%, \forall d, t = 0, \dots, T$,¹⁴ since, according to the *U.S. Individual Life Insurance Persistency Update*, the overall lapse rate for universal life insurance policies for all policy years combined was around 4 percent from 2003 through 2004 (see LIMRA and SOA, 2008, p. 64). As previously discussed, in our model surrender occurs independent of the interest rate and of other macroeconomic factors, and no optimal exercise behavior is assumed so that we can concentrate on health-dependent surrender experience. 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.

As a surrender charge is applied to the cash value, the surrender profits are positive for $q_{x+t}^S(d) \equiv 4\%$. The same basic surrender probability is employed in both the single and the annual premium case.¹⁵ 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.

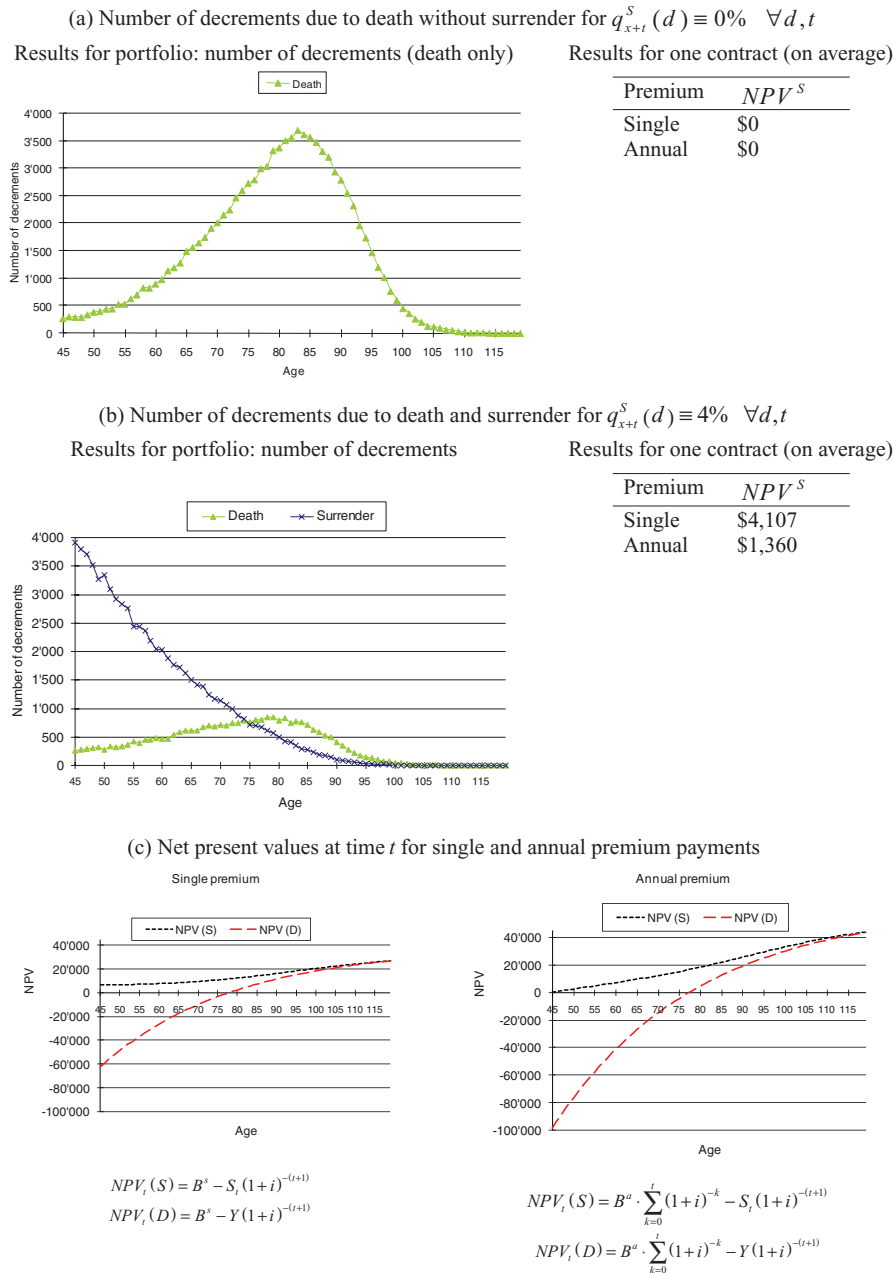
When introducing surrender rates as a second type of decrement in the portfolio, the curve showing number of deaths changes, as laid out in Part (b) of Figure 1. The

¹⁴ In an alternative scenario, we relax the assumption of constant annual surrender rates by taking into account the effect of policy duration in addition to the insured's health status.

¹⁵ According to the *III. Universal Life Persistency Study*, surrender probabilities generally decrease with increasing size of the initial premium (see LIMRA and SOA, 1995, p. 473). For initial payments of \$30,000 and higher, surrender rates are slightly enhanced. Surrender rates for initial premiums in the range of \$1,500–\$1,999 and for initial premiums above \$30,000 approximately coincide.

FIGURE 1

Base Case—Number of Decrements in Simulation; NPV^S for Surrender and Death at Deterministic Dates



graph shows that the number of surrenders at the beginning of the policy duration is substantially higher than the number of deaths, which can be attributed to two effects. First, we consider a fixed pool of contracts issued at time $t = 0$, which is reduced by decrements due to death or surrender each policy year. Hence, as during earlier policy years, probabilities of decrement apply to a larger number of policies, the absolute number of decrements is higher in this period. Second, the constant annual surrender rate of 4 percent is high compared to 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 $x + t$, $t = 0, \dots, T$ 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)).

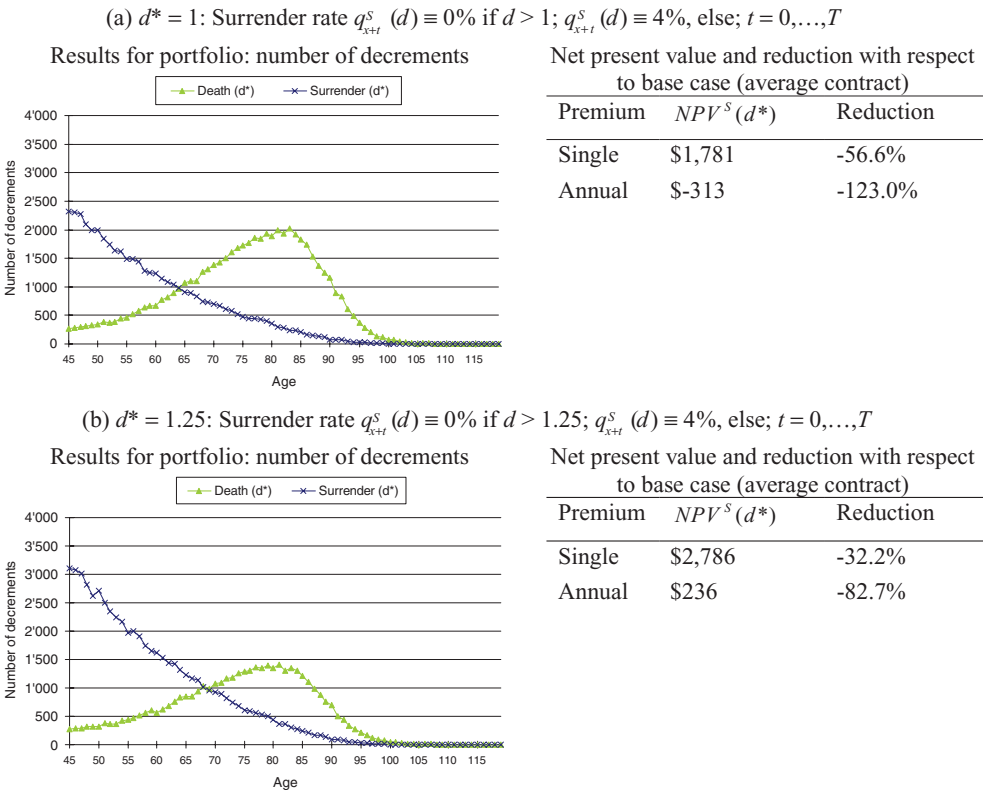
To calculate the net present value of an average contract in the portfolio (Equation (8)) for stochastic times of surrender and death, the deterministic values $NPV_t(D)$ and $NPV_t(S)$ are weighted with the number of decrements due to death and surrender, respectively, at the time of the decrement given 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

To assess the impact of adverse effects 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, that is, with a frailty factor d greater than some barrier d^* , and that surrender rates remain at 4 percent 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 $d^* = 1.25$ (Parts (a) and (b), respectively), that is, 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 considering only two causes

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 $t = 0, \dots, T$



of decrement, a much higher number of policies are 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 percent. In the annual premium payment setting, the net present value even becomes negative, implying a reduction of more than 120 percent. 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.

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 percent (single premium payment) and 82.7 percent (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.

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%

To identify the impact of adverse exercise behavior, that is, 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 $q_{x+t}^S(d) = (19,911 \cdot 0\% + 80,089 \cdot 4\%) / 100,000 \approx 3.2\% \forall d, t$.

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

Compared to the tremendous reduction of surrender profits in Figure 2, Part (b)—32.2 percent for a single premium—the decline is reduced to 11.6 percent 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 percent instead of 82.7 percent. 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.

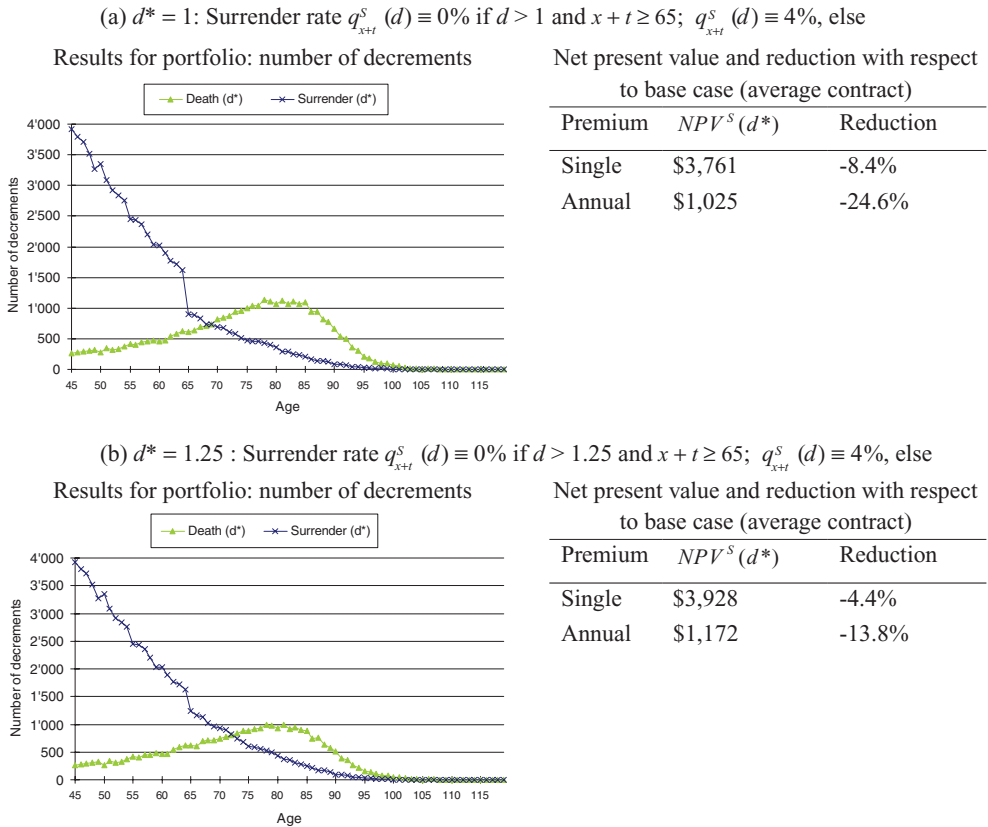
We next modify the underlying assumption that all impaired individuals with a frailty factor $d > d^*$ do not surrender during the *whole* policy duration. In fact, it is predominantly policyholders older than 65 who make up the target group for the life settlement market. Hence, we now assume that impaired 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 $q_{x+t}^S(d) \equiv 4\%$, $d \leq d^*$, $t = 0, \dots, T$. The resulting decrement curves and surrender profits NPV^S are illustrated in Figure 3.

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 percent (single) and 24.6 percent (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.

FIGURE 3

Secondary Market Scenario—Number of Decrements Due to Surrender and Death With $q_{x+t}^S(d) \equiv 0$ if $d > d^*$ Starting at Age 65, $q_{x+t}^S(d) \equiv 4$, Else



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.

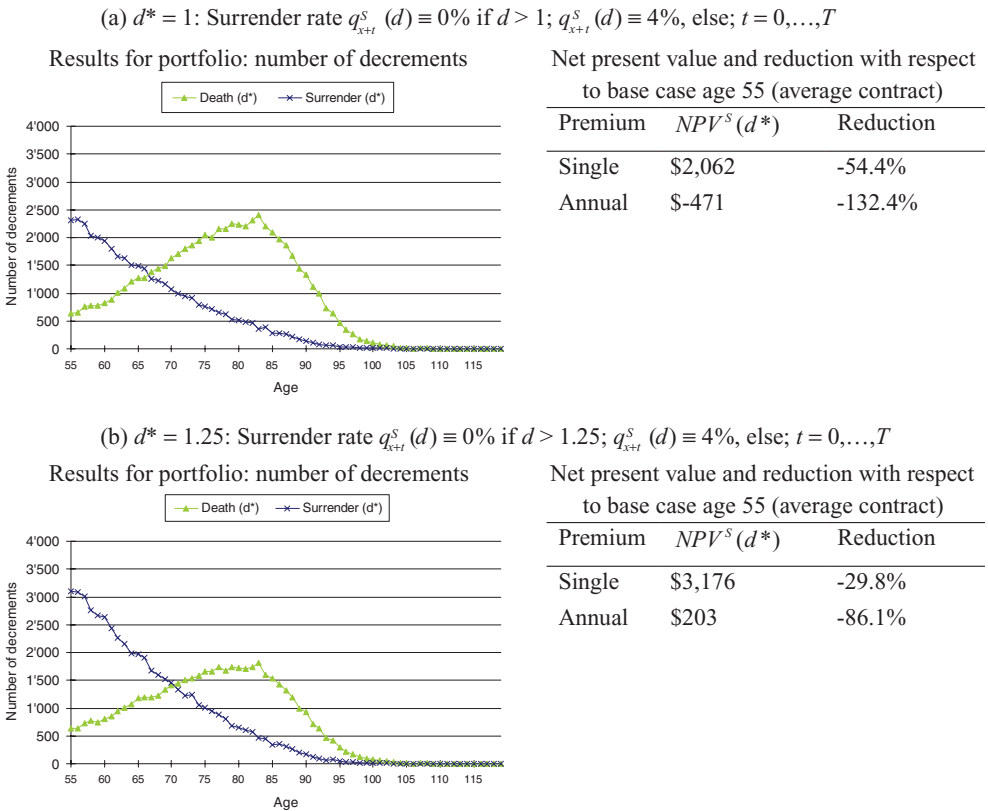
Table 3 shows that premiums and surrender profits for an average surrender rate of 4 percent are higher when the portfolio comprised 55-year-old policyholders than when it contains 45-year-olds (see Table 1). Figure 4 illustrates results that are derived under the same scenario as was used in Figure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

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

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
$NPV^S, q_{x+t}^s(d) \equiv 0\% \quad \forall d, t$	\$0	\$0
$NPV^S, q_{x+t}^s(d) \equiv 4\% \quad \forall d, t$	\$4,522	\$1,455

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 $t = 0, \dots, T$



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.

TABLE 4
Surrender Rates Depending on Policy Duration

Policy year	1	2	3	4	5	6	7	8-10	11-13	14+
Surrender rate	8%	7.5%	7%	6.5%	6%	5.5%	5%	4.5%	4%	3.8%

TABLE 5
Surrender Profits for Surrender Rates Given in Table 4 in the Base Case (No Adverse Exercise Behavior) and Secondary Market Scenarios (Exercise Behavior Depends on Insured's Health Status), Including Reduction With Respect to Base Case

	Base Case NPV ^S	$q_{x+t}^S(d) \equiv 0\%$ if $d > 1$		$q_{x+t}^S(d) \equiv 0\%$ if $d > 1.25$		$q_{x+t}^S(d) \equiv 0\%$ if $d > 1$, $x + t \geq 65$		$q_{x+t}^S(d) \equiv 0\%$ if $d > 1.25$, $x + t \geq 65$	
		NPV ^S	Reduction	NPV ^S	Reduction	NPV ^S	Reduction	NPV ^S	Reduction
Single	\$4,569	\$1,948	−57.4%	\$3,080	−32.6%	\$4,296	−6.0%	\$4,420	−3.3%
Annual	\$1,155	\$−599	−151.9%	\$−46	−103.9%	\$892	−22.7%	\$997	−13.7%

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 percent, that is, \$1,323 for annual premium payments (single: a 0.9 percent reduction, or \$4,072). Given an age of 65, the net present value was reduced about 13.8 percent to \$1,172 (single: 4.4 percent to \$3,928; see Figure 3). Similar effects occur when surrender rates are assumed to decrease over the policy duration. An example of decreasing surrender rates as observed in practice (see LIMRA and SOA, 2008) is set forth in Table 4.

As can be seen in Table 5, the reduction of surrender profits compared to the base case is in the same range as in the previous examples where a constant rate was used. However, for annual premium payments, there is a stronger reduction compared to the constant surrender rate case.

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, for example, 10–15 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 $i = 3$ percent to $i = 4$ percent, 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 percent, an interest rate of 4 percent leads to net present values of \$2,966 and \$1,022 for single and annual premiums, respectively. In the secondary market scenario— $q_{x+t}^s(d) \equiv 4$ percent 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 percent and 13.8 percent, respectively. These values approximately coincide with the 3 percent interest case (see Figure 3).

So as to concentrate on the main interactions between the secondary market and the life insurer's surrender profits, our model is, of necessity, a simplification of the "real world." In reality, interest rates are nondeterministic and in general do increase with increasing time to maturity. In addition, insurer investments and insured mortality develop stochastically in time, and interrelations involving different risk sources—for instance, correlations between interest rates and surrender behavior—will have an impact on the profitability of both the primary life insurance market and the secondary market. For example, given the calculation of the surrender payout in Equation (4), and assuming that increasing interest rates will lead to an increase in surrenders, the insurer's profitability will be positively affected if no secondary market exists. However, these profits will be heavily reduced, or possibly even negative, whenever policyholders with impaired health status sell their contracts on the secondary market instead of surrendering them. Due to complex interactions and counterbalancing effects, we do not believe it is feasible to derive the effects caused by interdependencies between certain risk sources on life insurer's surrender profits in a general way. Our results should thus be interpreted against this background.

Policy Implications

Our analyses revealed that reduced surrender rates for 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 exercise behavior. 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, that is, 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 (ADB) was developed by life insurance carriers in the early 1990s (see Doherty and Singer, 2002, pp. 31–33; Giacalone, 2001, p. 5). An ADB rider on a policy provides the opportunity of receiving between 25 percent and 100 percent 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 (see Doherty and Singer, 2003, p. 77).

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—policies purchased for the sole purpose of selling them to the secondary market (see Dunmore, 2006; Giacalone, 2001).

SUMMARY

In this article, 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; that is, 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 in 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 market scenario. This reduction has shown to be even higher in a portfolio comprising 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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