2004

# The Actuarial Value of Life Insurance Backdating

James M. Carson
*Florida State University*, jcarson@cob.fsu.edu

Krzysztof Ostaszewski
*Illinois State University*, krzysio@ilstu.edu

# The Actuarial Value of Life Insurance Backdating

James M. Carson* and Krzysztof Ostaszewski†

## Abstract‡

Backdating is a common (and legal) practice in the U.S. whereby a life insurance contract bears a policy date that is prior to the actual application date. This practice often results in the opportunity for some insureds to reduce the annual premium paid. Using cash flow projections and U.S. mortality, lapse, and interest rate data, we provide a model of the actuarial value of term life insurance backdating. Results indicate that the benefits to the applicant of backdating a term life insurance policy increase as the applicant age (and hence premium) increases. Increasing mortality, lapse, and interest rates, as well as increasing the length of the backdated period decreases the potential benefits of backdating. Finally, backdating appears to serve as a substitute for a finer partitioned pricing structure in the life insurance industry, as a risk-hedging mechanism for insurers, and as a risk-arbitrage tool for consumers.

Key words and phrases: *insurance pricing, risk arbitrage, risk hedging, phantom surrender charge, incentive compatible contracting*

*James M. Carson, Ph.D., C.P.C.U., C.L.U., holds the Midyette Eminent Scholar Chair in the College of Business at Florida State University. He serves as editor of the *Journal of Insurance Issues* and as president-elect of the American Risk and Insurance Association.

Dr. Carson's address is: College of Business, Florida State University, Tallahassee, FL 32306-1110, U.S.A. E-mail: *jcarson@cob.fsu.edu*

†Krzysztof M. Ostaszewski, Ph.D, F.S.A., C.F.A., M.A.A.A., is the actuarial program director and professor of mathematics at Illinois State University. He is currently a Fulbright Senior Specialist and was a Fulbright Research Fellow in 1995.

Dr. Ostaszewski's address is: Department of Mathematics, Illinois State University, Normal IL 61790-4520., U.S.A. E-mail: *krzysio@ilstu.edu*

‡The authors acknowledge the helpful comments of two anonymous referees, the editor, Randy Dumm, Kathleen McCullough, Ashwin Vasan, and participants at conferences held by S.O.A., A.R.I.A., W.R.I.A., and S.R.I.A. Dr. Ostaszewski acknowledges support of this research via a university research grant from Illinois State University.

# 1 Introduction

Life insurance backdating occurs when the insurance contract bears a policy date that is prior to the application date. From the applicant's perspective, the primary motivation for backdating is the reduction in premium that occurs because the premium is based on an age less than the applicant's life insurance age at the time of application. For example, suppose an insurer uses age nearest birthday. A person age 36 years and 9 months may be issued a policy that is backdated three months and one day in order to be charged the age 36 premium instead of the age 37 premium. Alternatively, for insurers that use age last birthday, a person age 36 years and two months may be issued a policy backdated two months and one day in order to be charged the age 35 premium instead of the age 36 premium. The obvious disadvantage of backdating is the necessity of paying premium for time that already has elapsed, i.e., from the backdated policy date to the actual application date.

To facilitate backdating, insurers often include, on the application for coverage, space for the agent/applicant to request that the policy be backdated. A survey (see Carson, 1994) yielded variations of the following comment from state insurance departments: "In researching the matter, it appears quite common in the industry for policies to be backdated." State laws in the U.S. typically allow backdating up to a maximum of six months. Thus, if birthdays and life insurance sales are assumed to be roughly evenly distributed throughout the year, only 50 percent of applications would be candidates for backdating. Therefore, if, for example, 40 percent of applications request backdating, this implies that up to 80 percent of the applications that are candidates for backdating actually request backdating. If, however, near future birthdays propel life insurance sales/purchases, then, for insurers using age nearest birthday, the 50 percent figure likely is a lower bound.

The question of whether to backdate essentially is a financial one: whether paying for lost time is offset by the right to pay lower premiums for the remaining life of the contract. Backdating appears to occur with significant regularity, as evidenced by discussions with U.S regulators, survey results, and examination of policy data from insurers. Surprisingly, however, little research exists on backdating, despite its potential for overcoming the effects of discrete (annual) life insurance pricing and serving as a potentially value-enhancing practice for the insured/policy owner.[1]

[1]When measuring age of the insured person, two approaches are common (see, for example, Bowers et al., 1997): such age can be expressed as a real number, for example

An applicant who backdates and keeps the policy in force for a relatively short period of time will have less opportunity to reap the benefits from backdating. Thus, the decision to backdate may be seen as a signal to the insurer that the applicant plans to keep the policy for a relatively long period of time.[2]

Carson (1994) discusses life insurance backdating with respect to agents, insurers, and consumers and provides an analytical model for determining the value of backdating that accounts for interest. The goals of the present paper are to extend previous research by providing an actuarial model for the value of backdating that additionally incorporates assumptions on mortality and policy lapse rates. The following sections provide a conceptual framework and numerical examples of backdating, details of the model, data, results, and conclusions.

# 2 Model for Backdating

## 2.1 Conceptual Framework

Conceptually, backdating may be appropriate if the present value of premiums to be paid as a result of backdating is less than the present value of premiums to be paid based on the applicant's current age. An example of premium payments under a backdated versus a nonbackdated policy is in Table 1, which shows the annual premium payments for backdated (three months) and nonbackdated $250,000 annual renewable term (ART) insurance contracts issued to a 56 year old nonsmoker (preferred risk) male who intends to hold the policy for six years. Premium data are for a large U.S. life insurer. In the present value calculations, the interest rate used is six percent, with annual

37.56 years (this is termed the continuous model) or as a whole number, for example 37 years (this is called the curtate or discrete model). While this terminology is not standard in economic literature, in this paper we refer to life insurance pricing based on the insured's age expressed as a whole number, as discrete pricing. This formulation can also be used for the age of the insured expressed in a unit of time shorter than a year, for example, a month. We term such shortening of the time unit used as a finer partition. Note also that discrete pricing exhibits elements of price discrimination of the form described in Nahata, Ostaszewski, and Sahoo (1990). To achieve a finer partitioned pricing structure, some single premium income annuity issuers interpolate rates monthly or daily, according to the actual age of the applicant.

[2]The payment of an additional premium to reduce future premiums is similar to a residential mortgage borrower paying discount points (i.e., upfront interest) in order to obtain a lower interest rate (and thus lower monthly payments) on a mortgage loan. For more of the tradeoff between interest rates and discount points, see, for example, Stone and Zissu (1990), Yang (1992), and Brueckner (1994).

compounding.[3] The next annual premium on the backdated contract is due in nine months, rather than in 12 months. Note that the six annual premiums on a backdated contract yield six years of coverage, less the number of backdated months. To achieve equal holding periods for the analysis, an additional number of months' coverage (three) for the backdated contract is purchased on a pro rata basis (no surcharge for partial year coverage, which yields a premium of 3/12 times \$1,468 equals \$367). This assumption is close to reality, because policyholders generally are able to switch the mode of payment (e.g., from annual to quarterly or monthly) after the issuance of the policy.[4] The present value of premiums under each alternative equals \$5,368 for the backdated contract and \$5,633 for the nonbackdated contract, whereby each contract provides six full years of coverage.

Thus, this prospective insured would appear to benefit by \$265 by purchasing coverage for time that already has elapsed, in order to gain the right to pay lower premiums over the next several years. Depending on several factors to be discussed, the benefit of backdating may be greater or less than that shown in this example; the benefit even may be negative (and thus a cost).

Continuing with the example above and taking the analysis from an annual to a monthly basis provides further understanding of the intricacies of backdating. That is, for the first nine months here, the insured enjoys a \$62 premium savings (\$825 versus \$763). If the insured should die during this period, backdating will have been advantageous. At the end of the first nine months, however, the premium for the second year is due. If the insured dies during the next three months just after paying the second annual premium, backdating will not have been advantageous, as the cost of coverage would be \$728 higher than without backdating (\$825 versus $763 + \$825/(1.06)^{9/12}$). For a contract that is backdated three months, this process continues for many years, as illustrated in Figure 1.

Figure 1 shows that insureds choosing to backdate must be aware of the true potential cost of backdating: the insured stands to gain from backdating during the first nine months of each policy year and stands to lose during the last three months of each policy year. This is due to the fact that future annual premiums for backdated policies will be

[3] Although the example employs the ART plan for illustrative purposes, it should be noted that level term and universal life are more commonly sold in today's market, while a diminishing amount of ART life insurance is sold.

[4] The results of the analysis will be biased in favor of backdating to the extent that this assumption is not valid. Alternatively, equal holding periods could be achieved by cancelling the nonbackdated contract prior to its expiration.

**Table 1**
**Backdated and Nonbackdated Scenarios**
**Annual Renewable Term**

| Backdated Contract | | Nonbackdated Contract | |
|---|---|---|---|
| Premium Due Date | Premium Amount | Premium Due Date | Premium Amount |
| Today | $ 763 | Today | $ 825 |
| + 9 months | $ 825 | + 12 months | $ 903 |
| + 21 months | $ 903 | + 24 months | $1,003 |
| + 33 months | $1,003 | + 36 months | $1,130 |
| + 45 months | $1,130 | + 48 months | $1,285 |
| + 57 months | $1,285 | + 60 months | $1,468 |
| + 69 months | $ 367 | | |
| Total Premiums Paid: | $6,614 | | $6,276 |
| Present Value at 6% | $5,368 | | $5,633 |
| Net Present Value = $5,633 - $5,368 = $265 | | | |

*Notes:* The contract in this example is a $250,000 annual renewable term issued to a male age 56 classified as a preferred risk, nonsmoker. The policy is backdated three months. Premium data are from Best's Policy Reports, June 2000, for a large U.S. life insurer. The interest rate used for discounting in this example is six percent.
The + 69 months premium of $367 is calculated as (3/12) times $1,468. This premium for three months of coverage is necessary to achieve equal holding periods (six years) for the comparative analysis.

due earlier (e.g., three months earlier) than for nonbackdated policies, creating what could be called a backdating phantom surrender charge. Further, this surrender charge can be more costly to the policy owner than the standard or regular surrender charge because the phantom surrender charge can apply even in the event of death, as is illustrated by the monthly NPV line in Figure 1. It is not for many years that the benefits of backdating are at all times positive.

## 2.2 Key Equations and Data

Equation (1) can be used to analyze the value of backdating. It considers annual premiums, the number of months by which the contract is backdated ($m$), and assumptions regarding the interest rate ($r$), the insured's backdated age ($x - 1$), and the holding period (number of

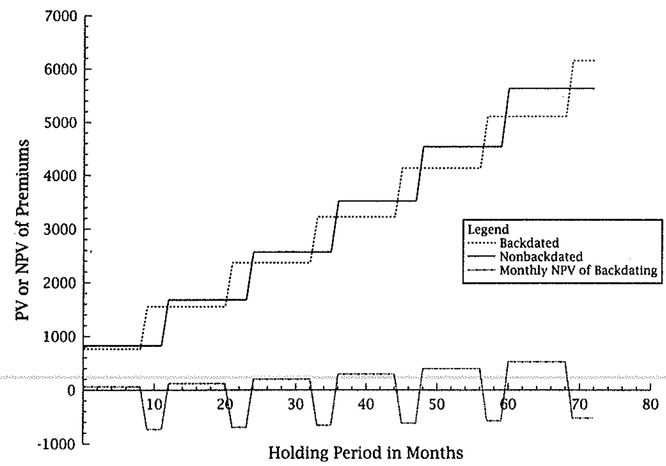


Figure 1: Present Value of Premiums and Net Present Value of Backdating

years, $y$). The equation gives the present value of premiums paid on a backdated contract for a given holding period, $\text{PVB}_{x-1,y}$, i.e.,

$$\text{PVB}_{x-1,y} = P_{x-1} + \sum_{k=1}^{y-1} P_{x-1+k}\, v^{k-\frac{m}{12}} + \frac{m}{12} \times P_{x-1+y}\, v^{y-\frac{m}{12}} \qquad (1)$$

where $P_z$ is the premium due at age $z$, and $v = 1/(1+r)$ is the discount factor. The last term in equation (1) adjusts for the additional number of months' coverage that should be purchased in order to provide equal periods of coverage between the backdated and nonbackdated contracts. Equation (1) is expressed in number of months by which the contract is backdated, rather than number of days, although either would be acceptable (with appropriate adjustments to the equation).[5] Note that premiums on the backdated contract begin at $x - 1$ and are consistent with those of the nonbackdated contract.

[5]Tax considerations generally are not relevant to the analysis, as individual purchases of coverage are made with after-tax dollars. In a business setting, tax implications may require additional analysis.

Equation (2) computes the present value of annual premiums paid on a nonbackdated contract for a given holding period $y$, i.e., $\mathrm{PVNB}_{x,y}$, which is given by

$$\mathrm{PVNB}_{x,y} = \sum_{k=0}^{y-1} P_{x+k} v^k. \tag{2}$$

The net present value, NPV, is the difference between the first two equations and is given by equation (3). Observe that equation (3) gives the annual NPV of backdating, which is simply the weighted average of the monthly NPVs for any given year.

$$\mathrm{NPV}_{x,y} = \mathrm{PVNB}_{x,y} - \mathrm{PVB}_{x-1,y}. \tag{3}$$

Equation (4) gives the actuarial net present value (ANPV) of backdating. This equation accounts for mortality, lapse, and interest rates. By accounting for mortality and lapse, equation (4) may be viewed as an analysis from a public policy perspective, as it is less common to think in terms of discounting for mortality and lapse for an individual. The term $\left({}_{k-1}p_x^{(\tau)} q_{x+k-1}^{(\tau)}\right)$ represents the probability that the policy owner will die or lapse during the year.[6] The last term in equation (4) expresses the fact that those dying in the last policy year enjoy the same benefits of backdating (lower premiums) as those who survive to policy termination.

$$\mathrm{ANPV}_{x,y} = \sum_{k=1}^{y-1} \mathrm{NPV}_{x,k} \times \left({}_{k-1}p_x^{(\tau)} q_{x+k-1}^{(\tau)}\right) + \mathrm{NPV}_{x,y} \times \left({}_{y-1}p_x^{(\tau)}\right). \tag{4}$$

Equations (1) through (4) are applied to life insurance premium data. Data are from A.M. Best (2000) for preferred risk, nonsmoking males aged (backdated/nonbackdated) 35/36 and 45/46, and $250,000 of annual renewable term insurance. The premium data used in the analysis are shown in Table 2. The NPVs of backdating for one month, three months, and six months are analyzed with respect to holding periods up to 30 years.

[6]Equation (4) could be adapted for monthly decrements and premium payments, as opposed to decrements that occur at the end of the year and premium payments at the beginning of each year (with an adjustment in the last year for the backdated policy), although the results would be minimally affected by such a change.

**Table 2**
**Annual Premium Data**
**For $250,000 Annual Renewable Term Insurance**

| Age | Premium | Age | Premium | Age | Premium |
|---|---|---|---|---|---|
| 35 | $258 | 49 | $523 | 63 | $1,915 |
| 36 | $270 | 50 | $550 | 64 | $2,180 |
| 37 | $283 | 51 | $583 | 65 | $2,473 |
| 38 | $295 | 52 | $620 | 66 | $2,793 |
| 39 | $308 | 53 | $663 | 67 | $3,140 |
| 40 | $325 | 54 | $710 | 68 | $3,515 |
| 41 | $343 | 55 | $763 | 69 | $3,918 |
| 42 | $368 | 56 | $825 | 70 | $4,348 |
| 43 | $388 | 57 | $903 | 71 | $4,805 |
| 44 | $408 | 58 | $1,003 | 72 | $5,290 |
| 45 | $428 | 59 | $1,130 | 73 | $5,983 |
| 46 | $448 | 60 | $1,285 | 74 | $6,875 |
| 47 | $470 | 61 | $1,468 | 75 | $7,900 |
| 48 | $495 | 62 | $1,678 | | |

*Notes:* Premium data are from *Best's Policy Reports*, June 2000, for preferred risk nonsmoking males for a large U.S. life insurer. Premium for age 75, however, is extrapolated from the previous years' premiums.

# 3 Main Results

Applying equation (3) to the premium data in Table 2, the annual NPVs (for holding periods up to 30 years) of backdating a contract versus not backdating a contract are shown in Figures 2 through 5 below. For a 36 year old applicant, Figure 2 illustrates that the annual NPVs range from -$129 to $569, for holding periods up to 30 years. As shown in Figure 3, however, the actual benefit or cost of backdating depends upon the particular month in which the policy ends. For the 36 year old applicant that backdates by six months, Figure 3 shows that for the first six months of each year, the monthly NPV of backdating is positive. During the latter six months of each policy year, however, monthly NPVs of backdating are negative. For the 36 year old applicant who backdates a term policy by six months, the annual NPV line

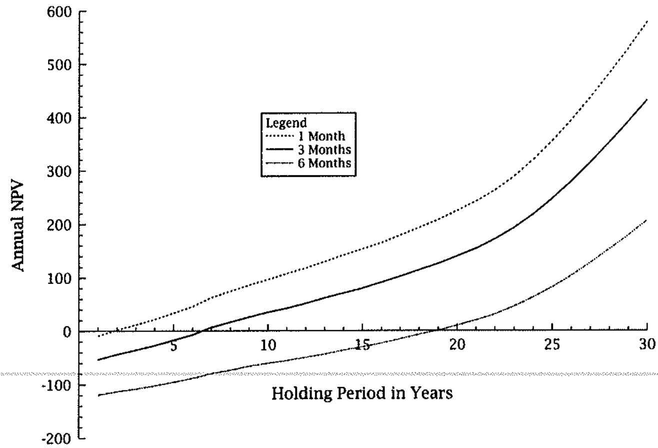


Figure 2: Annual NPV of Backdating: Age 36 Assumed Interest Rate: Six Percent Backdated by One, Three, and Six Months

shows that it takes almost 20 years before the weighted average of the monthly benefits and costs is positive.[7]

For the 46 year old applicant, Figure 4 illustrates that the annual NPVs range from -$200 to $1,933, for holding periods up to 30 years. As before, the actual benefit or cost of backdating depends upon the particular month in which the policy ends. For the 46 year old applicant that backdates one month, Figure 5 shows that for the first 11 months of each year, the monthly NPV of backdating is positive. During the last one month of each policy year, however, monthly NPVs of backdating are negative. For the 46 year old applicant who backdates a term policy by one month, the annual NPV line shows that it takes approximately two years before the weighted average of the benefits and costs is positive.[8]

[7]Note that the 6-month line of Figure 2 is the same as the annual NPV points in Figure 3.

[8]Note that the 1-month line of Figure 4 is the same as the annual NPV points in Figure 5.

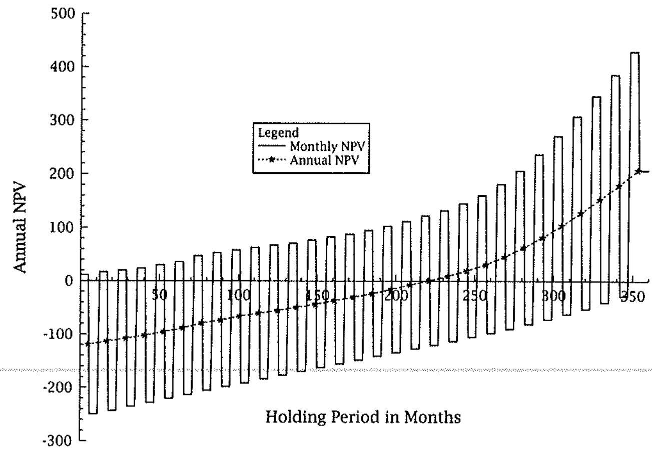


Figure 3: Monthly NPV and Annual NPV of Backdating: Age 36 Assumed Interest Rate: Six Percent Backdated by Six Months

Figures 2 and 4 clearly illustrate that the costs and benefits of backdating increase with age (premium). This finding is intuitively appealing, as the annual difference in mortality costs is greater at higher ages, and backdating to save age would be expected to have a larger impact on cost. These figures also illustrate that the benefit of backdating decreases as the number of months that a contract is backdated increases. For both ages examined, backdating an annual renewable term insurance contract by six months results in predominantly negative NPVs for holding periods of at least 13 years. The equations also are applied to 20-year level term insurance premium data. The resulting graphs are different than those shown here, but overall results are similar. The costs of backdating are somewhat larger (and the benefits somewhat smaller) based on the level term insurance premium data than the costs/benefits based on annual renewable term insurance premium data.

It is clear that the benefits of backdating are somewhat rear-end loaded. Even though a policy owner may intend to hold the policy for several decades, the potential for death or lapse often will make the

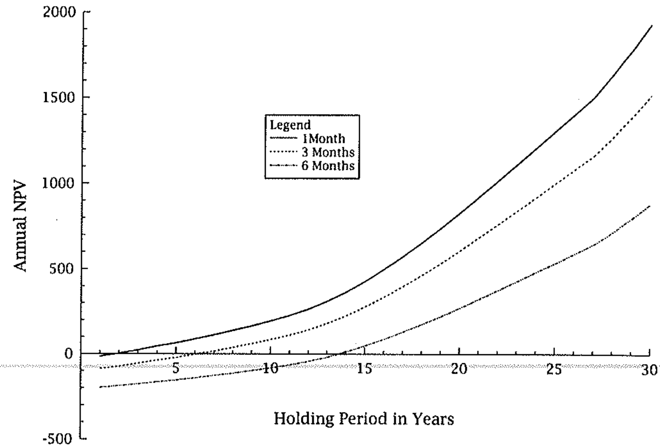


Figure 4: Annual NPV of Backdating: Age 46 Assumed Interest Rate: Six Percent Backdated by One, Three, and Six Months

holding period shorter than planned. This nature of backdating begs the question of the likely holding period for a policy owner. To answer this question, we use mortality and lapse data. For this analysis, we obtained mortality data from the Life Table for the Total Population: United States, 1979-1981 (see Bowers et al., 1997).[9] Because lapse rates vary across insurers (and across product lines), for simplicity we use lapse rates described in the Life Insurance Fact Book (1997) for ordinary life.[10] Thus, equation (4) provides the actuarial present value of backdating by accounting for mortality and policy lapse. Applying equation (4) to the data, the actuarial present value of backdating for a 46-year-old male equals \$72, \$314, and \$471, for backdating periods of six months, three months, and one month, respectively.

Note that the expected policy holding period (based on the mortality and lapse data described above) for the 46 year old male in the analysis

[9]Of course, other mortality tables also could be employed. Assuming lower mortality rates would lead to somewhat increased actuarial values of backdating, and vice versa.

[10]Lapse rates for years one, two, and forward are 17 percent, 17 percent, and 5 percent, respectively. Other lapse assumptions could be employed. Higher assumed lapse (and mortality) rates would of course reduce the actuarial value of backdating.

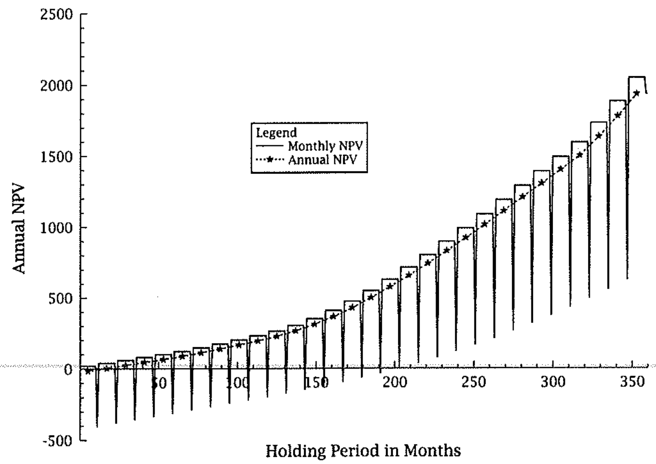


Figure 5: Monthly NPV and Annual NPV of Backdating: Age 46 Assumed Interest Rate: Six Percent Backdated by One Month

is 13 years. Thus, based on an expected policy holding period criterion, Figure 4 would suggest that the net present value of backdating (at the year-13 point) equals -\$18, \$180, or \$310, for backdating periods of six months, three months, and one month, respectively. The actuarial value amounts are somewhat higher than the values indicated by the simple expected policy holding period criterion. The higher actuarial values stem from the nature of exponential growth of the benefits of backdating, and the relatively high dollar values that are factored into the actuarial present value calculation, but not into the expected value calculation.

# 4 Discussion

Our analysis indicates that discrete (annual) mortality pricing of life insurance results in the opportunity for some insureds to reduce the cost of term life insurance via backdating. Backdating typically is driven by the agent as opposed to the policy owner, and backdating likely is the industry's response in lieu of a finer pricing structure. From a transaction cost perspective, allowing backdating may be less costly for an insurer than attempting to price more points on the age/price continuum.

While the benefits of backdating can be positive, the preceding analysis indicates that the benefits of backdating a term insurance contract generally are least likely to be positive in situations involving relatively long backdated periods and relatively short holding periods. The phantom surrender charge created by backdating (with the premium paid for time already elapsed) serves to align the interests of the insurer, agent, and policy owner in terms of policy persistency. In effect, backdating may serve as a bonding mechanism and as a signal that the policy owner intends to hold the policy longer than the typical policy owner. In this sense, backdating leads to superior incentive-compatible contracting between the various parties. Additionally, life insurance companies face significant risks due to surplus strain in early durations of life policies, and backdating transfers a (relatively small) part of that risk to consumers. From the perspective of the life insurance firm issuing the contract, backdating appears to be an indirect risk-hedging mechanism.

Backdating is a zero-sum game with respect to the insurer and the policy owner. Prior to policy termination, the winner from backdating is unknown and is not determined until the time of lapse/surrender or death. Figures 2 and 4 illustrate that the likelihood of benefiting from backdating (from a given policy owner's perspective) is maximized, ceteris paribus, with the shortest possible backdated period. Thus, backdating is, in a sense, risk arbitrage from the consumer's viewpoint: risk arbitrage, not in the sense that the contract must be held for some minimum amount of time to break even (as in Carson, 1994), but risk-arbitrage in the sense that benefits could change quickly to costs (as shown most clearly in Figure 1) depending on the specific month of death or lapse.

This study's results suggest that regulatory concerns over potential problems related to backdating are valid because backdating will not be beneficial to all who backdate—i.e., those insureds that lapse or die soon after paying a renewal premium generally will be worse off from backdating. The results also indicate that prohibition of backdating is overly restrictive and would preclude beneficial transactions for many applicants. Because backdating may be beneficial or detrimental to the policy owner, insurers are wise to explain the potential costs and benefits of backdating to prospective insureds. Other legal or ethical issues that might arise include whether it is an unfair trade practice to permit backdating for one applicant and not another similar applicant.

The actuarial present value of backdating suggests that backdating often is a value-enhancing practice. Higher mortality and lapse rates than those assumed here obviously would reduce the values associated with backdating. In addition, the choice of a particular interest rate has an important effect on the results of the analysis. Especially for holding periods greater than ten years, increasing (decreasing) the interest rate assumption results in lower (higher) NPVs of backdating. The magnitude of the effect of the interest rate assumption increases with the age (premium) of the applicant. Finally, the gains from backdating relate to the increase in premiums from year to year. Thus, to the extent that annual premium increases are similar between smoker/nonsmoker or male/female insureds, no significant differences between smoker/nonsmoker or male/female insureds would be expected. Because annual premium increases become more pronounced at later ages, however, the potential benefits of backdating increase with age, especially beyond age 45.

## 5 Closing Comments

Life insurance backdating is similar to paying discount points to obtain a lower interest rate on a mortgage. Our analysis indicates that life insurance contract prices based on annual age differences result in the opportunity for some applicants to reduce their cost of coverage. In a sense, backdating is a market response to a pricing practice that does not distinguish between age differences less than one year. Backdating appears to serve as a substitute for a finer partitioned pricing structure in the life insurance industry, as a risk-hedging mechanism for insurers, and as a risk-arbitrage tool for consumers. While applicants realize the benefits of backdating immediately upon policy inception, these benefits quickly turn into costs for a number of months upon payment of each successive annual premium, and this cycle continues for many years. Thus, backdating is not a perfect substitute for a pricing structure with finer partitioning.

Findings indicate that the potential benefit of backdating tends to increase as the number of months by which the contract is backdated is decreased. Specifically, the annual NPVs of backdating a contract six months were predominantly negative for both ages examined (36 and 46) for holding periods of up to at least 13 years. For contracts backdated only one month and for later ages, however, the potential to reduce the cost of coverage is substantial, even for relatively short holding periods. Increasing the assumed interest rate assumption (as well as mortality and lapse assumptions) decreases the costs and benefits of backdating. As discussed earlier, the potential benefits of backdating tend to increase with age of the applicant.

The equations presented here can be used to determine the financial and actuarial value of backdating a term life insurance contract. Future research on this topic might focus on the extent to which backdating for other types of life insurance contracts (e.g., cash value life insurance) differs from this analysis for term insurance.

## References

A.M. Best. *Best's Policy Reports—Term Insurance* Oldwick, NJ: A.M. Best Co., June, 2000.

American Council of Life Insurance. *Life Insurance Fact Book*, Washington, D.C., 1997.

Bowers, Jr., N.L., Gerber, H.U., Hickman, J.C., Jones, D.A., Nesbitt, C. J. *Actuarial Mathematics.* Society of Actuaries, Schaumburg, IL, 1997.

Brueckner, J.K. "Borrower Mobility, Self-Selection, and the Relative Prices of Fixed and Adjustable-Rate Morgages." *Journal of Financial Intermediation* 2 (1992): 401–421.

Carson, J.M. "Backdating of Life Insurance Contracts: An Examination." *Journal of Insurance Regulation* 13 (1994): 185–200.

Nahata, B., Ostaszewski, K. and Sahoo, P.K. "Direction of Price Changes in Third-Degree Price Discrimination." *American Economic Review* 80 (1990): 1254–1258.

Stone, C.A. and Zissu, A.M. "Choosing a Discount Point/Contract Rate Combination." *Journal of Real Estate Finance and Economics* 3 (1990): 283–293.

Yang, T. L. "Self Selection in the Fixed-Rate Mortgage Market." *Journal of the American Real Estate and Urban Economics Association* 20 (1992): 359–391.