

PRICE REGULATION IN SECONDARY INSURANCE MARKETS

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ABSTRACT

Secondary life insurance markets are growing rapidly. From nearly no transactions in 1980, a wide variety of similar products in this market has developed, including viatical settlements, accelerated death benefits, and life settlements and as the population ages, these markets will become increasingly popular. Eight state governments, in a bid to guarantee sellers a "fair" price, have passed regulations setting a price floor on secondary life insurance market transactions, and more are considering doing the same. Using data from a unique random sample of HIV+ patients, we estimate welfare losses from transactions prevented by binding price floors in the viatical settlements market (an important segment of the secondary life insurance market). We find that price floors bind on HIV patients with greater than 4 years of life expectancy. Furthermore, HIV patients from states with price floors are significantly less likely to viaticate than similarly healthy HIV patients from other states. If price floors were adopted nationwide, they would rule out transactions worth \$119 million per year. We find that the magnitude of welfare loss from these blocked transactions would be highest for consumers who are relatively poor, have weak bequest motives, and have a high rate of time preference.

INTRODUCTION

Secondary life insurance markets allow consumers to cash out life insurance holdings prior to death. While these markets are growing rapidly, and state and federal governments are in the process of implementing a variety of regulatory mechanisms in these markets, there has been no attention given to these markets in the economic

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literature. In this article, we analyze empirically the effects of price regulation in an important segment of secondary life insurance markets. An important part of our empirical work tests for whether these are best explained by competitive models or monopsonistic models.

Competitive models of price regulation predict that producers will supply less, and consumers will have excess demand when binding price ceilings are imposed. A similar story holds for binding price floors, although there the problem is one of excess supply. This basic tenet of microeconomics implies that price regulation has a very circumscribed role in competitive markets. If firms enjoy market power and produce less than the socially optimal output, then optimally designed price regulation can increase both consumer and social welfare by increasing the market output to the socially optimal level, and transferring wealth from firms to consumers. Thus, policy makers often use such regulation to ensure that consumers receive a “reasonable” price in new markets.

We describe the welfare effects of price regulations in an important segment of the secondary life insurance market—the viatical settlements market. In “Background,” we describe the growth and regulation of these markets. In “Actuarially Fair Prices and Minimum Price Floors,” we develop a simple model relating the actuarially fair price of a viatical settlement transaction to the life expectancy of sellers. We then describe the predictions from economic theory of the impact of price regulation on market outcomes depending on market structure, and the relationship between the mandated price floor and the actuarially fair price. In “Data,” we describe the unique longitudinal database on HIV patients receiving care in the United States that we use to test our hypotheses about the effects of these price regulations, while in “Empirical Method” we describe our empirical modeling strategy. In “Results,” we provide our empirical estimates of the effect of pricing regulations on the likelihood of viatical settlement sales. This allows us to estimate the total value of viatical settlement sales that are blocked (or increased) by pricing regulations. Finally, in “Welfare Implications,” we develop and calibrate a utility maximizing model of life insurance sales to estimate the welfare consequences of price regulations for different subgroups of the HIV+ population.

BACKGROUND

A typical transaction in a secondary life insurance market works this way: the policyholder gets an immediate up-front payment at a discount to the face value of the life insurance; in return, he makes a third party (sometimes the life insurance company itself in the case of accelerated death benefits) a beneficiary of the policy. The third party collects the death benefits when the policyholder dies but pays premiums on the policy while the policyholder is alive. It is important to recognize that the initial payout depends on the life expectancy of the policyholder, since the company collects the full value only when the patient dies.

From nearly no transactions in 1980, a wide variety of similar products in secondary life insurance markets have developed, including viatical settlements, accelerated death benefits (ADB), and life settlements. Although viatical settlements, life settlements, and ADBs are all secondary life insurance contracts, they differ in important ways. Accelerated death benefits give policyholders the option to sell their policy to

the life insurance company that originally issued the policy. However, this option is only available to policyholders whose policies have an ADB rider and who have life expectancy of less than 1 year. The American Council of Life Insurance (1998a) reports that over \$10 trillion in life insurance contracts (78 percent of all life insurance dollars) are held by companies that offer accelerated death benefits. Terminally ill policyholders also have the option to sell their policies to independent financial companies in the viatical settlements market. In contrast to ADBs, there are no restrictions on the life expectancy of the policyholders in the viatical settlements markets. In fact, these companies are now actively marketing and buying policies from the elderly with no terminal illness. These secondary life insurance transactions by the elderly are called life settlements or senior settlements.

Secondary life insurance markets are likely to become increasingly important, as they attract the elderly, the frail, the disabled, and the HIV positive. Anyone who undergoes an unexpectedly large health shock after buying a life insurance policy will have an incentive to cash out (see Bhattacharya, Goldman, and Sood, 2001). As the population ages, these markets will become increasingly popular. Indeed, Congress recently passed the Health Insurance Portability and Accountability Act, which exempts proceeds from secondary life insurance transactions from federal income taxes.¹ Nevertheless, there has been little serious economic analysis of these markets.

This article focuses on the viatical settlement market. The viatical settlement industry emerged in 1989 in response to the AIDS epidemic.² Beneficiaries with advanced HIV disease faced very high medical expenses as new treatments emerged. To finance this medical care, many patients considered the sale of their life insurance policies. By 1991, an estimated \$50 million of viatical settlements had been sold. The industry has been growing rapidly since then with \$500 million in policies viaticated by 1995 and \$1 billion in policies viaticated by 1998 (National Viatical Association, 1999), despite the development of effective treatments for HIV disease.

There has been increasing pressure to regulate this industry, spurred in part by recognition that one of the parties to the transaction is exceptionally vulnerable—that is, terminally ill patients and the elderly. The National Association of Insurance Commissioners (NAIC) has issued model legislation as guidelines for state regulators. The main provisions of the NAIC model legislation include that firms should be licensed and that they should disclose the possible financial consequences of the transaction including the effect on taxes and eligibility for need-based programs. The model regulation also establishes that consumers receive a certain percentage of the face value of their life insurance policy. The minimum settlement percentage set by the regulation depends on the life expectancy of the policyholder and the credit rating of the insurer that issued the policy. The minimum settlement percentage is higher for policies with high credit rating (low default risk) and low life expectancy as firms are more likely to collect the benefits of these policies in the near term.

¹ Health Insurance Portability and Accountability Act of 1996, U.S. PL 104-191.

² The viatical industry was first conceived by Rob Worley in 1986. Legal maneuvering at both the state and federal level prevented Worley from starting his company until 1989 (American Cash Flow Corporation, 2001).

Not surprisingly, these minimum price floors are controversial. The regulators argue that these regulations mitigate firm market power and ensure that consumers receive a reasonable return on life insurance sales. The industry argues that the minimum payments rule out certain settlements that are otherwise mutually beneficial, thereby distorting the market. Proponents of regulation counter that such price supports are necessary to prevent companies from taking advantage of seniors and the chronically ill because the secondary life insurance market may be imperfectly competitive. At present, approximately half of the states have passed legislation covering viatical settlements and accelerated death benefits, many using the NAIC model (National Association of Insurance Commissioners, 1999); eight states have passed the price floor provisions.

ACTUARIALLY FAIR PRICES AND MINIMUM PRICE FLOORS

In this section, we first derive the actuarially fair price of secondary insurance contracts.³ Understanding how these contracts are priced is a key component in understanding the effects of price regulation on these markets. In Bhattacharya, Goldman, and Sood (2001), we show that full-information models fit the facts of the viatical settlement market better than models that focus on adverse selection.⁴ Moreover, the institutional details of this industry argue against the importance of adverse selection in these markets. In particular, unlike firms in other insurance markets, viatical companies scrutinize patient medical records before making an offer to buy. Hence, we focus our attention here on full-information models.

As in all markets for mortality contingent contracts, viatical settlement firms need to know the health of consumers to derive the actuarially fair price. Typically, these firms use the services of in-house staff, independent physicians, actuaries, and other consultants to determine the mortality risks of potential consumers.⁵ The actuarially fair price will also depend on the cost of funds for viatical settlement firms. As one might expect, the actuarially fair price increases with the mortality risk (as firms are more likely to collect benefits earlier) of the consumer and decreases with the costs of borrowing for the firm.

We first consider an infinite-period model where (at time $t = 0$) a consumer is endowed with a life insurance policy that will pay \$1 upon the consumer's death, and for which the consumer pays a yearly premium, ρ , for as long as he survives. While ρ was set

³ There is a long literature on the pricing of life insurance contracts. For example, Grosen and Jorgensen (1997) discuss the pricing of life insurance when there are early exercisable interest rate guarantees; Grosen and Jorgensen (2002) discuss a pricing formula for life insurance that accounts for insolvency risk; and Carson (1996) discuss a pricing formula for universal life insurance surrender values. To focus attention on the pricing of secondary contracts, we abstract away from these wrinkles in our pricing formulas.

⁴ Traditional models of asymmetric information demonstrate that asymmetric information might lead to adverse selection in insurance markets; that is, high-risk individuals are more likely to participate and low risks are driven out of the market. Since, consumers are sellers in this market, adverse selection in these markets leads to the opposite of the typical "lemons" problems—patients with unobserved mortality risks rather than the healthier patients are driven out of the market. However, we find no evidence of such effects in this market.

⁵ See National Association of Insurance Commissioners (1999).

based upon the consumer's mortality risk profile at the time the policy was originally purchased ($t < 0$), the consumer has undergone a health shock that leaves him with a new mortality profile, though the premiums on the policy are "locked in" at the old value.

Let $a = (a_1, a_2, a_3, \dots, a_t, \dots)$ represent the probability of death (reflecting the new mortality profile) for the insured consumer for each time period t , given the best information at the time of sale ($t = 0$) of the policy in the secondary insurance market. Let $S_t = \sum_{\tau=t}^{\infty} a_{\tau}$ be the probability that the insured survives to the beginning of period t , where $S_1 = 1$. If $P(a)$ is the unit price a firm is willing to pay for life insurance to a consumer with mortality risk a , then present value of the expected profit from the purchase of the policy is

$$E[\text{Profit}] = \sum_{t=1}^{\infty} (a_t - \rho S_t) b^t - P(a), \quad (1)$$

where $b = \frac{1}{1+r}$ and r is the cost of capital for viatical settlement firms. The first term in (1) represents the present value of expected revenue after the consumer's death (net of premium payments) and the second term represents the cash payment for the policy.⁶

If market is competitive, then the firms will make zero profits and charge a price:

$$P(a) = \sum_{t=1}^{\infty} (a_t - \rho S_t) b^t. \quad (2)$$

Figure 1 shows the equilibrium output and price in perfectly competitive market given the mortality risk of the consumer and the cost of capital for firms. In equilibrium, prices are actuarially fair (demand is perfectly elastic), and the output is determined by intersection of the market demand and supply curves. Given this model it is easy to draw out the implications of minimum price regulation for a perfectly competitive viatical settlements market. If the minimum price floor is set below the actuarially fair price, then the price regulation will have no effect on market outcomes in a perfectly competitive market as price competition among viatical settlement firms will ensure that the market price is already higher than the minimum price. On the other hand, if the minimum price floor is set above the actuarially fair price firms will exit the market and no transaction will occur, as trading at the minimum price floor will result in losses for firms.

Points Q_m and P_m in Figure 2 show the equilibrium output and price in a monopsonistic viatical settlement market. In this case, market output is determined by the intersection of the marginal expense curve and the actuarially fair price. Firms make positive profits since prices are less than actuarially fair. Also, the number of transactions is less than the perfectly competitive level. Like the perfectly competitive case, if the

⁶ This pricing equation assumes that the policy has no accumulated cash value. This is reasonable as most HIV patients are relatively young and therefore their policies have not accumulated much cash value.

FIGURE 1
Market Price and Output Under Perfect Competition

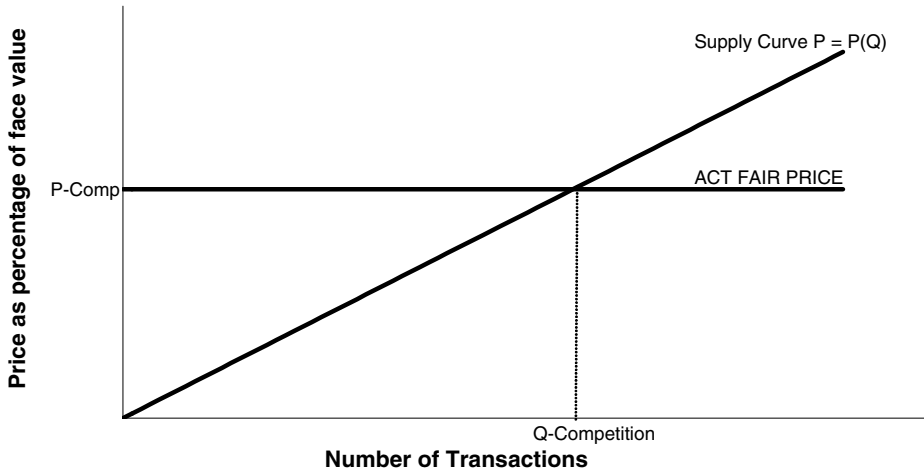
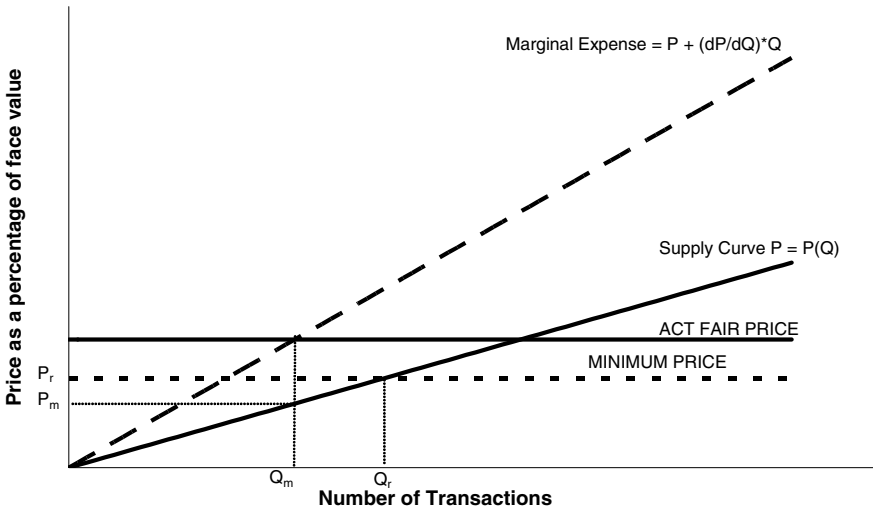


FIGURE 2
Market Price and Output Under Monopsony



minimum price were set above the actuarially fair price, the firm would exit the market since trading at the regulated price would imply giving consumers more than the present value of the death benefits on their life insurance. However, imposition of price floor below the actuarially fair price but above the market price should increase the market price and number of transactions in regulated states as firms in regulated states can transact at the price floor and still make positive profits. This case is shown in

Figure 2—the number of transactions increases from Q_m to Q_r and the price increases from P_m to P_r .

In summary, economic theory predicts that minimum prices above the actuarially fair price rule out certain viatical settlements that are otherwise appropriate and therefore reduce the likelihood of trades. Minimum prices below the actuarially fair price have no effect on the viatical settlements market in competitive markets but might increase the likelihood of trades and welfare in monopsonistic or less competitive markets. We empirically test each of these predictions in this article and estimate the welfare consequence of price regulation for different subgroups of the HIV+ population.

DATA

We evaluate the impact of minimum price regulation on the viatical settlements market using data from the HIV Costs and Services Utilization Study (HCSUS)—a nationally representative survey of HIV-infected adults receiving care in the United States. This data set is appropriate because it contains extensive information on a sample of terminally ill patients who constitute a large share of the viatical settlements market.

HCSUS is a panel study that followed the same set of patients over three interview waves. There were 2,864 respondents in the baseline survey, conducted between 1996 and 1997; 2,466 respondents in the first follow-up (FU1) survey, conducted in late 1997; and 2,267 respondents in the second follow-up (FU2) survey, conducted in 1998. The data set has information on the respondents' demographics, income and assets, health status, life insurance, and participation in the viatical settlements market.

Questions about life insurance holdings and sales were asked in the FU1 and FU2 surveys but not in the baseline survey. Of the 2,466 respondents in FU1, 1,353 (54.7 percent) reported life insurance holdings. These 1,353 respondents are our analytic sample as they are the only respondents who could have sold their life insurance policies in the viatical settlements market. Three hundred forty-four of these respondents have missing values for at least one of the key variables—diagnosis date, health status—so we exclude them, leaving 1,009 respondents. In our remaining analytic sample, 132 (13 percent) respondents had sold their life insurance by the FU1 interview date, and an additional 33 respondents sold their life insurance between the FU1 and FU2 interview dates.

Table 1 compares summary statistics from the baseline interview of respondents who viaticated at some point in time with those who never did.⁷ Viators are more likely than nonviators to be male, white, richer, and older. They are also typically in poorer health, with lower CD4 T-cell levels at the baseline survey and more progressive HIV disease.

Table 2 provides the minimum price floors based on the NAIC model. Eight states including Kansas, Louisiana, Minnesota, North Carolina, Oregon, Virginia, Washington, and Wisconsin have adopted minimum price legislation based on the NAIC model (National Association of Insurance Commissioners, 1997). More than 10 percent of the respondents in our analytic sample resided in states with minimum price regulation.

⁷ Including the 344 respondents who had at least one missing value has no appreciable effect on the summary statistics that we report in Table 1.

TABLE 1
Demographics at Baseline of Viators Versus Nonviators

Variables	Entire Sample	Viators	Nonviators
Age	35	37	35
Male	81%	88%	80%
White	59%	78%	56%
Black	24%	16%	26%
Hispanic	11%	5%	12%
<i>Monthly Income</i>			
<\$500	15%	13%	16%
\$501–\$2000	41%	41%	40%
>\$2000	44%	46%	44%
<i>Disease Stage</i>			
Asymptomatic	9%	9%	9%
Symptomatic	51%	38%	54%
AIDS	39%	53%	37%
<i>CD4 T-Cell Levels</i>			
<50 cells/ml	12%	15%	11%
50–200 cells/ml	25%	41%	22%
201–500 cells/ml	42%	32%	44%
>500 cells/ml	21%	13%	23%
N	1,009	165	844

TABLE 2
Mandated Minimum Prices as a Percentage of Face Value

Life Expectancy	Minimum Price
<6 months	0.80
6–12 months	0.70
12–18 months	0.65
18–24 months	0.60
>24 months	0.50

EMPIRICAL METHODS

In this section, we describe our empirical model. Our main purpose is to determine from the data subgroups of the HIV population for whom price regulations are most likely to bind (that is, those for whom the minimum price is higher than the actuarially fair price) and the subgroups for whom regulation might be beneficial in less competitive markets (that is, minimum price is less than actuarially fair price). Not surprisingly, we focus much of our attention on subgroups defined by life expectancy, since as long as firms are profit maximizing, prices will depend critically on health status. The price regulations described in Table 2 show that regulators have put some effort into tailoring policy to take this fact into account. In this section, we determine empirically the extent to which they have been successful.

Modeling the Probability of Selling Life Insurance in the Secondary Market

Although HCSUS respondents report whether they sold their life insurance, they report neither the exact date of sale nor the quantity sold. Fortunately, because HCSUS respondents report whether they viaticated by FU1 and by FU2, we can determine the time at risk to viaticate. Given these data, we estimate an empirical model of the decision to viaticate that allows for time-varying covariates (including health status, assets, and income change over the course of the panel).

There are three kinds of respondents—those who have viaticated by FU1, those who viaticated between FU1 and FU2, and those who never viaticate in the observation window. Each has a different contribution to the likelihood function. Let $\lambda(t)$ be the probability of not viaticating at time t given that the respondent has not viaticated in the preceding $t - 1$ years. Time is measured starting from the year of diagnosis with HIV, or the viatical settlements market inception date—1988—whichever is earlier. The probability that a respondent never viaticated is $\prod_{t=1}^T \lambda(t)$, where T is years between the start and end of the observation window. Similarly, the probability that a respondent viaticated by FU1 is $1 - \prod_{t=1}^{T_1} \lambda(t)$, where T_1 is years between the start and the FU1 interview date. The probability that a respondent did not viaticate between the start date and FU1 but did viaticate by FU2 is $\prod_{t=1}^{T_1} \lambda(t) - \prod_{t=1}^{T_2} \lambda(t)$, where T_2 is years between the start and the FU2 interview date. Combining these three types of respondents gives the likelihood function:

$$\mathcal{L} = \prod_{i=1}^N \left\{ D_{1i} \left[\prod_{t=1}^{T_1} \lambda_i(t) - \prod_{t=1}^{T_2} \lambda_i(t) \right] + D_{2i} \left[1 - \prod_{t=1}^{T_1} \lambda_i(t) \right] + D_{3i} \left[\prod_{t=1}^T \lambda_i(t) \right] \right\}. \tag{3}$$

In Equation (3), i subscripts over the N respondents, D_{1i} is a binary variable that indicates whether respondent i viaticated between FU1 and FU2, D_{2i} indicates whether respondent i viaticated by FU1, and D_{3i} indicates that respondent i never viaticated.

We model the hazard of not viaticating as,

$$\lambda_i(t) = \frac{1}{1 + \exp(\lambda_i^0 + X_{it}\beta)}. \tag{4}$$

Here, X_{it} is a vector of covariates measured at time t , β is the vector of regression coefficients, and $\frac{1}{1 + \exp(\lambda_i^0)}$ for $t = 1, \dots, T$, is the baseline logit hazard rate. We plug (4) into (3) and maximize the latter to estimate the parameters λ_i^0 (T of them) and β . We set $T = 9$. Given the HCSUS sampling period, this implies that each period in our empirical model corresponds to 4 months in real time.

HCSUS respondents were sampled only at three discrete times. One major consequence of this sampling strategy is that we do not observe X_{it} at each point in time t , so we have no measures of patient health status or changes in assets between surveys.

We use a step function approximation to impute values of X_{it} . For example, suppose a respondent is sampled at time points t_1 , t_2 , and t_3 , and reports values for X_t of x_1 , x_2 , and x_3 at each of these time points, respectively. We assign

$$X_t = \begin{cases} x_1 & \text{for } t \leq t_1, \\ x_2 & \text{for } t_1 < t \leq t_2, \\ x_3 & \text{for } t_2 < t \leq t_3. \end{cases}$$

We include as covariates demographics, life expectancy, income, a binary variable for minimum price regulation, and measures of the actuarially fair price and the minimum regulated price.

Estimating Life Expectancy and the Actuarially Fair Price

We use the Cox proportional hazard model to estimate the life expectancy of HIV+ patients. Equations (5) and (6) give the hazard rate and survival function under the proportional hazard assumption:

$$h(t) = h_0(t) \exp(X\beta), \quad (5)$$

$$S(t) = \left[\exp \left(- \int_0^t h_0(u) du \right) \right]^{\exp(X\beta)}. \quad (6)$$

Here, t is the survival time; $h_0(t)$ is the baseline hazard function, X is a vector of explanatory variables, and β is the corresponding vector of parameters for the covariates. We estimate the parameters $h_0(t)$ and using maximum likelihood estimation.

However, the parameters $h_0(t)$ are only estimated at times when failure occurs. To calculate life expectancy we need estimates of baseline hazards for all time periods. We predict the baseline hazard for nonfailure times by fitting a linear trend to the estimated baseline hazard.

The estimated life expectancy of a respondent with hazard rate $h(t)$ is simply the area under the survivor function:

$$LE(h(t)) = \int_0^{\infty} \hat{S}(t) dt. \quad (7)$$

The estimated actuarially fair price of a life insurance policy—net of per-period estimated premiums $\hat{\pi}$ —with \$1 face value is

$$AFP(h(t)) = \int_0^{\infty} [\hat{f}(t) - \hat{\pi} \hat{S}(t)] \exp(-rt) dt \quad (8)$$

Here, $\hat{f}(t)$ is the estimated probability density function and r reflects the cost of capital for viatical settlement firms. This equation is the continuous time equivalent of the pricing Equation (2).

We estimate per-period premiums, $\hat{\rho}$, assuming a constant mortality hazard evaluated at the time the policy was purchased (that is, when the insured person was healthy). Let L be the life expectancy associated with this mortality hazard. The pricing equation for this actuarially fair life insurance policy assumes that the present value of premiums paid equals the present value of the life insurance benefit (again at the time of purchase). It is easy to show that this pricing equation implies $\rho = \frac{1}{L}$. We obtain estimates of L from the National Center for Health Statistics—Anderson (1999).⁸

Since we did not observe in our data when policies were purchased, we assumed that people bought them the year prior to contracting HIV disease.⁹ Thus, our estimate of premiums paid is an upper bound on actual premiums paid. This implies our estimate of actuarially fair prices for viatical settlements—Equation (8)—is a lower bound on the true actuarially fair price. Thus, we are effectively overestimating the size of the population on whom minimum price regulations are binding. If we were to assume zero premiums—that is, an infinite life span prior to contracting HIV disease—we would underestimate the size of this bound population. Our results with this underestimate of the bound population are qualitatively and quantitatively similar to the ones with the overestimate of the bound population, and are available upon request.

Based upon information from Ibbotson Associates (1997), we estimated the cost of capital for viatical settlement firms as 16.5 percent per annum. This estimate is based on the weighted average cost of capital of firms in the same standard industrial classification code as viatical settlement firms.

Another way to estimate the cost of funds for viatical settlement firms is to compute the returns viatical settlement firms offer to investors. Investors can usually purchase policies from viatical firms according to the following schedule: \$100,000 for a policy with (1) face value of \$112,000 and life expectancy of policyholder of 1 year, or (2) face value of \$128,000 and life expectancy of 2 years, or (3) face value of \$142,000 and life expectancy of 3 years (the internet is replete with such offers, for example, see www.sicviatical.com). Based on this price schedule, the annual cost of funds for viatical settlements is about 16 percent per annum.

Covariates in the Cox proportional hazard models include indicator variables for level of CD4+ T-lymphocyte (CD4) cell count and stage of disease. When HCSUS was conducted, the two most important health status measures for HIV patients were CD4+ T-lymphocyte cell count and the Center for Disease Control (CDC) definition of clinical stage. CD4+ T-cell count measures the function of a patient's immune system; depletion correlates strongly with worsening HIV disease and increasing risk of opportunistic infections (Fauci et al., 1998). While healthy patients have CD4 cell

⁸ The life expectancy estimates are stratified by age and sex.

⁹ For the approximately 5 percent of the sample who contracted HIV after age 50, we assumed they purchased life insurance at age 50. Without this extra assumption, our calculations for premiums would exceed the viatical settlement value for two people in the HCSUS sample.

counts above 500 cells/ml, declines into lower clinically recognized ranges correlate with worsening disease. These ranges are: between 200 and 500 cells/ml, between 50 and 200 cells/ml, and below 50 cells/ml. There are three categories in CDC definition of clinical stage: asymptomatic, symptomatic, and AIDS (Centers for Disease Control and Prevention, 1993). Patients have AIDS if they manifest conditions such as Kaposi's Sarcoma, Toxoplasmosis, or other life-threatening conditions on the CDC list. Symptomatic HIV+ patients manifest some conditions related to their infection, but not one of the AIDS defining conditions. A depletion in CD4 cells correlates strongly with the worsening of HIV disease and the risk of developing an AIDS-defining opportunistic infection.

RESULTS

In this section, we identify which subgroups in the HIV population face binding price regulation (that is, those patients for whom minimum prices are greater than actuarially fair prices) and which subgroups face nonbinding price regulation (that is, minimum prices are less than or equal to actuarially fair prices). We then examine whether those groups for whom the regulation is binding are less likely to sell their life insurance policies over any given time period (or perhaps delay selling their policies) than similarly healthy patients in unregulated states. We also examine whether those groups for whom regulation is nonbinding benefit from regulation and are more likely to sell (if markets are noncompetitive) or as likely to sell (if markets are competitive) their life insurance policies than similarly healthy groups in unregulated states. Finally, based on our results we estimate the total value of trades in this market that would be blocked if minimum price regulations of the sort shown in Table 2 were expanded nationwide.

Life Expectancy, Actuarially Fair Prices, and Price Floors

Figure 3 shows the minimum prices and the average actuarially fair prices as a function of life expectancy. Minimum prices are based on legislated minimum prices of Table 2; hence the discrete jumps every 6 months until 2 years. Actuarially fair prices are calculated using Equation (8).

A well-designed pricing scheme would keep the minimum prices just below the actuarially fair price to minimize industry profits but ensure that trades can take place. If the price floors are set too high, the market might disappear completely. If they are too low, they will not be binding since low minimum prices will be bid away by demand-side competition. As shown in Figure 3, the mandated prices are lower than the actuarially fair price for very sick patients, suggesting that these might increase the likelihood of trades if the markets are noncompetitive and market prices in the absence of regulation are lower than regulated prices. However, if markets are competitive, then these regulations will have no effect on market outcomes for the very sick patients. For patients with more than approximately 4.5 years of life expectancy, the minimum prices are higher than the actuarially fair price, so we expect very few trades for these HIV+ patients in relatively good health, as firms would make losses if they trade at the mandated minimum prices.

We predict life expectancy for our sample using Equation (7). The results are shown in Table 3. The only covariates are CD4 count and disease stage. Patients with more

FIGURE 3
Minimum and Actuarially Fair Prices as a Function of Life Expectancy

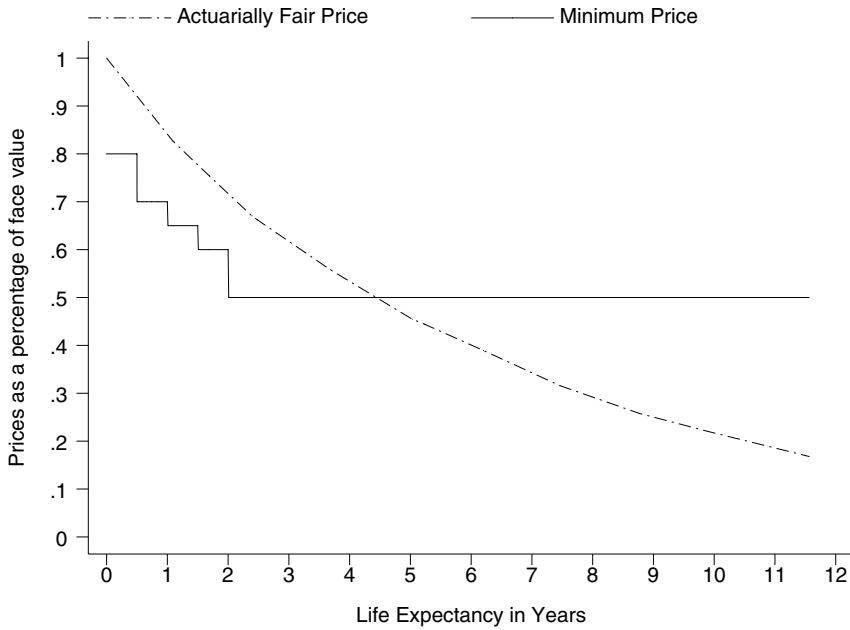


TABLE 3
Life Expectancy in Years by CD4 Level and Stage of Disease

CD4 Level	Clinical Stage of Disease		
	Asymptomatic	Symptomatic	AIDS
CD4 > 500	11.56	8.77	6.20
CD4 201–500	9.90	7.46	5.23
CD4 51–200	5.03	3.68	2.48
CD4 < 50	2.39	1.69	1.09

advanced disease and lower CD4 counts have the lower life expectancy than patients with asymptomatic infection and higher CD4 counts. These life expectancy estimates are similar to those reported in the medical literature, giving us confidence in our mortality model (Freedberg et al., 2001). A comparison of Table 3 with Figure 3 determines the patients for whom we expect the minimum prices to be not binding. The sickest patients—that is, those with CD4 count <50 cells/ml or for persons with AIDS and CD4 counts between 51 and 200 cells/ml—face minimum prices below the actuarially fair price.

Settlement Decision

Table 4 shows our unadjusted estimate of the effect of price floors on the likelihood of viatication. Of the 1,009 respondents in our sample, 123 (12 percent) reported residing

TABLE 4
Regulatory Status and Likelihood of Viaticating

	Unregulated States	Regulated States
Life expectancy > 4.5 years	12.2% ⁽¹⁾ (588)	6.8% ⁽²⁾ (73)
Life expectancy < 4.5 years	24.8% ⁽³⁾ (298)	28.0% ⁽⁴⁾ (50)

Notes: Each cell reports the percent of the HIV population who owned life insurance at the first HCSUS wave who viaticated by the third (and final) HCSUS wave. Regulations are binding for patients residing in regulated states with life expectancy >4.5 years. A one-sided hypothesis test that (1) and (2) are equal is rejected at with a p -value of 0.05. A one-sided hypothesis test that (3) and (4) are equal cannot be rejected ($p = 0.32$).

in states with minimum price regulation and the remaining 886 respondents resided in states with no price regulation in the baseline HCSUS survey. Figure 3 shows that price regulation is binding for respondents with life expectancy >4.5 years, therefore we would expect that among respondents with life expectancy >4.5 years those residing in regulated states should be less likely to viaticate than similarly healthy respondents in unregulated states. Table 4 confirms this hypothesis and shows that only 6.8 percent of the respondents residing in regulated states sold their life insurance policies by the time of the second HCSUS follow-up survey (FU2), while 12.2 percent of the respondents residing in unregulated states sold their life insurance policies in the same period.¹⁰ Despite small sample size in regulated states this difference is statistically significant at the 95 percent confidence level.

Figure 3 shows that minimum prices were lower than actuarially fair price for respondents with a life expectancy of 4.5 years. Therefore, if markets were noncompetitive these respondents might benefit from price regulation and we would expect that respondents in regulated states are more likely to sell their life insurance than similar respondents in unregulated states. However, if the markets were competitive, then the regulation would be nonbinding and would not affect the likelihood of sales. Table 4 shows that among respondents with life expectancy <4.5 years, 28 percent of the respondents residing in regulated states and 24.8 percent of the respondents residing in unregulated states sold their life insurance policies by FU2. However, this difference is not statistically significant. These results are clearly consistent with the story that relatively healthy respondents (life expectancy >4.5 years) in regulated states face binding price regulation and therefore are less likely to find buyers for their life insurance policy. In contrast, price regulation has no effect on market outcomes for the relatively unhealthy respondents in regulated states and these respondents are as

¹⁰ These results are not sensitive to small changes (plus or minus 3 percentage points) in our estimate of the cost of capital for viatical firms. The reasoning is that changes in the cost of capital shift the cut-off life expectancy for determining which patients face binding regulation. However, since we do not have any patients in the 3.7–5 years life expectancy range (see Table 3), small shifts in our estimate of the cut-off life expectancy (4.5 years) do not affect our classification of patients into those facing binding or nonbinding regulation.

TABLE 5
Results of Empirical Models of the Hazard of Viatication

Variables	Hazard Ratio (SE)		
	(1)	(2)	(3)
Life exp >4.5 and regulation ^a	0.477 (0.306)	0.460 (0.294)	0.468 (0.301)
Life exp <4.5 and regulation ^b	0.939 (0.195)	0.984 (0.216)	0.972 (0.216)
Male	–	1.203 (0.292)	1.173 (0.290)
Black ^c	–	0.620 (0.112)	0.642 (0.119)
Hispanic ^c	–	0.334 (0.115)	0.339 (0.121)
Other race ^c	–	0.448 (0.207)	0.441 (0.205)
Age	–	1.172 (0.052)	1.170 (0.053)
Married	–	0.953 (0.186)	0.931 (0.186)
Number of children	–	0.959 (0.058)	0.963 (0.059)
Income \$500–\$2,000 ^d	–	–	0.888 (0.194)
Income >\$2,000 ^d	–	–	1.087 (0.243)
Employed full or part time	–	–	0.963 (0.146)

^aReference category: life exp >4.5 and no regulation.

^bReference category: life exp <4.5 and no regulation.

^cReference category: white.

^dReference category: income <\$500.

likely (when compared with similar respondents in unregulated states) to sell their life insurance policies.

Table 5 reports the average hazard ratios for the hazard of selling life insurance at $t = 1$ and baseline hazard rates for four different specifications of the empirical model reported in Equation (3). We average the hazard ratios for each covariate across all individuals in the sample as they depend not only on the regression coefficient associated with the covariate but also on the values of the other covariates. Appendix A specifies our methodology for computing the hazard ratios and their standard errors.

The second column (Model 1) in Table 5 reports the results for the simplest empirical model needed to test the prediction from economic theory. The results show that among respondents with life expectancy >4.5 years those residing in regulated states (that is, those facing binding price regulation) are less likely to viaticate than similarly

healthy respondents residing in unregulated states (hazard ratio 0.48, standard error 0.31).¹¹ In contrast, there were no differences in the viatication hazards across regulated and unregulated states for respondents with life expectancy <4.5 years (hazard ratio 0.94, standard error 0.20). This suggests that for respondents with life expectancy <4.5 years market prices were higher than the minimum prices thus these respondents did not face binding regulation even if they resided in regulated states.

Model 2 in Table 5 adds demographic variables to the explanatory variables in Model 1. We also add marital status and the number of children as additional explanatory variables as measures of the bequest motives of the respondents.¹² Respondents who are younger, married, and have more children are less likely to viaticate. Whites have significantly higher hazards of viaticating than do Blacks, Hispanics, and respondents of other races. As was true in Model 1, the results of this model conform to the prediction that price regulation restricts demand for the life insurance policies of the relatively healthy but has no impact on life insurance sales by the relatively unhealthy.

Model 3 adds indicator variables for income and employment to measure the liquidity constraints facing respondents. Respondents who are employed and who have higher incomes are less likely to viaticate, however, the differences are small and not statistically significant. The results from this model also support the hypothesis that price regulation is binding for the relatively healthy but has no effect on the likelihood of viatication for the relatively unhealthy.

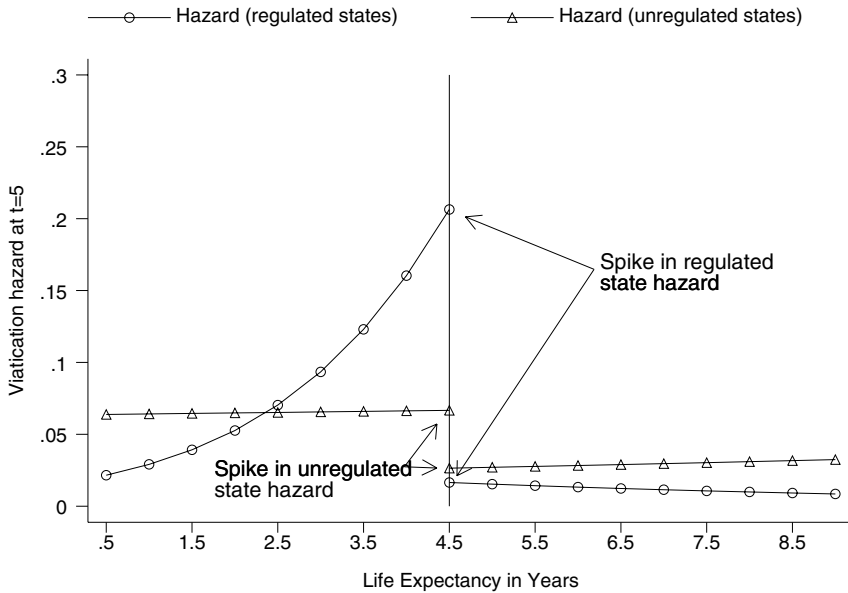
These results are clearly consistent with the prediction that minimum prices are higher than actuarially fair prices for relatively healthy HIV+ patients in regulated states, and that therefore these patients are unable to sell their life insurance policies. However, as the health of these patients deteriorates the difference between minimum and actuarially fair prices declines and eventually, when the life expectancy of these patients falls below 4.5 years, price regulation is no longer binding. In effect, these patients, who were unable to sell their policies earlier due to binding regulation, represent a pent up demand for life insurance sales which is fulfilled when they become sick enough. Therefore, we might expect a spike in the viatication hazard of patients in regulated states at 4.5 years. To test this prediction we model the viatication hazard as a piecewise linear function of the life expectancy that allows for a discontinuity in the viatication hazard at 4.5 years.

Figure 4 shows the estimated viatication hazard from this model. There is a large spike in the viatication hazard for respondents residing in regulated states at 4.5 years of life expectancy. The difference in viatication hazards at the two end points of the spike is statistically significant at the 90 percent confidence level. Figure 4 also shows that among respondents with life expectancy >4.5 those residing in regulated states

¹¹ In an alternative specification we tested whether these respondents offset binding price regulation by borrowing against their life insurance policy. However, we found no such effect. In fact, these respondents were less likely to borrow but this effect was not statistically significant (hazard ratio 0.79, standard error 0.37).

¹² We would expect that respondents with stronger bequest motives are less likely to viaticate since these respondents more strongly prefer having income left to their beneficiaries at the end of their lives. Unless other transactions occur, a viatical settlement leaves less money to beneficiaries.

FIGURE 4
Viatication Hazard as a Function of Life Expectancy



have lower viatication hazard. However, this difference is not statistically significant due to small sample size in regulated states. All the slopes in Figure 4 are statistically indistinguishable from zero.

The results in Table 5 also show that for respondents with life expectancy < 4.5 years, price regulation has no effect on the likelihood of life insurance sales. This suggests that for these consumers market prices in the absence of regulation are already higher than the regulated price. Table 6 reports average market prices from Texas (a state with no price regulation) for respondents in different life expectancy groups for the years 1995–1997. These prices were obtained from detailed annual statements filed with the Texas Department of Insurance by each company licensed to trade viatical settlements in Texas. Each annual report contains detailed information on each viatical settlement contract including face value of policy sold, settlement amount received, life expectancy of seller, type of terminal illness, and date of transaction. Table 6 clearly supports the results from our empirical model, market prices are higher than minimum prices for consumers with life expectancy of less than 4.5 years. In addition for consumers with life expectancy > 4.5 years, market prices are much lower than the minimum price suggesting that these consumers would face binding price regulation in regulated states.

Table 7 shows a calculation of the value of trades blocked if all states were to implement minimum price regulation. The HCSUS data represent approximately 231,400 HIV+ adults who received care in the first 2 months of 1996 (Bozzette et al., 1998). Our analytic sample represents an estimated 123,200 of these HIV+ adults who owned life insurance. Of these patients, an estimated 82,074 patients would face binding price regulation if all states were to implement minimum price regulation. An estimated

TABLE 6

Average Viatical Settlement Prices in Texas Between 1995 and 1997

Life Expectancy (Months)	Regulated Minimum Price ^a	Average Prices in Texas (SD)
6–12	0.70	0.76 ^b (0.07)
12–18	0.65	0.72 ^b (0.09)
18–24	0.60	0.67 ^b (0.07)
24–54	0.50	0.51 ^b (0.14)
54+	0.50	0.31 ^b (0.13)

^aFrom the NAIC model regulation. Prices are expressed as a percentage of face value.

^bStatistically different from the minimum price at 95 percent confidence level.

TABLE 7

Trades Blocked If All States Enacted Minimum Price Regulation

Row	Label	Quantity
1	Estimated number of HIV+ patients with binding price regulation	82,074
2	Percent who would have viaticated with no regulation	12.2%
3	Percent who would have viaticated with regulation	6.8%
4	Number of trades blocked—Row (1) × (Row (2) – Row (3))	4,432
5	Avg. face value of life insurance	\$78,895
6	Avg. actuarially fair price as percentage of face value for patients with binding regulation	34%
7	Avg. Price of trade blocked—Row (5) × Row (6)	\$26,824
8	Total Value of trades blocked—Row (4) × Row (7)	\$118,883,861

4,431 (5.4 percent)¹³ of these patients would have sold their life insurance policies if these states had not implemented minimum price regulation. The average face value of the life insurance holdings of these patients were \$78,895 and they could sell their policies in the viatical market and obtain about 34 percent of the face value in immediate cash payment. This implies that if price regulation were implemented in all states it would rule out transactions worth approximately \$119 million.

¹³ This is the percentage of respondents who faced nonbinding price regulation and sold life insurance (12.2 percent) less than the percentage of respondents who faced binding price regulation and sold life insurance (6.8 percent).

However, we show in the next section that the magnitude of welfare loss from these blocked transactions depends on liquidity constraints, bequest motives, mortality risks, and the degree of time preference among consumers.

WELFARE IMPLICATIONS

In this section, we develop a simple economic model of the decision to viaticate. We confine our analysis to welfare losses from binding price regulation because we find no evidence in the previous section for monopsony, and hence no evidence of welfare gains to those for whom the regulation does not bind. We then calibrate this model to draw out the welfare implications of binding price regulation under different assumptions about consumers' wealth, bequest motives, mortality risks, and time preferences.

The Decision to Viaticate

Our simple model has three periods.¹⁴ Consider a consumer who may live either two periods with probability π or three periods with probability $1 - \pi$. It is important to make clear the timing of decisions and information revelation. We adopt the following convention. Let $t = 0$ be the first period, which the consumer will survive with certainty and during which the consumer can engage in lending, borrowing, and sales on the viatical settlement market. At the beginning of the second period, $t = 1$, information about the mortality of the consumer is revealed; if the consumer dies, all his assets are given as bequests to his heirs during that period. A consumer who survives $t = 1$ will certainly die at the beginning of the third period, $t = 2$, at which time his remaining assets will go to his heirs.

The consumer's initial wealth includes a term life insurance policy with face value \bar{F} dollars and an endowment with a market value of W dollars (net of premiums on the policy, which because of an unanticipated health shock, were priced based upon a mortality risk unrelated to π).

We consider two versions of the consumer's problem. In the first version, the consumer is free to sell his life insurance policies on the secondary insurance market in either the first or second period.¹⁵ In the second version of the problem, the consumer faces a binding price floor. In this version, it is impossible to find any buyer willing to pay the regulated price, so selling the endowed life insurance policy is impossible.

¹⁴ We consider a finite-period model of secondary insurance markets (rather than an infinite-period model) because it makes the analytics of welfare effects of regulation simpler. In particular, it allows us to reduce the dimensionality of the mortality profile, a , to a single number, and thus makes statements about changes in consumer "health" easier to interpret in the context of the model. Additionally, limiting the model to three periods has the additional benefit of focusing attention on the key trade-offs that consumers face, and thus enables us to highlight the motivations behind consumer participation in the viatical settlement market.

¹⁵ Since everyone dies with certainty in the third period, there is no room for a secondary life insurance market in that period.

The Unregulated Consumer Problem

During first period, $t = 0$, consumer sells an amount F of his life insurance policy at the actuarially fair price P_1 , consumes an amount C_1 , and lends his remaining endowment at the market interest rate, r .

Let B_D be the bequests leaves as assets to his heirs if the consumer dies at the beginning of the second period. These assets consist of the consumers' wealth and viatical settlement money not spent on consumption in the previous period (plus interest), and any proceeds of his remaining life insurance policy:

$$B_D = (W + P_1F - C_1)(1 + r) + \bar{F} - F. \quad (9)$$

If the consumer survives to the second period ($t = 1$), he sells his remaining life insurance policy at the actuarially fair price P_2 , consumes an amount C_2 and gives the remainder of his wealth B_S as bequests in $t = 2$:¹⁶

$$B_S = (W + P_1F - C_1)(1 + r) + (\bar{F} - F)P_2 - C_2. \quad (10)$$

The consumer's problem is to maximize expected utility from consumption and bequests subject to the budget constraints that consumption in each time period cannot exceed the total value of the consumer's endowment and proceeds from life insurance sales:¹⁷

$$\max_{C_1, C_2, F} EU = U(C_1) + \pi\beta V(B_D) + (1 - \pi)\beta U(C_2) + (1 - \pi)\beta V(B_S). \quad (11)$$

subject to:

$$W + P_1F - C_1 \geq 0, \quad (12)$$

$$(W + P_1F - C_1)(1 + r) + P_2(\bar{F} - F) - C_2 \geq 0, \quad (13)$$

$$\bar{F} - F \geq 0, \quad (14)$$

$$P_1 - \frac{\pi}{1 + r} - \frac{1 - \pi}{(1 + r)^2} = 0, \quad (15)$$

$$P_2 - \frac{1}{1 + r} = 0, \quad (16)$$

$$\{C_1, C_2, F, B_D, B_S\} \geq 0, \quad (17)$$

¹⁶ Since all uncertainty is resolved at the beginning of the second period, we assume that if the consumer survives to the second period, he leaves his bequest at the beginning of the second period rather than when he dies at the end of the second period. This assumption implies that the consumer only cares about the utility derived by his heir from the bequests. An heir who prefers to receive the bequest at the end of the second period can simply buy a bond of 1-year maturity with his bequests. Abel (1986) uses a similar technique in a different setting.

¹⁷ Consumers cannot borrow against term life insurance policies because term contracts (unlike whole life contracts) do not accumulate cash value (American Council of Life Insurance, 1998b).

where Equations (12) and (13) give the budget constraints for consumption in the first and second period, respectively. Equation (14) states that life insurance sales cannot exceed the face value of life insurance. Equations (15) and (16) give the actuarially fair price of term life insurance in the viatical settlements market assuming that the consumer continues to pay the premiums on the policy. They are the analog of (2) in this three-period setting. Equation (17) is simply the nonnegativity constraint for consumption, bequests, and life insurance sales.

Let λ_1 , λ_2 , and λ_3 be the Lagrange multiplier associated with constraints (12), (13), and (14), respectively. The Kuhn–Tucker conditions for the above constrained maximization problem are as follows:

$$U'(C_1) - (1+r)\beta(\pi V'(B_D) + (1-\pi)V'(B_s)) - \lambda_1 - (1+r)\lambda_2 \leq 0 \quad \text{and if equality, then } C_1 > 0, \quad (18)$$

$$\beta(1-\pi)(U'(C_2) - V'(B_s)) - \lambda_2 \leq 0 \quad \text{and if equality, then } C_2 > 0, \quad (19)$$

$$\beta(1-\pi)\pi\left(\frac{r}{1+r}\right)(V'(B_s) - V'(B_D)) - \lambda_3 \leq 0 \quad \text{and if equality, then } F > 0, \quad (20)$$

$$W + P_1F - C_1 \geq 0 \quad \text{and if equality, then } \lambda_1 = 0, \quad (21)$$

$$(W + P_1F - C_1)(1+r) + P_2(\bar{F} - F) - C_2 \geq 0 \quad \text{and if equality, then } \lambda_2 = 0, \quad (22)$$

$$\bar{F} - F \geq 0 \quad \text{and if equality, then } \lambda_3 = 0. \quad (23)$$

Equation (18) shows that at an interior solution, consumers choose consumption in the first period so that the ratio of the marginal utility of consumption to the expected marginal utility of bequests equals the ratio of the consumer's intertemporal discount factor to the market discount factor. Similarly, Equation (19) shows that once the uncertainty about death is resolved, consumers choose consumption so that the marginal utility of consumption in the second period equals the marginal utility of bequests in the second period.

Equation (20)—the first-order condition for life insurance sales—illustrates the first motivation for selling life insurance. Equation (20) shows that given a consumption plan, selling life insurance enables consumers to increase bequests if they survive to the third period at the cost of reducing bequests if they die at the beginning of the second period. Just like in other insurance markets, at the optimum, risk-averse consumers viaticate to equalize the marginal utility from bequests across the two possible states of the world—death at the end of the first period or death at the end of the second period.¹⁸ Therefore, if consumers were to face binding price regulation

¹⁸ Of course, a consumer may wish to sell more life insurance than he is endowed with—that is, he may end up at a corner of Equation (23)—and thus be unable to equalize the marginal utility from bequests in the final two periods.

(that is, life insurance sales were prohibited), they would be forced to leave more bequests if they die in the first period and too few bequests if they were to die in the second period.

However, reducing the riskiness of the bequest portfolio is not the only motivation for selling life insurance. Consumers might want to sell their life insurance policies to increase consumption in the first period. Equation (21) shows that if consumers face binding price regulation in the first period then consumers can only consume their endowment in the first period and will be forced to leave their entire life insurance policy as a bequest if they were to die at the end of the first period. This follows from the fact that consumers cannot borrow against their term life insurance policies. On the other hand, if life insurance sales are allowed, consumers can increase consumption beyond their initial endowment at the cost of reducing bequests. This seems to be the primary welfare gain from life insurance sales as consumers in secondary life insurance markets are often too frail to work—due to life-threatening illness—and may have insufficient liquid assets to finance medical treatment or other consumption needs.

The Consumer Problem With Price Regulation

In this article, we are mainly interested in the effects of binding price regulation on consumer welfare, and only secondarily interested in the determinants of the decision to viaticate. Price regulation is easy to introduce in the context of the consumer's problem, Equations (11)–(17). Binding price regulation effectively eliminates the possibility of finding a buyer for a consumer's policy, thus the consumer no longer has life insurance sales as an instrument in moving funds around between periods and between states of the world.¹⁹ In the context of our model, then, imposing this regulation requires the addition of an additional constraint:

$$F = 0. \tag{24}$$

Consumers maximize (11) with respect to only C_1 and C_2 . The budget constraints (12) and (13) have F zeroed out, and the life insurance maximum sales constraint (14) is automatically satisfied. Finally, the period 1 pricing Equation (15) is superfluous. The first-order conditions for the solution in the presence of binding regulation are similar to the unregulated case, except for the absence of Equation (20), which equates the marginal utility from bequests in period 2 and period 3, as we discussed above.

Estimating the Welfare Loss From Binding Price Regulation

The main goal from our simulations is to calculate how much welfare is lost when price regulations are imposed. We define welfare loss as the additional wealth required to equate the utility derived under binding price regulation to utility with no price regulation. Let $EU_{nc}^*(W)$ be the indirect utility derived from solving the problem

¹⁹ This abstracts away from the sometimes costly mechanisms that consumers may use to skirt the regulation, including black markets, and conducting transactions with buyers in other, nonregulated, states. This latter possibility would, of course, be blocked if all states were to adopt the price regulation.

in Equation (11) in the absence of price regulations (“*nc*” for no constraint). Similarly, let $EU_c^*(W)$ be the indirect utility in the presence of the price regulation (“*c*” for constrained). Then our measure of welfare loss, γ , is defined implicitly by the following equation:

$$EU_{nc}^*(W) = EU_c^*(W + \gamma). \quad (25)$$

Equation (25) has a unique solution with $\gamma \geq 0$. This is because

$$EU_{nc}^*(W) \geq EU_c^*(W) \quad \forall W \geq 0,$$

and because indirect utility is increasing in wealth (since the marginal utility of consumption and bequests is always positive). We normalize γ by the total value of trades blocked (shown in Table 7) in the results on welfare losses that we report in “Simulation Results.” That is, we report welfare losses as a fraction of the total value of trades blocked.

Calibrating the Model

We calibrate the economic model for the welfare loss simulations as follows. Each time period in the model corresponds to a 5-year period in real time, thus in our economic model, at the beginning of the first period the consumer has a life expectancy ranging from 5 (when the probability of death before the second period, $\pi = 1$) to 10 years (when $\pi = 0$).²⁰ Thus, conditional on surviving the beginning of the second period, the consumer has a life expectancy of 5 years.

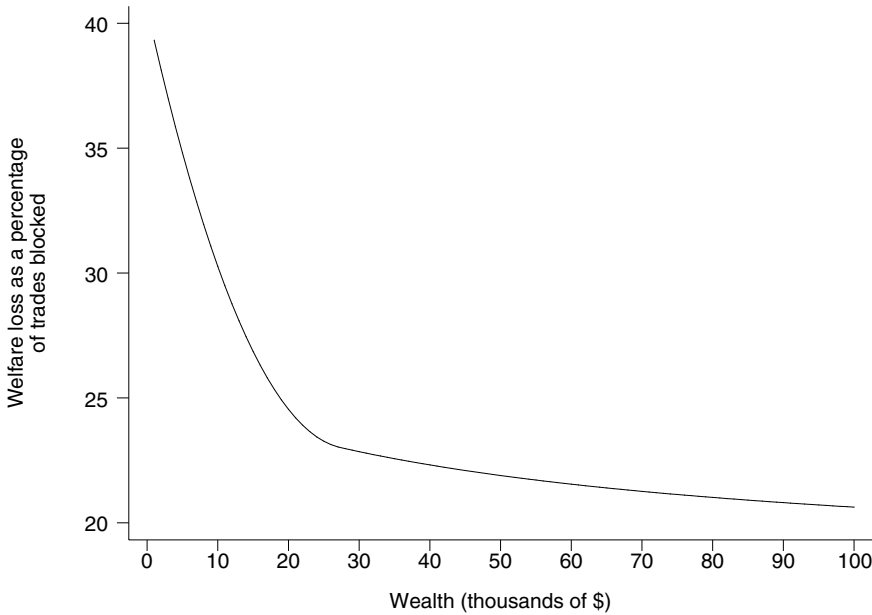
We assume that price regulation is binding for consumers with a life expectancy ≤ 5 years. Therefore, the consumer faces binding price regulation in the first period, but no longer faces binding regulation if he survives the beginning of the second period. This accords well with the empirical results where consumers face binding price regulation initially but as health deteriorates and life expectancy falls below 4.5 years, price regulation is no longer binding.

We assume that utility from consumption in each period has the following function form, chosen for its simplicity: $U(C) = \ln C$. Similarly, we assume utility from bequests is $V(B) = \alpha \ln B$, $\alpha \in [0, 1]$. In Appendix B, we derive closed-form optimum consumption and bequest decisions under these assumptions for both the binding regulation and nonbinding regulation cases. We use these objects to derive the indirect utility functions that we use to estimate welfare losses.

We calibrate the budget set parameters of baseline model using the sample means from the HCSUS data—wealth is \$50,000, face value of life insurance is \$80,000, and life expectancy is 7.5 years ($\pi = 0.5$). For the base case, we set the preference parameters to $\alpha = 0.5$ (that is, people value money spent on consumption twice as much as they value money spent on bequests), and $\beta = 0.6$ (which reflects a yearly discount rate of approximately 10 percent). While we use these parameters for our base case,

²⁰ Since the consumer dies with certainty at the beginning of the final period, it contributes nothing to his life expectancy.

FIGURE 5
Welfare Loss From Regulation and Initial Wealth



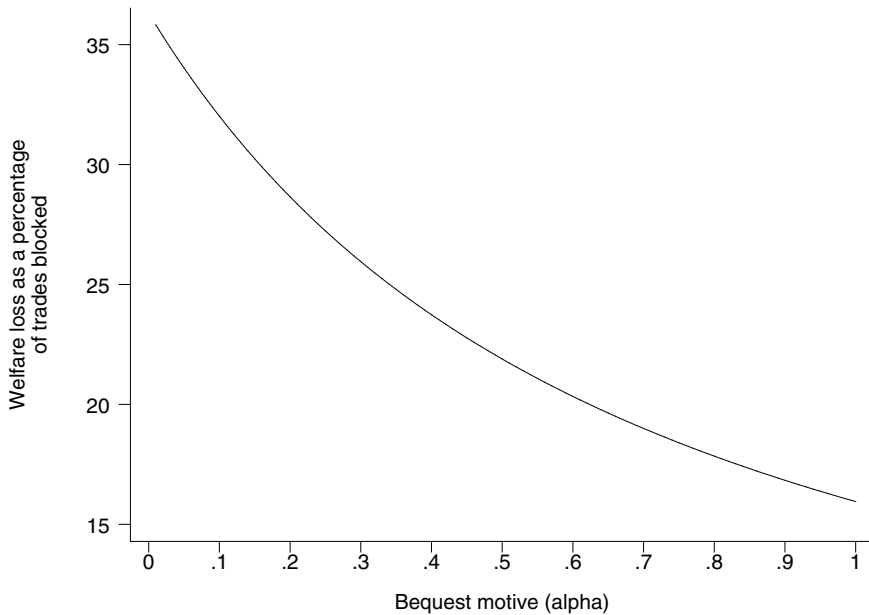
we examine how the welfare loss from binding price regulations change as these parameters change as well.

Simulation Results

Figure 5 shows that the welfare loss from binding price regulation is inversely related to the value of the consumer's initial wealth (W). Relatively poor consumers with low initial wealth suffer a much higher welfare loss than relatively rich consumers. In addition, the figure shows that the relationship between wealth and welfare loss is nonlinear—a small increase in wealth reduces welfare loss more dramatically for relatively poor consumers than it does for rich consumers. The intuition for the result is that consumers with low wealth are cash strapped and face a binding budget constraint for current consumption. They want to increase consumption by selling insurance but are unable to do so because of binding regulation. On the other hand, wealthy consumers have enough wealth to finance current consumption but even they suffer a welfare loss (although much smaller) from binding price regulation. For wealthy consumers, the welfare loss stems from their inability to reduce the “riskiness” of their bequest portfolio. These consumers want to viaticate and buy bonds with the proceeds from life insurance sales to increase future consumption and bequests at the cost of reducing immediate bequests (B_D) but are unable to do so because of binding regulation.

Figure 6 shows that the welfare loss from binding price regulation is inversely related to the strength of bequest motive (α). The intuition for this result is that binding price regulation forces consumers to leave higher immediate bequests than optimal.

FIGURE 6
Welfare Loss From Regulation and the Bequest Motive

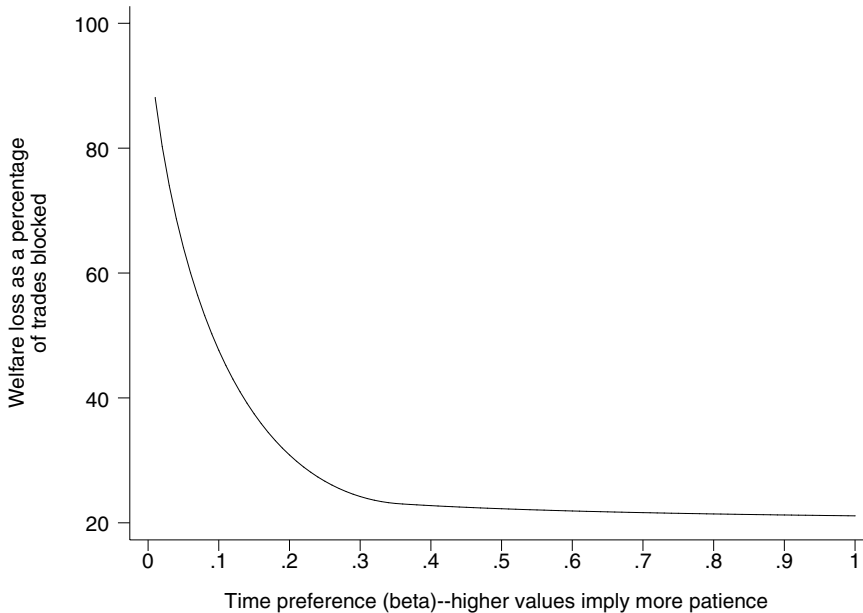


Therefore, consumers who have a stronger bequest motive suffer a lower welfare loss, as they derive higher utility from these bequests than consumers with weak bequest motives.

Figure 7 shows the relationship between time preference and welfare loss from binding price regulation. More impatient consumers suffer higher welfare loss. This result can be explained by the fact that impatient consumers want to use a larger proportion of wealth for current consumption, and are therefore more likely to face a binding budget constraint for current consumption. Consequently, these consumers suffer a higher welfare loss as binding price regulation restricts current consumption by prohibiting life insurance sales to finance current consumption.

The relationship between mortality risks and welfare loss is complicated and depends on several factors. There are several effects of changes in mortality risk on the welfare loss from binding price regulation. First, changes in mortality risk change the optimal value of consumption and bequests. In particular, an increase in mortality risk implies an increase in current consumption—at the cost of future consumption and bequests. Thus, increases in mortality risk should increase the welfare loss from binding price regulation as binding price regulation constraints current consumption. Second, changes in mortality risk change the riskiness of consumer's bequest portfolio as they affect the likelihood of immediate (B_D) versus longer-term (B_S) bequests. Assuming that the value of immediate and long-term bequests is fixed, the variance of the bequest portfolio will increase with initial increase in mortality risk, reach a maximum at $\pi = 0.5$, and then decline. Therefore, if reducing the "riskiness" or variance of

FIGURE 7
Welfare Loss From Regulation and Time Preference



the bequest portfolio were the primary motivation for life insurance sales, we would expect a similar nonmonotonic relationship between mortality risk and welfare loss.

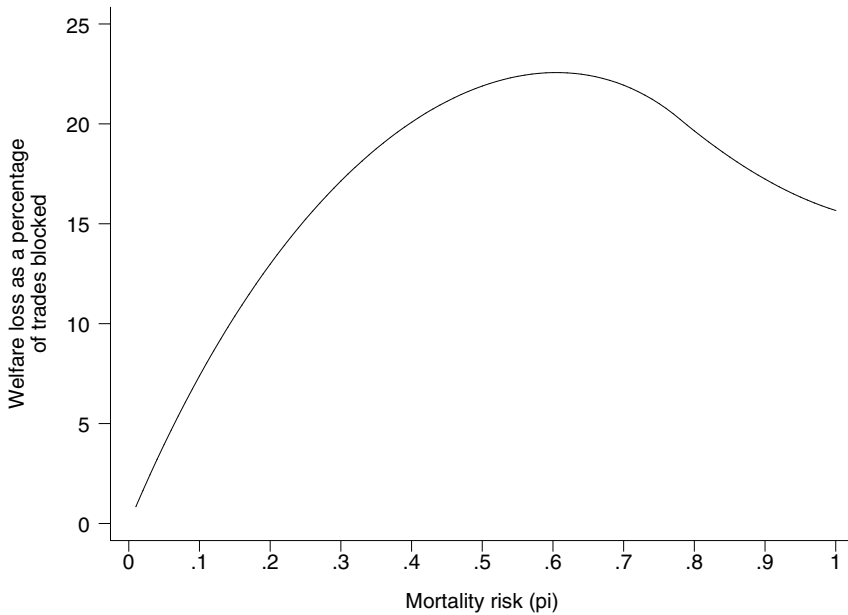
Figure 8 shows this nonmonotonic relationship between mortality risk and welfare loss for the baseline model. In an alternate simulation (not shown here) in which the current consumption constraint was binding for all values of mortality risk, we find that welfare loss rises monotonically with increase in mortality risk, as one might expect given our discussion in the previous paragraph.

CONCLUSION

The existing price regulation in the viatical settlements market rules is binding for the relatively healthy consumers but has no effect on market outcomes for the relatively unhealthy consumers. Thus, the regulatory scheme imposed by most states discriminates against the relatively healthy HIV population and rules out certain viatical settlements for this population trades that are otherwise appropriate. This imposes a daunting prospect for HIV+ patients with life insurance but limited liquidity. They would like to finance treatment by selling their life insurance in the early stages of infection—thereby forestalling progression to AIDS and eventual mortality—but regulatory restrictions require them to let their health deteriorate before they can find a buyer of their policy. Of course, some of these effects might be mitigated by the fact that HIV patients with relatively higher life expectancy are more likely to be employed and have employer-sponsored health insurance benefits.

The welfare losses from these restrictions could be large if more states implement such regulations. Indeed, our estimates of welfare loss are conservative since they

FIGURE 8
Welfare Loss From Regulation and Mortality Risk



exclude the elderly, the disabled, and patients with other illnesses such as cancer. They also exclude the effects of these regulations on the potentially much larger market for accelerated death benefits. Even if only a small fraction of the \$10 trillion in life insurance at risk of being cashed out with accelerated death benefits are actually prevented, the welfare losses are likely to be enormous, and entirely unnecessary. These welfare losses are large enough to encourage black markets—already there are reports of fraud by unregulated companies such as the “The Grim Reaper” thriving in this market (Wolk, 1997). On the other hand, as Coase puts it, “. . . there have been very few controls which have not been modified to take [economic] forces into account, or even abandoned, so that market forces have free sway” (Coase, 1994).

APPENDIX A

Monte Carlo Computation of Hazard Ratios

We use Monte Carlo simulations to calculate the hazard ratios, hazard rates, and standard errors reported in Table 5. Let

$$\mu_{\text{est}} = \begin{pmatrix} \beta_{\text{est}} \\ \lambda^0_{\text{est}} \end{pmatrix}$$

be the maximum likelihood estimates of $\beta = (\beta_1, \beta_2, \dots, \beta_k)$ (where k is the number of covariates) and $\lambda^0 = (\lambda(1), \lambda(2), \dots, \lambda(9))$ from Equation (4), and let Σ_{est} be the estimated variance covariance matrix of μ , which is asymptotically distributed multivariate normal.

In each iteration of the Monte Carlo simulation, we draw a random vector of regression coefficients, $\mu^{(i)} = (\beta^{(i)}, \lambda^{0(i)})$ from $N(\mu_{est}, \Sigma_{est})$, where i indexes over the iterations. Using this randomly drawn $\mu^{(i)}$, we calculate an average hazard ratio for each dichotomous covariate:

$$\text{hazard ratio}_{i,k} = \frac{1}{N} \sum_{j=1}^N \frac{1 - \lambda_j(1 | X_k = 1, X_{k+1} = 0, \dots, X_{k+m} = 0, \mu = \mu^{(i)})}{1 - \lambda_j(1 | X_k = 0, X_{k+1} = 0, \dots, X_{k+m} = 0, \mu = \mu^{(i)})}, \quad (A1)$$

where j subscripts over the N respondents in the data set and (X_k, \dots, X_{k+m}) is a mutually exclusive set of dichotomous covariates.

For continuously measured covariates, we calculate the average hazard ratio using:

$$\text{hazard ratio}_{i,k} = \frac{1}{N} \sum_{j=1}^N \frac{1 - \lambda_j(1 | X_k = X_k + \theta, \mu = \mu^{(i)})}{1 - \lambda_j(1 | X_k = X_k, \mu = \mu^{(i)})}, \quad (A2)$$

where θ is an arbitrary offset. For the hazard ratio corresponding to age, we set $\theta = 5$ years. Also, we calculate the baseline hazard of viaticating at each time period,

$$\text{baseline hazard rate}_i(t) = \frac{\exp(\lambda_t^{0(i)})}{1 + \exp(\lambda_t^{0(i)})} \quad \text{for } t = 1, \dots, 9 \text{ years.} \quad (A3)$$

We repeat 10,000 iterations. Finally, we calculate the mean and standard deviation of Equations (A1), (A2), and (A3) over all the 10,000 iterations, which we report in Table 5.

APPENDIX B

Solving the Model for the Simulations

In this appendix, we derive closed-form solutions for optimal consumption, bequests, and life insurance sales under two different regimes: an unregulated regime and a regime with binding price regulation. The main purpose of this exercise is to derive the indirect utility functions that we use to calculate welfare losses due to regulation.

The Unregulated Consumer Problem. Assuming that consumption and bequest are strictly nonnegative the Kuhn–Tucker for the consumer’s problem are

$$U'(C_1) - (1 + r)\beta(\pi V'(B_D) + (1 - \pi)V'(B_s)) - \lambda_1 - (1 + r)\lambda_2 = 0, \quad (B1)$$

$$\beta(1 - \pi)(U'(C_2) - V'(B_s)) - \lambda_2 = 0, \quad (B2)$$

$$\beta(1 - \pi)\pi \left(\frac{r}{1 + r} \right) (V'(B_s) - V'(B_D)) - \lambda_3 = 0, \quad (B3)$$

$$W + P_1F - C_1 \geq 0, \quad \text{if } >, \lambda_1 = 0, \tag{B4}$$

$$(W + P_1F - C_1)(1 + r) + P_2(\bar{F} - F) - C_2 \geq 0, \quad \text{if } >, \lambda_2 = 0, \tag{B5}$$

$$\bar{F} - F \geq 0, \quad \text{if } >, \lambda_3 = 0. \tag{B6}$$

We first establish that as long as it is optimum for consumers to avoid zero consumption and bequests, they will sell their entire life insurance policy.

Proposition 1: *If $C_1 > 0, C_2 > 0, B_D > 0,$ and $B_S > 0,$ then the constraint on life insurance sales is binding at the optimum.*

Proof: Assume that the insurance sales constraint is nonbinding ($F < \bar{F}$ and $\lambda_3 = 0$). Notice that $\lambda_3 = 0$ and Equation (B3) imply $B_D = B_S$. Solving this for F yields:

$$F = \left(\frac{r}{1 + r} \right) C_2 + \bar{F}. \tag{B7}$$

However, given that $C_2 > 0,$ Equation (B7) violates $F < \bar{F}.$ Therefore, at the optimum $F = \bar{F}.$ Q.E.D.

Also notice that $F = \bar{F}$ and $B_D > 0$ together imply that the constraint on first-period consumption (Equation (B4)) is nonbinding. Similarly $F = \bar{F}$ and $B_S > 0$ imply that the constraint of second-period consumption (Equation (B5)) is nonbinding. Therefore, at an optimum where consumption and bequests are strictly nonnegative, $\lambda_1 = 0, \lambda_2 = 0,$ and $\lambda_3 > 0.$ Thus, the Kuhn–Tucker conditions reduce to:

$$U'(C_1) - (1 + r)\beta(\pi V'(B_D) + (1 - \pi)V'(B_S)) = 0, \tag{B8}$$

$$\beta(1 - \pi)(U'(C_2) - V'(B_S)) = 0, \tag{B9}$$

$$F = \bar{F}, \tag{B10}$$

$$(V'(B_S) - V'(B_D)) > 0, \tag{B11}$$

$$W + P_1F - C_1 > 0, \tag{B12}$$

$$(W + P_1F - C_1)(1 + r) + P_2(\bar{F} - F) - C_2 > 0. \tag{B13}$$

To obtain closed-form solutions, we assume $U(C) = \ln C$ and $V(B) = \alpha \ln B.$ Solving Equations (B8)–(B10) for $C_1, C_2,$ and F yields the following two possible roots:

$$C_1^* = \frac{-A_2 \pm \sqrt{A_2^2 - 4A_2A_3}}{2 * A_1}, \tag{B14}$$

$$C_2^* = \frac{1+r}{1+\alpha} (W + P_1 \bar{F} - C_1^*), \quad (\text{B15})$$

$$F^* = \bar{F}, \quad (\text{B16})$$

where

$$A_1 = (1+r)^2(1+\beta(1+\alpha-\pi)), \quad (\text{B17})$$

$$A_2 = (-1)(1+r)(W + P_1 \bar{F})(2+\beta(1+\alpha-\pi)), \quad (\text{B18})$$

$$A_3 = (W + P_1 \bar{F})^2. \quad (\text{B19})$$

Finally, we choose as the optimum the root that satisfies the remaining Kuhn–Tucker conditions (Equations (B11)–(B13)) and which yields strictly nonnegative values for consumption and bequests. Inputting the optimal solution values in the expected utility function (Equation (11)) yields the indirect utility function $EU_{nc}^*(W)$.

The Regulated Consumer Problem. Assuming that consumption and bequest are strictly nonnegative, the Kuhn–Tucker conditions for the consumer’s problem in the regulated case ($F = 0$) are

$$U'(C_1) - (1+r)\beta(\pi V'(B_D) + (1-\pi)V'(B_S)) - \lambda_1 - (1+r)\lambda_2 = 0, \quad (\text{B20})$$

$$\beta(1-\pi)(U'(C_2) - V'(B_S)) - \lambda_2 = 0, \quad (\text{B21})$$

$$W - C_1 \geq 0, \quad \text{if } >, \lambda_1 = 0, \quad (\text{B22})$$

$$(W - C_1)(1+r) + P_2 \bar{F} - C_2 \geq 0, \quad \text{if } >, \lambda_2 = 0. \quad (\text{B23})$$

There are four possible solutions to the above Kuhn–Tucker conditions—($\lambda_1 > 0$, $\lambda_2 > 0$), ($\lambda_1 > 0$, $\lambda_2 = 0$), ($\lambda_1 = 0$, $\lambda_2 > 0$), and ($\lambda_1 = 0$, $\lambda_2 = 0$).

Notice, however, that $B_S > 0$ implies that the constraint for second-period consumption is nonbinding. Thus, $\lambda_2 = 0$ and there are two cases left to consider.

Case 1 ($\lambda_1 = 0$, $\lambda_2 = 0$): *The constraints on first-period consumption (B22) and second-period consumption (B23) are nonbinding at the optimum.*

Again to obtain closed-form solutions, we assume $U(C) = \ln C$ and $V(B) = \alpha \ln B$. Solving Equations (B20) and (B21) for C_1 and C_2 yields the two roots:

$$C_1^* = \frac{-A_2 \pm \sqrt{A_2^2 - 4A_2A_3}}{2 * A_1} \quad (\text{B24})$$

and

$$C_2^* = \frac{1+r}{1+\alpha} \left(W + \frac{\bar{F}}{(1+r)^2} - C_1^* \right), \tag{B25}$$

where

$$A_1 = (1+r)^2(1+\beta(1+\alpha-\pi)), \tag{B26}$$

$$A_2 = (-1)(1+r)(W+P_1\bar{F})(2+\beta(1+\alpha-\pi)), \tag{B27}$$

and

$$A_3 = (\pi\beta\alpha) \left(W(1+r) + \frac{\bar{F}}{1+r} \right) + \beta(1+\alpha)(1-\pi)(W(1+r) + \bar{F}) - (2(1+r)^2W + \bar{F}(2+r)). \tag{B28}$$

We choose as a potential optimum the solution that satisfies the remaining Kuhn–Tucker conditions (Equations (B22) and (B23)) and which yields strictly nonnegative values for consumption and bequests. It is possible that no solution will satisfy these Kuhn–Tucker conditions. The solution is a provisional optimum because we have yet to consider case 2.

Case 2 ($\lambda_1 > 0, \lambda_2 = 0$): *The constraints on first-period consumption (B22) is binding, while the constraint on second-period consumption (B23) is nonbinding at the optimum.*

Assuming that consumption and bequest are strictly nonnegative the Kuhn–Tucker for this case are

$$\beta(1-\pi)(U'(C_2) - V'(B_s)) = 0, \tag{B29}$$

$$W - C_1 = 0, \tag{B30}$$

$$U'(C_1) - (1+r)\beta(\pi V'(B_D) + (1-\pi)V'(B_s)) > 0, \tag{B31}$$

$$(W - C_1)(1+r) + P_2\bar{F} - C_2 > 0. \tag{B32}$$

Solving (B29) and (B30) for C_1 and C_2 yields the following possible solution for this case:

$$C_1^* = W, \tag{B33}$$

$$C_2^* = \left(\frac{\bar{F}}{(1+r)(1+\alpha)} \right). \tag{B34}$$

To find the optimum, we consider the value of the utility function (11) for each of the potential optima from cases 1 and 2. We take the solution that satisfies all the constraints and yields maximum utility. Inputting the optimal solution values in the expected utility function (11) yields the indirect utility function $EU_c^*(W)$.

REFERENCES

- Abel, A. B., 1986, Capital Accumulation and Uncertain Lifetimes With Adverse Selection, *Econometrica*, 54(5): 1079-1097.
- American Cash Flow Corporation, 2001, *Pioneers of the Cash Flow Industry* (Orlando, FL: ACFC).
- American Council of Life Insurance, 1998a, *Accelerated Death Benefits* (Washington, DC: LIMRA International).
- American Council of Life Insurance, 1998b, *What You Should Know About Buying Life Insurance* (Washington, DC: American Council of Life Insurance).
- Anderson, R. N., 1999, United States Life Tables, 1997, *National Vital Statistics Reports*, 47(28): 1-37.
- Bhattacharya, J., D. P. Goldman, and N. Sood, 2001, The Decision to Sell Life Insurance, Mimeo, RAND.
- Bozzette, S. A., S. H. Berry, N. Duan, M. R. Frankel, A. A. Leibowitz, D. Lefkowitz, C. A. Emmons, J. W. Senterfitt, M. L. Berk, S. C. Morton, M. F. Shapiro, R. M. Andersen, W. E. Cunningham, M. Marcus, N. S. Wenger, L. A. Athey, S. M. Smith, E. G. Bing, J. A. Brown, M. A. Burnham, D. P. Goldman, D. E. Kanouse, J. W. Keeseey, D. F. McCaffrey, J. F. Perlman, M. A. Schuster, P. D. Cleary, J. A. Fleishman, R. D. Hays, J. A. McCutchan, D. Richman, and The HIV Cost and Services Utilization Study Consortium, 1998, The Care of HIV-Infected Adults in the United States, *New England Journal of Medicine*, 339: 1897-1904.
- Carson, J. M., 1996, Determinants of Universal Life Insurance Cash Values, *Journal of Risk and Insurance*, 63(4): 673-681.
- Centers for Disease Control and Prevention, 1993, 1993 Revised Classification System for HIV Infection and Expanded Surveillance Case Definition for AIDS Among Adolescents and Adults, *JAMA*, 269: 729-730.
- Coase, R. H., 1994, *Essays on Economics and Economists* (Chicago, IL: University of Chicago Press).
- Fauci, A. S., E. Braunwald, K. J. Isselbacher, J. D. Wilson, J. B. Martin, D. L. Kasper, S. L. Hauser, and D. L. Longo, ed., 1998, *Harrison's Principles of Internal Medicine*, 14th edition. (New York, NY: McGraw-Hill Inc).
- Freedberg, K., E. Losina, M. Weinstien, A. Palitel, C. Cohen, G. Seage, D. Craven, H. Zhang, A. Kimmel, and S. Goldie, 2001, The Cost Effectiveness of Combination Antiretroviral Therapy for HIV disease, *New England Journal of Medicine*, 344: 824-831.
- Grosen, A., and P. L. Jorgensen, 1997, Valuation of Early Exercisable Interest Rate Guarantees, *Journal of Risk and Insurance*, 64(3): 481-503.

- Grosen, A., and P. L. Jorgensen, 2002, Life Insurance Liabilities at Market Value: An Analysis of Insolvency Risk, Bonus Policy, and Regulatory Intervention Rules in a Barrier Option Framework, *Journal of Risk and Insurance*, 69(1): 63-91.
- Ibbotson Associates, 1997, *Cost of Capital Quarterly, 1997 Yearbook* (Chicago, IL: Ibbotson).
- National Association of Insurance Commissioners, 1997, *Model Regulation for Viatical Settlements* (Kansas City, MO: NAIC).
- National Association of Insurance Commissioners, 1999, *Advisory Package on Viatical Settlements* (Kansas City, MO: NAIC).
- National Viatical Association, 1999, *NVA Information Booklet*, Washington, DC.
- Wolk, G. G., 1997, *Cash for Final Days: A Financial Guide for the Terminally Ill and their Advisors* (Los Angeles, CA: Bialkin Books).