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Cashing Out Life Insurance: An Analysis of the Viatical Settlements Market

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Abstract

People near the end of their lives are too frail to work, have low incomes and often lack health insurance coverage. Consequently, these people are often under extreme financial stress – they need cash now to buy life saving treatments and but do not have enough income or liquid assets to pay mounting prescription and doctor bills. Such people are increasingly using a new financial vehicle called a viatical settlement. These settlements which first arose in the context of HIV, allow policyholders to convert their previously non-liquid life insurance policies into cash at a discount to the policies' face value. (The discount depends on life expectancy.)

Despite its growing importance, there has been little scrutiny of the viatical settlements market. This dissertation fills this information gap by conducting two separate analyses of the viatical settlement market using a unique database of viatical settlements involving HIV+ patients

The first analysis, evaluates the impact of existing minimum price regulations in the viatical settlements market. These price floors are perhaps the most controversial of the current regulations, thus a good candidate for analysis. The viatical settlement industry argues that the price floors are set too high and thus make it unprofitable to buy polices at the minimum mandated prices. On the other hand, insurance regulators argue that price floors are necessary to guarantee a fair rate of return to the sellers in these market who otherwise might fall prey to high-pressure marketing tactics of viatical settlement firms. The results of this analysis show that price floors bind on HIV patients with greater than 4.5 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. Finally, 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.

The second analysis, evaluates consumer decisions in the viatical settlement market. In order to make optimal decisions, consumers deciding between selling their life insurance and borrowing should be able to do two things (1) accurately assess their mortality risks (2) compare the real (rather than nominal) cost of selling life insurance to the cost of borrowing. This analysis tests whether consumers can perform the above two tasks well. The results of this analysis suggest that consumers do make mistakes in deciding between selling their life insurance and borrowing The empirical evidence is consistent with two hypothesis motivated by the psychology and behavioral economics literature – (1) relatively unhealthy consumers are too optimistic about their mortality risks (2) consumers tend to focus on the nominal prices, rather than on real discounted expected price.

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Chapter 1. Introduction And Research Questions

1.1 Introduction

People with life threatening illness are too frail to work, have low incomes and often lack health insurance coverage. Consequently, these people are often under extreme financial stress – they need cash now to buy life saving treatments and but do not have enough income or liquid assets to pay mounting prescription and doctor bills. Viatical settlements give cash into the hands of these very ill people. These settlements, which first arose in the context of HIV, allow terminally ill people to convert their previously non-liquid life insurance policies into cash. In a typical viatical settlement transaction, a terminally ill policyholder sells her life insurance policy to an independent viatical settlement company for immediate cash payment. The viatical settlement company in turn becomes the sole beneficiary on the policy and assumes the premium payments, if any. When the policyholder dies, the settlement company collects the death benefit from the policy.

These markets have become an increasingly important source of income for persons nearing the end of their life. Indeed, Congress passed the Health Insurance Portability and Accountability Act, that exempts proceeds from viatical settlement transactions from federal income taxes (HIPAA, 1996).

Contrary to popular expectations, the discovery of new and effective medication for HIV infection appears not to have deterred growth of the viatical settlements market. The introduction of protease inhibitors and the increasing use of highly active anti-retroviral therapies (HAART) have dramatically improved life expectancy of HIV+ individuals. Age-adjusted death rates from HIV infection fell 47 percent in the U.S. from 1996 to 1997, following a 25 percent decline the year before (CDC HIV/AIDS surveillance report, 1997). Many feared that this remarkable improvement in the life expectancy of HIV+ persons would lead to the bankruptcy of this industry as viatical settlement firms would suffer huge losses on their portfolio of life insurance policies bought from HIV+ patients in the pre-HAART era. However, the viatical settlement market continues to grow, in fact according to the National Viatical Association (a trade association of viatical brokers and companies) the size of the viatical settlements market doubled from $500 million in 1995 to $1billion in 1998 (NVA, 1999). The increasing popularity of these transactions undoubtedly reflects the fact that less than one in three HIV patients have private insurance to pay for their expensive anti-viral therapy and monitoring – which costs up to $14,000 per year. These patients might have no option but to sell their life insurance to finance drug costs that rose by approximately 33 percent between 1996 and mid 1997 (Bozzette et al., 2001)

In addition to the growth in traditional transactions -- purchases from HIV+ patients -- companies are expanding their business by marketing and actively buying polices from the elderly. As the population ages, this market segment (called Life or Senior Settlements) is becoming increasingly popular. In part this reflects demographic trends, but also the rising importance of outpatient drug therapy and the lack of Medicare prescription drug coverage (Joyce et al., 2002). Indeed, a 1999 study by the Conning Corporation, a leading insurance research and investment management firm, said that the potential market for life settlements could be "conservatively" estimated at over $100 billion (OFIS, 2002).

1.2 Regulation of Viatical Settlements

Since viatical settlements are not insurance products, they are not covered by existing insurance regulations. However, there has been increasing pressure to regulate this industry, spurred in part by recognition that the sellers in these transactions-- terminally ill patients or elderly are especially vulnerable. In response to this growing demand for regulation, the National Association of Insurance Commissioners (NAIC) issued model legislation in 1994, as guidelines for state regulators. The model legislation recommended that each state should require viatical settlement companies to be licensed by the department of insurance. In order to maintain the license, companies would be required to comply with several filing requirements and consumer safeguards. The main consumer safeguards recommended by this model legislation include –

- Disclosure to consumers (sellers) of possible alternatives to viatical settlements
- Disclosure to consumers of possible financial effects of the transaction, including tax consequences and the possible impact on eligibility for need based programs such as Medicaid
- Provisions that allow a "cooling off" period, usually within 15 days of the sale of the policy, during which the seller can cancel or rescind a viatical settlement contract.
- Standards for advertising to assure that the companies provide accurate information to consumers
- Provisions that establish that consumers must receive at least a certain percentage of the face value of the life insurance policy. These minimum payment levels are based on the life expectancy of the consumer and the credit rating of the life insurance company that originally issued the policy. Table 1.1 provides the minimum payment levels stipulated by the model regulation (NAIC, 1997).

Table 1.1: Mandated Minimum Prices as a Percentage of Face Value

Life Expectancy	Minimum Percentage of Face Value[a]
Less than 6 months	80%
At least 6 but less than 12 months	70%
At least 12 but less than 18 months	65%
At least 18 but less than 24 months	60%
Greater than 24 months	50%

Note: [a] The percentage maybe reduced by 5% for policies from insurers rated less than the top 4 categories of A.M. Best credit rating

California was the first state to implement regulation, and many others followed soon. At present, roughly half the states require viatical settlement firms to be licensed, however, the license requirements vary considerably across states. Table 1.2, culled from NAIC (1997) describes viatical settlement regulatory environment in a selection of states that have implemented such laws.

Table 1.2: Viatical Settlement Regulations

State	Filing of Annual statements	Disclosure of financial consequences	Cooling-off period	Minimum Payment levels
California	Yes	Yes	15 days	No
Florida	No	Yes	No	No
Illinois	Yes	Yes	No	No
Indiana	Yes	Yes	30 days	No
Kansas	Yes	Yes	30 days	Yes
Louisiana	No	Yes	No	Yes
Minnesota	Yes	Yes	Yes	Yes
New York	Yes	Yes	30 days	No
North Carolina	Yes	Yes	No	Yes
North Dakota	Yes	Yes	No	No
Oregon	Yes	Yes	Yes	Yes
Texas	No	No	No	No
Vermont	No	Yes	Yes	No
Virginia	Yes	Yes	No	Yes
Washington	Yes	Yes	No	Yes

Wisconsin	Yes	Yes	No	Yes

1.3 Research Questions

Despite its growing importance, there has been little scrutiny of the viatical settlements market. There might be viable arguments for regulation of this industry, which by its very nature attracts the sickest patients with poor financial alternatives; but the appropriate regulatory role is unknown. Although, about half the states have adopted regulation of the viatical settlements market, and others are contemplating doing so, there is little empirical information available regarding the potential efficacy of these regulations. A systematic study of state experience with viatical regulation can definitely illuminate future policy options.

However, analyzing past regulations and policies is not enough for effective public policy on viatical settlements. More needs to be known about, which consumers participate in these markets, what factors do consumers consider in deciding between viatical settlements and alternative financial options, and how they make these complex decisions. This dissertation fills this information gap by conducting two separate analyses of the viatical settlement market using a unique database of viatical settlements involving HIV+ patients.

The first analysis, evaluates the impact of existing price regulations in the viatical settlements market. These price floors are perhaps the most controversial of the current regulations, thus a good candidate for analysis. The viatical settlement industry argues that the price floors are set too high and thus make it unprofitable to buy polices at the minimum mandated prices. On the other hand, insurance regulators argue that price floors are necessary to guarantee a fair rate of return to the sellers in these market who otherwise might fall prey to high-pressure marketing tactics of viatical settlement firms. This analysis uses nationally representative data on viatical settlements by HIV+ patients in states with and without price to analyze each of these claims. It also develops a model of the decision to sell insurance to estimate the welfare gain or loss from the existing price regulations.

The second analysis, evaluates consumer decisions in the viatical settlement market. In order to make optimal decisions, consumers deciding between selling their life insurance and borrowing should at a minimum be able to do two things (1) accurately assess their mortality risks (2) compare the real (rather than nominal) cost of selling life insurance to the cost of borrowing. This analysis tests whether consumers can perform the above two tasks well. To set up this test, we first develop an economic model of the consumer decision to sell life insurance. In this model consumers know their true mortality risks and choose borrowing or life insurance sales (or both) to maximize expected lifetime utility. This model of a "sophisticated" consumer is contrasted with a behavioral model that relies heavily on two important insights from the psychology and emerging behavioral economics literature – (1) relatively unhealthy consumers are too optimistic about their mortality risks (2) consumers tend to focus on the nominal prices, rather than on real discounted expected price. Finally predictions from each of these models are tested using longitudinal data on HIV+ patients with life insurance.

1.4 Organization of the Dissertation

The next chapter reviews the literature on price regulation of insurance markets. Chapter 2 also reviews the psychology and behavioral economics literature on risk perception and decision-making under uncertainty. Chapter 3 describes the two primary data sources – (1) the HIV Costs and Utilization Survey (2) data on viatical settlement transactions obtained from the Texas Department of Insurance under the Freedom of Information Act (FOIA). Chapter 4 reports results on the analysis of existing price regulations in this market. Chapter 5 reports the results on the analysis of consumer decisions in this market. Chapter 6 concludes with directions for future research and policy implications.

Chapter 2. Literature Review

2.1 Price Regulation of Insurance Markets

While there is no literature on price regulation of the viatical settlements market, there is a vast literature on the price regulation of property-liability insurance markets

The property and liability insurance market consists of three large markets – automobile insurance, homeowners insurance, and workers compensation. Each of these markets in turn has two components: (1) the "voluntary market" where insurers sell policies voluntarily (2) and the "residual market" where insurers are required to issue policies to mostly "high-risk" consumers who could not obtain insurance in the voluntary market. Most states regulate premiums in the residual market and about half the states also regulate premiums in the voluntary market. In these states, insurers or rating bureaus representing insurers are required to obtain prior approval of all premiums from the state insurance department.

There are two competing views in the literature regarding why insurance premiums are regulated. According to regulators, premium regulation is necessary to lower prices and curtail excessive industry profits due to oligopoly power. By contrast, others argue that premium regulation is a mechanism for protecting industry profits -- premium regulation and reliance on rating bureaus facilitates price fixing and helps sustain monopoly profits in the insurance industry (Joskow 1973, Stigler 1971).

As a consequence, numerous studies have attempted to determine whether regulation actually lowers prices by analyzing the ratio of losses to premiums. These loss ratios can be viewed as the inverse of the price of insurance. The primary motivation for analyzing loss ratios rather than premiums is that it provides a single measure of price of insurance that is applicable across a wide variety of insurance products. In general, these studies indicate that regulated states experienced lower, but not always statistically different, price growth compared to states with no prior approval regulation, i.e. regulation has a positive impact, on loss ratios (Ippolito 1979, Petersen 1981, Harrington 1984, Grabowski et al. 1985, Pauly et al. 1986, Bradford 1998, Harrington 2002). In fact, Boyer (2000) finds evidence that just the threat of stringent regulation as portrayed in the popular and industry press decreased premium inflation in the automobile insurance market.

Despite the evidence that prior-approval regulation generally lowers premium inflation, it is not clear whether regulation is beneficial to consumers. Premium growth suppression, especially in a period of rising costs, can produce several detrimental and counterproductive effects. For example inadequate premiums might reduce voluntary insurance sales by current insurers thereby increasing the residual market share. Insurers might also respond to premium suppression by reducing the services they provide to customers thus lowering the quality of insurance offered to customers. Stringent premium suppression that cannot be offset by reduction in quality and level of services might eventually lead to firm exit. Finally, premium suppression might also affect the incentives for loss reduction by policyholders. For example, if policyholders anticipate little or no premium increases then they might have less of an incentive to control losses.

The empirical evidence on these detrimental effects of premium regulation is not as extensive. There is some evidence that states with prior-approval regulation have larger residual market shares (Harrington 2000, Harrington 2002). The evidence on firm exit due to premium regulation is mixed and primarily anecdotal. For example, case studies reported in a recent AEI-Brookings book on insurance regulation find that stringent automobile insurance regulation in New Jersey and Massachusetts led to widespread insurer exit from these states. In contrast, stringent automobile insurance premium regulation in California did not lead to any firm exit (AEI, 2000). Finally, there is some evidence that premium suppression reduces policyholder incentive for controlling losses. Harrington and Danzon (2000), analyze the relationship between insurance rate regulation, inflationary cost surges and incentives for loss control using state level data on workers' compensation insurance for 24 states during 1984 to 1990. Their results indicate a positive relationship between loss growth and measures of regulatory price constraints, suggesting that rate regulation increased the frequency and/or severity of employee injuries.

This dissertation adds to the literature by analyzing price regulation in the new and yet largely unregulated viatical settlements market. In addition, this dissertation explicitly tests the effects of both binding and non-binding price regulation on the likelihood of viatical settlement transactions by consumers. Finally, this dissertation estimates the welfare gain or loss from price regulation under varying assumptions about consumer preferences and asset allocation.

2.2 Consumer behavior in mortality contingent claims markets

Despite the emerging significance of the viatical settlements market, outside the occasional newspaper and trade journal report and there are no peer-reviewed publication on consumer decisions in the viatical settlements market. However, there has been some interest in related areas – the life insurance market and the market for annuities. The seminal work by Yaari (1965) extends the standard life cycle hypothesis of consumption to include uncertainty about the date of death and analyzes the demand for life insurance. Hurd (1989) develops a consumption model with mortality risk and bequests and an exogenous annuity market. A typical prediction from such models is that increasing mortality risks acts like an increase in the subjective time rate of discount, increasing present consumption at the expense of future consumption. Prior research in the annuities markets has identified mortality risk, marital status, risk aversion, health status, and time horizon as important determinants of the decision to annuitize resources (Brown, 1999).

This dissertation uses the basic framework developed in this literature to develop an economic model of the decision to sell life insurance. This model is compared to a behavioral model that relies heavily on insights from the psychology and behavioral economic literature. The next section of this chapter reports a brief review of these literatures.

2.3 Psychology and Behavioral Economics Literature on Risk Perceptions and Consumer Decisions Under Uncertainty

There are extensive literatures on both consumer perception of mortality risk and distortions in consumer decision-making under uncertainty. In the past, these literatures have typically relied on two types of non-market evidence: small-scale psychological experiments and consumer self-reports of risk perceptions. Recently, market based tests of the predictions of behavioral economics have emerged in two different settings—in financial markets (see Barberis and Thaler 2002) and in the analysis of consumer savings behavior (see Laibson 1997). This section briefly summarizes the findings from both the psychology and the emerging behavioral economics literature that are most relevant to this research. Barberis and Thaler (2002), Mullainathan and Thaler (2000), Camerer (1995), Rabin (1998), Kahneman and Tversky (2000) provide a deeper and more extensive review.

2.3.1 Consumer perception of mortality risks

Extensive evidence from the psychology literature shows that people make systematic mistakes in assessing their mortality risks. In particular, Lichtenstein et al. (1978) and several other studies have shown that people underestimate mortality risks from likely causes of death and overestimate mortality risks from unlikely causes of death. In related research, studies have found that people overestimate highly publicized risks. For example Moore and Zhu (2000) hypothesize that given the recent flood of information on the alleged hazards of passive smoking in government publications and the media, people are likely to overestimate the health risk of passive smoking. They find evidence consistent with a model whereby individuals systematically overestimate the effects of passive smoking on their health and where the short-term effects of passive smoking on health care costs are negligible.

In addition to the evidence from psychology literature, recent studies using data on subjective survival expectations from the Health Retirement Study (HRS) and the Asset and Health Dynamics Among the Oldest Old (AHEAD) find that people tend to be optimistic about their longevity, with extent of optimism greater for people with low life expectancy. Schoenbaum (1997) using data from the HRS shows that current heavy smokers (who have low life expectancy) tend to be very optimistic about their probability of surviving to age 75, i.e. subjective survival probabilities are higher than those obtained from actuarial models. For never smokers (who have relatively high life expectancy) the subjective probability of surviving to age 75 is marginally lesser than the actuarial prediction. Data from the AHEAD reported in Hurd et al. (1999) show a very similar pattern. For example, among female respondents in the 85-89 age group the subjective probability of surviving to the 100 years is 0.30 while the life table value is merely 0.07. In contrast, the relatively young female respondents in the 70-74 age group are pessimistic about their mortality risks – their subjective probability of surviving to 85 years is 0.51 and the life table value is 0.58.

In summary, the data from these studies show that peoples' perceptions of their own mortality risks are systematically biased and seem to support the psychology literature. In particular, people with relatively *low life expectancy* (death is a likely event) tend to *underestimate* their mortality risks and people with relatively *high life expectancy* (death is an unlikely event) tend to marginally *overestimate* their mortality risks.

2.3.2 Limits to consumer problem solving ability

Many standard textbooks on life insurance markets claim that price comparisons in life insurance are sufficiently complex to be well beyond the analytic capabilities of the "ordinary" consumers (Maclean, 1962, Magee, 1958). Belth (1966) argues that the inability of consumers to make price comparisons in life insurance markets explains the persistence of substantial variation in prices of similar life insurance products.

There is also a growing body of evidence from other markets that suggests that consumers have limited information processing ability and that they use simple heuristics to economize on this scarce resource. Numerous studies have documented how these simple heuristics sometimes lead consumers to make systematic mistakes. For example, Odean (1998) finds that customers at a large brokerage firms were less likely to realize capital losses than gains despite tax incentives that encourage loss realization. Odean shows that this loss aversion is consistent with prospect theory

(Kahneman and Tversky, 1979) and mental accounting (Thaler, 1985) where in consumers treat stocks in their portfolio as separate gambles and are risk taking in losses and risk-averse in gains (as measured from the original purchase price). Similarly, Benartzi and Thaler (2001), find that individuals making asset allocation decisions in defined contribution plans use the naïve "1/n strategy": they divide contributions evenly across the funds offered in the plans. Consistent with this naïve notion of diversification they find that the proportion invested in stocks depends strongly on the proportion of stock funds in the plan.

Bernheim et al. (1997) analyze household data on wealth and savings, arguing that the data are consistent with "rule of thumb" and "mental accounting" theories of wealth accumulation. They find little support for the traditional life cycle model of savings and wealth accumulation. Liabson (1997) also analyzes household savings behavior and argues that people not only find it difficult to make optimal savings decisions but often find it difficult to stick their decisions. In particular, consumers' short run discount rates are much higher than their long run discount rates, implying that preferences are time inconsistent. This discount structure leads consumers to save little today even though savings are optimal from a life cycle perspective. Liabson argues that consumers often invest in illiquid assets or other commitment devices to overcome this tendency for over consumption.

This dissertation adds to this literature by developing a market-based test of whether consumers make systematic mistakes in assessing their own mortality risks, and whether they are able to make "correct" price comparisons between insurance and credit markets[1]. Data on viatical settlements are ideal for this test, as these markets require consumers to assess risks regarding their own mortality accurately, as well as decode price signals in an unfamiliar environment.

[1] In particular, this test distinguishes sophisticated consumers from ordinary ones; it does not pinpoint whether mistakes by ordinary consumers, if they occur, are due to misperceived mortality risk or misassessed price signals

Chapter 3. Data

3.1 HIV Costs and Services Utilization Study (HCSUS)

The primary data source for this dissertation is the HIV Costs and Services Utilization Study – a nationally representative survey of HIV+ patients receiving care in the contiguous United States. This dataset is appropriate as it contains extensive information on a sample of terminally ill people who constitute a large share of the viatical settlements market.

The HCSUS employed a multistage design in which geographical areas, medical providers, and patients were sampled. In the first stage, 8 Metropolitan Statistical Areas (MSAs) with the largest AIDS caseloads with certainty plus an additional 20 MSAs and 24 clusters of rural counties were sampled (Lam and Liu, 1996). In the second stage, 145 urban and 51 rural providers of HIV were sampled. In the third stage, 4,042 eligible patients who visited participating providers were sampled. The overall coverage rate (i.e., the ratio of the population directly represented to the population that would have been directly represented if we had complete responses at all levels) was about 68%.

HCSUS followed eligible 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 dataset 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%) reported life insurance holdings. These 1,353 respondents are our analytic sample as they are the only patients at risk to viaticate. 344 respondents were excluded due to missing values for at least one of the key variables—diagnosis date, health status, liquid assets, or non-liquid assets. In our remaining analytic sample, 132 (13%)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 3.1 compares summary statistics from the baseline interview of respondents who viaticated at some point in time with those who never did. Viators are more likely than never-viators 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.

There are several advantages of using the HCSUS data. First, it is the only nationally representative data on viatical settlements by HIV+ patients. Second, the data can be linked to mortality records for up to 2 years after the last interview date. The mortality data and information on health and disease stage indicators in HCSUS are critical for reliably estimating the life expectancy of HIV+ patients and estimating actuarially fair prices for life insurance polices held by these patients. Finally, the data identify the state of residence of each respondent thus can be linked to the state viatical regulation data presented in Table 1.2

3.2 Viatical Settlement Price Data From Texas

One drawback of the HCSUS data is that it does not contain information on viatical settlement prices. To supplement the HCSUS data, this dissertation will use data on viatical settlements prices from Texas for the period 1995 to 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 3.1: Demographics at Baseline and Participation in the Viatical Market

Variables	Entire sample (N = 1,009)	Sold life insurance (N=165)	Did not sell (N=844)
Age	35 years	37 years	35 years
Male	81%	88%	80%
Have college degree	26%	33%	26%
Race			
White	60%	78%	56%
Black	24%	16%	26%
Hispanic	11%	5%	12%
Other	5%	1%	6%
Monthly Income			
< $500	15%	13%	16%
$501 - $2000	41%	41%	40%
> $2000	44%	46%	44%
Liquid assets			
< $5,000	72%	65%	74%
$5,001 - $25,000	13%	16%	13%
> $25,000	15%	19%	13%
House ownership	32%	35%	31%
Non-liquid assets:			
< $10,000	69%	61%	71%
$10,001 - $50,000	14%	19%	12%
$50,001 - $200,000	11%	12%	11%
> $200,000	6%	8%	6%
Disease Stage:			
Asymptomatic	9%	9%	9%
Symptomatic	51%	38%	54%
AIDS	40%	53%	37%
CD4 T-cell levels:			
< 50 cells per ml	12%	15%	11%
50 – 200 cells per ml	25%	41%	22%
201 – 500 cells per ml	42%	32%	44%
> 500 cells per ml	21%	13%	23%

Chapter 4. Price Regulation of Viatical Settlements

4.1 Introduction

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. On the other hand 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 consumer receive a ``reasonable'' price in new markets.

This chapter describes the effects of price regulations in the viatical settlements market. The next section describes the actuarially fair price of a viatical settlement transaction. Section 4.3 describes the predictions from economic theory of the impact of price regulation on market outcomes depending on the relationship between the mandated price floor, the market price and the actuarially fair price. Section 4.4 describes the empirical strategy. Section 4.5 describes the empirical results and Section 4.6 estimates the welfare loss or gain from these regulations. Section 4.7 concludes and discusses policy implications of the analysis.

4.2 Pricing of Viatical Settlements

This section derives the actuarially fair price of viatical settlement contracts. Understanding how these contracts are priced is a key component in understanding the decision by consumers to sell their life insurance contracts, and in understanding the effects of price regulation on these decisions.

As in all markets for mortality contingent contracts, viatical settlement firms need to determine 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 estimate the mortality risks of potential consumers (NVA, 1999). 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 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, $\$\rho$, for as long as he survives. While $\$\rho$ was set 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 $a = (a_1, a_2, a_3, \ldots a_t, \ldots)$ represent the probability of death (reflecting the new mortality profile) for the insured consumer for each time period *t*. 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:

$$E[Profit] = \sum_{t=1}^{\infty} (a_t - \rho S_t) b^t - P(a) \qquad (4.1)$$

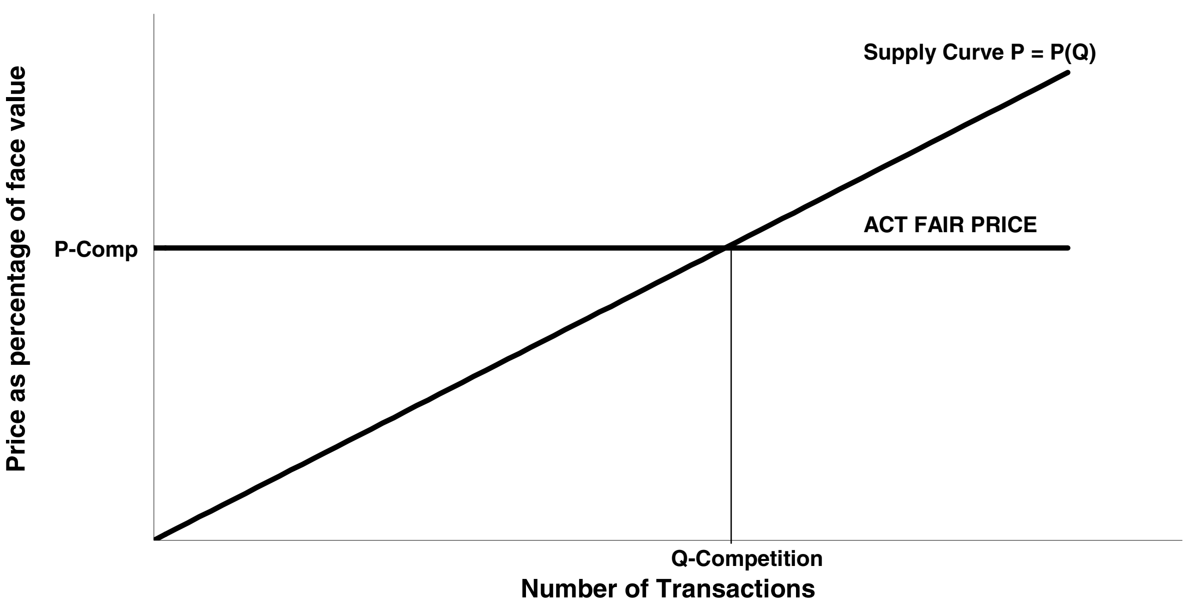
Where, $b = \frac{1}{1+r}$ and r is the cost of capital for viatical settlement firms. The first term in equation (4.1) represents the present value of expected revenue after the consumer's death (net of premium payments) and the second term represents the cash payment for the policy.

If prices are actuarially fair then firms will make zero profits and charge a price:

$$P(a) = \sum_{t=1}^{\infty} (a_t - \pi S_t) b^t \qquad (4.2)$$

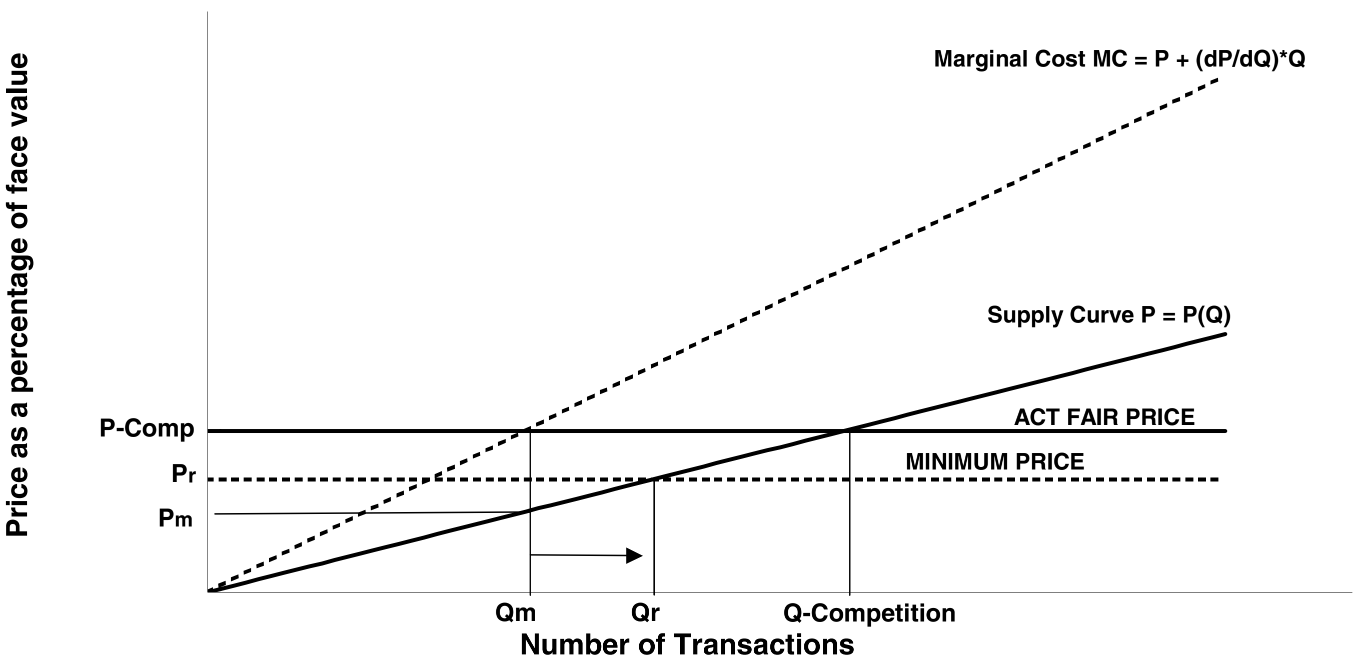
Figure 4.1 shows the equilibrium output and price in a perfectly competitive market given the mortality risk of the consumer and the cost of capital for firms. In equilibrium, prices are actuarially fair (demand curve is perfectly elastic), and output is determined by the intersection of the market demand 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.

Figure 4.1: Market Price and Output under Perfect Competition



Points Q_m and P_m in Figure 4.2 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 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 4.2 --the number of transactions increases from Q_m to Q_r and the price increases from P_m to P_r.

Figure 4.2: Market Price and Output under Monopsony



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.

4.3 Empirical Methods

This section describes the empirical model. The 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, this analysis focuses 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 1.2 show that regulators have put some effort into tailoring policy to take this fact into account. The purpose of this chapter is to describe the empirical strategy for determining the extent to which they have been successful.

4.3.1 Modeling the hazard of selling life insurance

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 date and the FU2 interview date. Combining these three types of respondents gives the likelihood function:

$$L=\prod_{i=1}^{N}\left\{D_{1i}\left[\prod_{t=1}^{T_1}\lambda_i(t)-\prod_{t=1}^{T_2}\lambda_i(t)\right]+D_{2i}\left[1-\prod_{t=1}^{T_1}\lambda_i(t)\right]+D_{3i}\left[\prod_{t=1}^{T}\lambda_i(t)\right]\right\} \tag{4.3}$$

In equation (4.3), 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 if respondent i viaticated by FU1, and D_{3i} indicates that respondent i never viaticated.

The hazard of not viaticating is modeled as a logit function:

$$\lambda_i(t)=\frac{1}{1+\exp(\lambda_t^0+X_{it}\beta)} \tag{4.4}$$

Here, X_{it} is a vector of covariates measured at time t, β is the vector of regression coefficients, and $\frac{1}{1+\exp(\lambda_t^0)}$ is the baseline logit hazard rate. Independent variables in the model include demographics, life expectancy, income, a binary variable for minimum price regulation and measures of the actuarially fair price and the minimum regulated price. Maximizing (4.3) yields the parameters λ_t^0 and β.

HCSUS respondents were sampled only at three discrete times. One major consequence of this sampling strategy is that X_{it} is not observed at each point in time t, so no measures of patient health status or changes in assets between surveys are available. A step function approximation is used 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. Then the imputed values at each time point are assigned as follows:

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

4.3.2 Estimating Life Expectancy and the Actuarially Fair Price

Life expectancy is estimated using the Cox proportional hazard model. Equations (4.5) and (4.6) give the hazard rate and survival function under the proportional hazard assumption:

$$h(t) = h_0(t)\exp(X\beta) \tag{4.5}$$

$$S(t) = \left[\exp\left(-\int_0^t h_0(u)du\right)\right]^{\exp(X\beta)} \tag{4.6}$$

Where 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. The parameters $h_0(t)$ and β are estimated 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. These are predicted 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:

$$LE(h(t)) = \int_0^\infty \hat{S}(t)dt \tag{4.7}$$

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

$$AFP(h(t)) = \int_0^\infty \left[\hat{f}(t) - \hat{\rho}\hat{S}(t)\right]\exp(-rt)\,dt \tag{4.8}$$

Where $\hat{f}(t)$ 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 (4.2).

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 λ be this constant hazard at the time of purchase. 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). Since the exact date of when policies were purchased is not observed, we assumed that people bought them the year prior to contracting HIV disease[2]. Thus, the estimate of premiums paid is an upper bound on actual premiums paid. This implies our estimate of actuarially fair prices for viatical settlements—equation (4.8)—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. The results with this underestimate of the bound population are qualitatively similar to the ones with the overestimate of the bound population, and are available upon request.

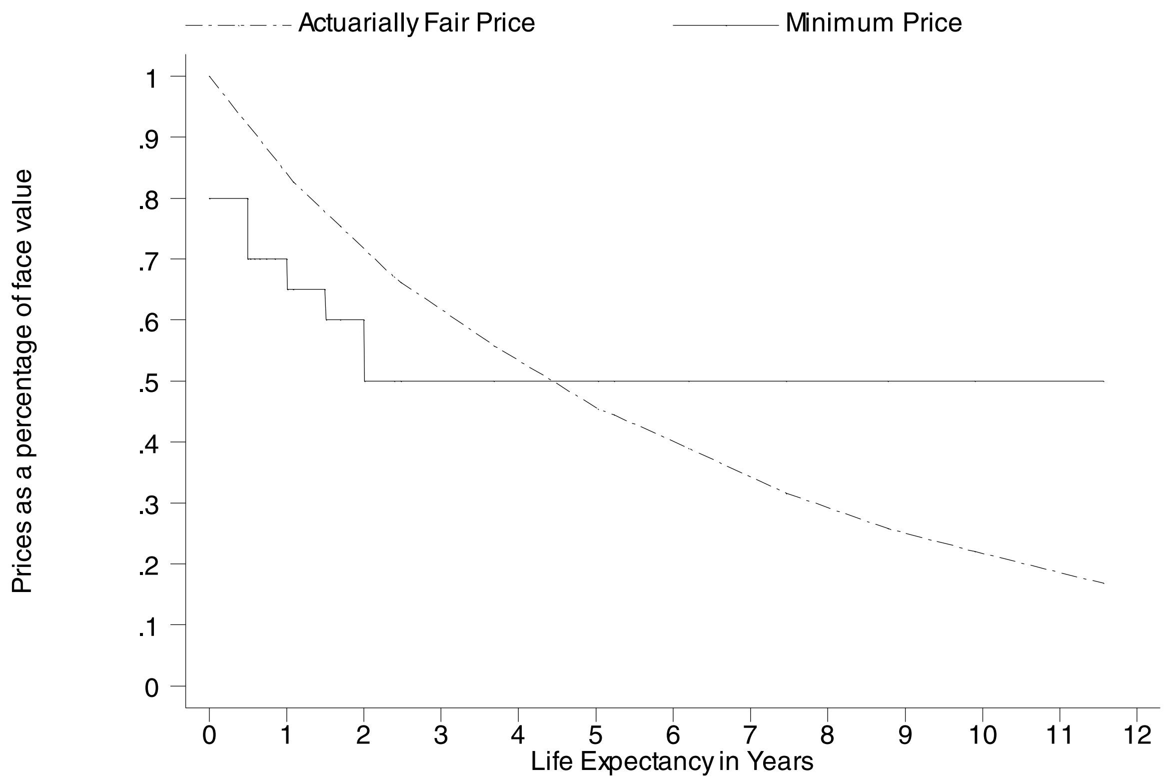
The estimated cost of capital for viatical settlement firms is 16.52 % per annum. This estimate is based on the weighted average cost of capital of firms in the same standard industrial classification code (SIC code 6799) as viatical settlement firms (Ibbotson, 1997).

[2] For the approximately 5% 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 our population.

An alternate 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 (the internet is replete with such offers for example see http://www.sicviatical.com/docs/index-mission2.htm) polices from viatical firms according to the following schedule: $100,000 for a policy with face value of $112,000 and life expectancy of policyholder of 1 years, or $100,000 for a policy with face value of $128,000 and life expectancy of 2 year, or $100,000 for a policy with face value of $142,000 and life expectancy of 3 years. Based on this price schedule the annual cost of funds for viatical settlements is about 16% 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 counts above 500 cells per ml., declines into lower clinically recognized ranges correlate with worsening disease. These ranges are: between 200 and 500 cells per ml., between 50 and 200 cells per ml., and below 50 cells per ml. There are three categories in CDC definition of clinical stage: asymptomatic, symptomatic, and AIDS (CDC, 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.

Figure 4.3: Minimum and Actuarially Fair Prices as a Function of Life Expectancy



4.4 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 non-binding 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 non-binding benefit from regulation and are more likely to sell (if markets are non-competitive) 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 1.1 were expanded nationwide.

4.4.1 Life Expectancy Actuarially Fair Prices and Price Floors

Figure 4.3 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 1.1 hence the discrete jumps every six months until two years. Actuarially fair prices are calculated using equation (4.8).

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 4.3, 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 non-competitive 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.

Table 4.1: Life Expectancy in Years by CD4 level and Stage of Disease

	Clinical Stage of Disease		
CD4 Level	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

We predict life expectancy for our sample using equation (4.7). The results are shown in Table 4.1. The only covariates are CD4 count and disease stage. Patients with more 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 4.1 with Figure 4.3 determines the patients for whom we expect the minimum prices to be not binding. The sickest patients--that is, those with CD4 count less than 50 cells per ml or for persons with AIDS and CD4 counts between 51 to 200 cells per ml--face minimum prices below the actuarially fair price.

Table 4.2: Regulatory Status and Likelihood of Viaticating

	Unregulated Percent Sold (N)	Regulated Percent Sold (N)
Life Expectancy > 4.5yrs	12.2% (1)	6.8% (2)*
	(588)	(73)
Life Expectancy < 4.5yrs	24.8% (3)	28.0% (4)
	(298)	(50)
Hypothesis Tests:		
Hypothesis	p-value	
Ho: (1) - (2) = 0 Ha: (1) > (2)	0.05	
Ho: (3) - (4) = 0 Ha: (3) < (4)	0.32	

Note: *Regulations are binding for patients residing in regulated states with Life Expectancy greater than 4.5 years.

4.4.2 Settlement Decision

Table 4.2 shows the unadjusted estimate of the effect of price floors on the likelihood of viatication. Of the 1009 respondents in our sample, 123 (12%) reported residing in states with minimum price regulation and the remaining 886 respondents resided in states with no price regulation in the baseline HCSUS survey. Figure 4.3 shows that price regulation is binding for respondents with life expectancy greater than 4.5 years, therefore we would expect that among respondents with life expectancy greater than 4.5 years those residing in regulated states should be less likely to sell life insurance than similarly healthy respondents in unregulated states. Table 4.2 confirms this hypothesis and shows that only 6.8% 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% of the respondents residing in unregulated states sold their life insurance policies in the same period. Despite the small sample size in regulated states this difference is statistically significant at the 95 percent confidence level.

Figure 4.3 shows that minimum prices were lower than actuarially fair price for respondents with a life expectancy of 4.5 years. Therefore if markets were non-competitive 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 non-binding and would not affect the likelihood of sales. Table 4.2 shows that among respondents with life expectancy less than 4.5 years, 28% of the respondents residing in regulated states and 24.8% 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 likely (when compared with similar respondents in unregulated states) to sell their life insurance policies.

Table 4.3 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 (4.3). 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.

Table 4.3: Results of Empirical Models of the Hazard of Viatication

Variables	Model 1 Haz. Ratio (s.e.)	Model 2 Haz. Ratio (s.e.)	Model 3 Haz. Ratio (s.e.)
L.E. > 4.5 years and Price regulation*	0.477 (0.306)	0.460 (0.294)	0.468 (0.301)
L.E < 4.5 years and Price regulation**	0.939 (0.195)	0.984 (0.216)	0.972 (0.216)
Male	--	1.203 (0.292)	1.173 (0.290)
Black#	--	0.620 (0.112)	0.642 (0.119)
Hispanic#	--	0.334 (0.115)	0.339 (0.121)
Other Race#	--	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 -2000‡	--	--	0.888 (0.194)
Income > $2000‡	--	--	1.087 (0.243)
Employed Full or Part time	--	--	0.963 (0.146)

Reference Categories: # White; ‡ Income < $500; * L.E. > 4.5 years and unregulated; ** L.E < 4.5 years and unregulated

The second column (Model 1) in Table 4.3 reports the results for the simplest empirical model needed to test the prediction from the competitive model. The results show that among respondents with life expectancy greater than 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)[3]. In contrast there were no differences in the viatication hazards across regulated and unregulated states for respondents with life expectancy less than 4.5 years (hazard ratio 0.94, standard error 0.20). This suggests that for respondents with life expectancy less than 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[4].

Model 2 in Table 4.3 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. 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

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[3] In an alternate 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, std error 0.37)

[4] 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 to 5 years life expectancy range (see Table 4.1), 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 non-binding regulation.

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 healthy.

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 piece-wise linear function of the life expectancy that allows for a discontinuity in the viatication hazard at 4.5 years. Figure 4.4 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% confidence level. Figure 4.4 also shows that among respondents with life expectancy greater than 4.5 years those residing in regulated states have lower viatication hazard. However, this difference is not statistically significant due to small sample size in regulated states. All the slopes in Figure 4.4 are statistically indistinguishable from zero.

The results in Table 4.3 also show that for respondents with life expectancy less than 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 4.4 reports average markets prices from Texas (a state with no price regulation) for respondents in different life expectancy groups for the years 1995 to 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.

Figure 4.4: Viatication Hazard as a Function of Life Expectancy

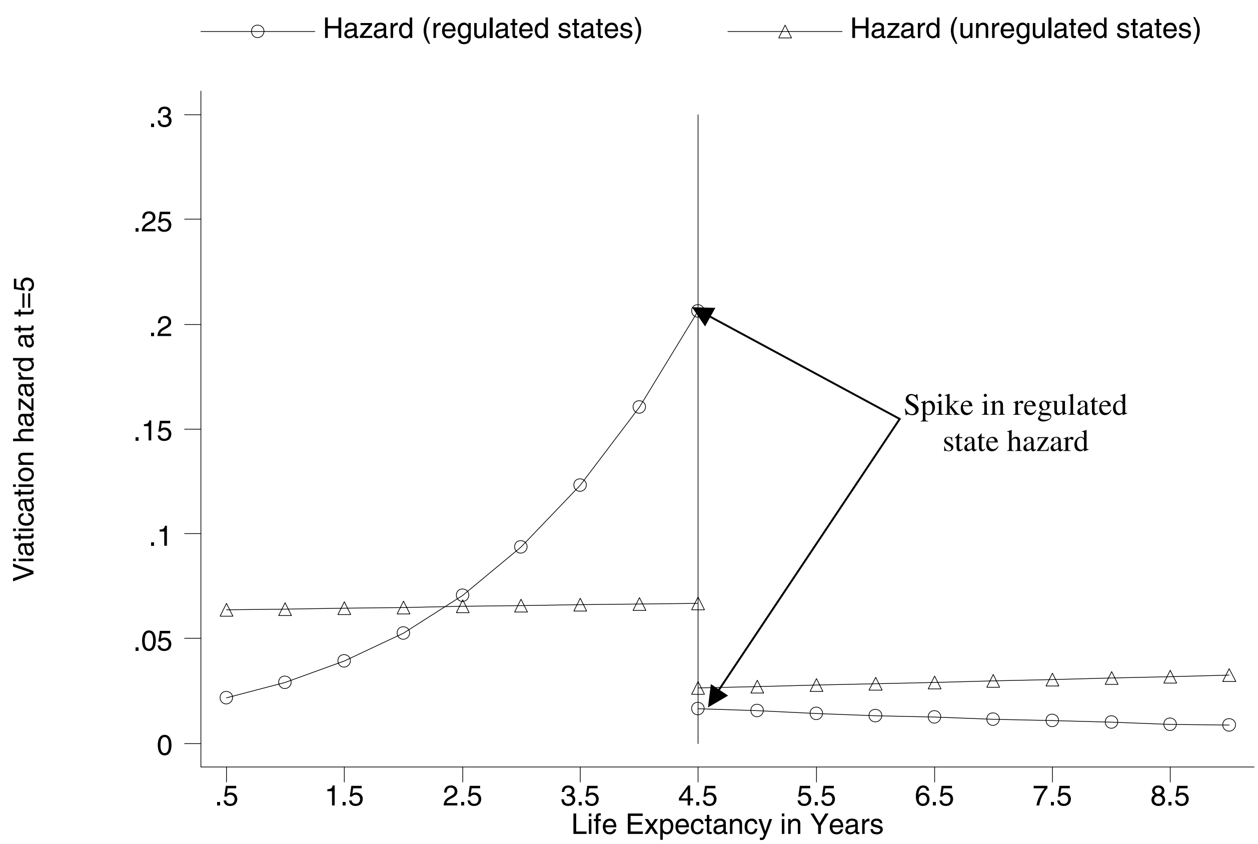

Table 4.4: Average Viatical Settlement Prices in Texas between 1995 and 1997

Life Expectancy	Regulated Minimum Price[a]	Average Prices in Texas (Std Dev.)
6 to 12 months	0.70	0.76[b]
		(0.07)
12 to 18 months	0.65	0.72[b]
		(0.09)
18 to 24 months	0.60	0.67[b]
		(0.07)
24 to 54 months	0.50	0.51[b]
		(0.14)
54+ months	0.50	0.31[b]
		(0.13)

Notes: [a] From the NAIC model legislation. Prices are expressed as a percentage of face value.

[b] Statistically different from the minimum price at the 95% confidence interval.

Table 4.4 clearly supports the results from the 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 greater than 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 4.5 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 4,431 (5.4%)[5] 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.

However, the entire value of trades blocked does not constitute a welfare loss. The next section develops an economic model of the decision to sell life insurance to estimate the welfare loss form these blocked transactions. This model also shows how the magnitude of welfare loss depends on liquidity constraints, bequest motives, mortality risks, and the degree of time preference among consumers.

4.5 Welfare Implications

This section develops a simple two period model of consumption and bequest decisions to demonstrate the incentives that consumers have to sell life insurance

[5] This is the percentage of respondents who faced non-binding price regulation and sold life insurance (12.2%) less the percentage of respondents who faced binding price regulation and sold life insurance (6.8%).

policies in secondary insurance markets. This model is used to draw out the potential welfare implications of binding price regulations that prohibit life insurance sales. A finite period model of secondary insurance markets (rather than an infinite period model) is developed as it makes the analytics of welfare effects of regulation simpler. In particular, it reduces the dimensionality of the mortality profile, 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 two periods has the additional benefit of focusing attention on the key trade-offs that consumers face, and thus highlights the motivations behind consumer participation in the viatical settlement market.

Table 4.5: Value of Trades Blocked If All States Enacted Minimum Price Regulation

Row	Label	Quantity
1	Estimated 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) X (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) X Row(6)	$26,824
8	Total Value of trades blocked—Row(4) X Row(7)	$118,883,861

4.5.1 The Decision to Sell Life Insurance

Consider a consumer who may live either one period with probability π or two periods with probability $1-\pi$. It is important to make clear the timing of decisions and information revelation. At the beginning of the first period, which the consumer will survive with certainty, the consumer engages in lending, borrowing, and sales on the viatical settlement market. At the end of the first period (or beginning of second period), information about the mortality of the consumer is revealed; if the consumer dies, all his assets are given as bequests to his heirs at that time point. A consumer who survives the first period will certainly die at the end of the second period, 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).

Two versions of the consumer's problem are considered. In the first version, the consumer is free to sell his life insurance policies on the secondary insurance market in either the beginning of the first or second period.

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 in the first time period. However, since all uncertainty about mortality is resolved in the first time period the consumer can sell his policy in the second time period.

The unregulated consumer problem

At the beginning of the first period, the 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 assets that the consumer leaves to his heirs as bequests if he dies at the end of the first 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.

$$B_D = \left(L_1 + P_1 * F - C_1\right) * \left(1 + r\right) + \bar{F} - F \qquad (4.9)$$

If the consumer survives to the second period, 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[6].

$$B_S = \left(W + P_1 * F - C_1\right) * \left(1 + r\right) + (\bar{F} - F) * P_2 - C_2 \tag{4.10}$$

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[7].

$$\underset{\{C_1, C_2, F\}}{MaxEU} = U\left(C_1\right) + \pi\beta V\left(B_D\right) + \left(1 - \pi\right)\beta U\left(C_2\right) + \left(1 - \pi\right)\beta V\left(B_S\right) \tag{4.11}$$

Subject to:

$$W + P_1 F - C_1 \geq 0 \tag{4.12}$$

$$\left(W + P_1 F - C_1\right)\left(1 + r\right) + P_2(\bar{F} - F) - C_2 \geq 0 \tag{4.13}$$

$$\bar{F} - F \geq 0 \tag{4.14}$$

$$P_1 = \frac{\pi}{1 + r} + \frac{1 - \pi}{\left(1 + r\right)^2} \tag{4.15}$$

$$P_2 = \frac{1}{1 + r} \tag{4.16}$$

$$\left\{C_1, C_2, F, B_D, B_s\right\} \geq 0 \tag{4.17}$$

Where equations (4.12) and (4.13) give the budget constraints for consumption in the first and second period respectively. Equation (4.14) states that life insurance sales cannot exceed the face value of life insurance. Equations (4.15) and (4.16) give the

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[6] 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 one-year maturity with his bequests. Abel (1986) uses a similar technique in a different setting.}

[7] I assume that consumers cannot borrow against their life insurance policy. This is true for most life insurance policies, as these policies do not usually have an investment component (ACLI, 1998).

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 (4.2) in this three period setting. Equation (4.17) is simply the non-negativity constraint for consumption, bequests and life insurance sales.

Let λ_1, λ_2, and λ_3 be the Lagrange multiplier associated with constraints (4.12), (4.13), and (4.14) respectively. The Kuhn-Tucker conditions for the above constrained maximization problem are as follows.

$$U'(C_1)-(1+r)\beta\left(\pi V'(B_D)+(1-\pi)V'(B_s)\right)-\lambda_1-(1+r)\lambda_2 \le 0 \quad \text{and if equality, then } C_1 > 0 \tag{4.18}$$

$$\beta(1-\pi)\left(U'(C_2)-V'(B_s)\right)-\lambda_2 \le 0 \quad \text{if equality, then } C_2 > 0 \tag{4.19}$$

$$\beta(1-\pi)\pi\left(\frac{r}{1+r}\right)\left(V'(B_s)-V'(B_D)\right)-\lambda_3 \le 0 \quad \text{if equality, then } F > 0 \tag{4.20}$$

$$W + P_1F - C_1 \ge 0 \quad \text{if } >\text{, then } \lambda_1 = 0 \tag{4.21}$$

$$\left(W + P_1F - C_1\right)(1+r)+P_2(\bar{F}-F)-C_2 \ge 0 \quad \text{and if } >\text{, then } \lambda_2 = 0 \tag{4.22}$$

$$\bar{F} - F \ge 0 \quad \text{and if } >\text{, then } \lambda_3 = 0 \tag{4.23}$$

Equation (4.18) 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 (4.19) 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 (4.20)--the first order condition for life insurance sales--illustrates the first motivation for selling life insurance. Equation (4.20) shows that given a consumption plan, selling life insurance enables consumers to increase bequests if they survive to the second period at the cost of reducing bequests if they die at the end of the first period. Just like in other insurance markets, at the optimum, risk-averse consumers sell life insurance 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[8]. Therefore, if consumers were to face binding price regulation (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 (4.21) 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 might be the primary welfare gain from life insurance sales as consumers in the viatical settlement market 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

Price regulation is easy to introduce in the context of the consumer's problem, equations (4.11)-(4.17). 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

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[8]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 (4.23)--and thus be unable to equalize the marginal utility from bequests in the final two periods.

the world[9]. In the context of our model, then, imposing this regulation requires the addition of an additional constraint:

$$F = 0 \qquad (4.24)$$

Consumers maximize (4.11) with respect to only C_1 and C_2. The budget constraints (4.12) and (4.13) have *F* zeroed out, and the life insurance maximum sales constraint (4.14) is automatically satisfied. Finally, the period one pricing equation (4.15) 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 (4.20), which equates the marginal utility from bequests in period one and period two.

4.5.2 Estimating the Welfare Loss from Binding Price Regulation

The main goal of the simulations is to calculate how much welfare is lost when price regulations are imposed. Welfare loss is defined 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 in equation (4.11) 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:

$$EU_{nc}^{*}(W) = EU_{c}^{*}(W + \gamma) \qquad (4.25)$$

Equation (4.25) has a unique solution with $\gamma \geq 0$ as 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 in the results on welfare losses that we

[9] This abstracts away from the mechanisms that consumers may use to skirt the regulation, including black markets, and conducting transactions with buyers in other, non-regulated, states. This latter possibility would, of course, be blocked if all states were to adopt the price regulation.

report in section 4.5.3. That is, we report welfare losses as a fraction of the total value of trades blocked.

Calibrating the model

The economic model for the welfare loss simulations is calibrated as follows. Each time period in the model corresponds to a 5 year period in real time, thus in this model, at the beginning of the first period the consumer has a life expectancy ranging from 5 years (when the probability of death before the second period, π equals one) to 10 years (when π = 0). Thus, conditional on surviving the beginning of the second period, the consumer has a life expectancy of 5 years.

Based upon the results in section 4.4, we assume that price regulation is binding for consumers with a life expectancy less than or equal to 5 years. Therefore, the consumer faces binding price regulation in the first period, but no longer faces binding regulation if he survives to 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.

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 $U(B)=\alpha\ln(B)$, $\alpha\in[0,1]$. Appendix B derives closed-form optimum consumption and bequest decisions under these assumptions for both the binding regulation and non-binding regulation cases. These objects are used to derive the indirect utility functions and estimate welfare losses.

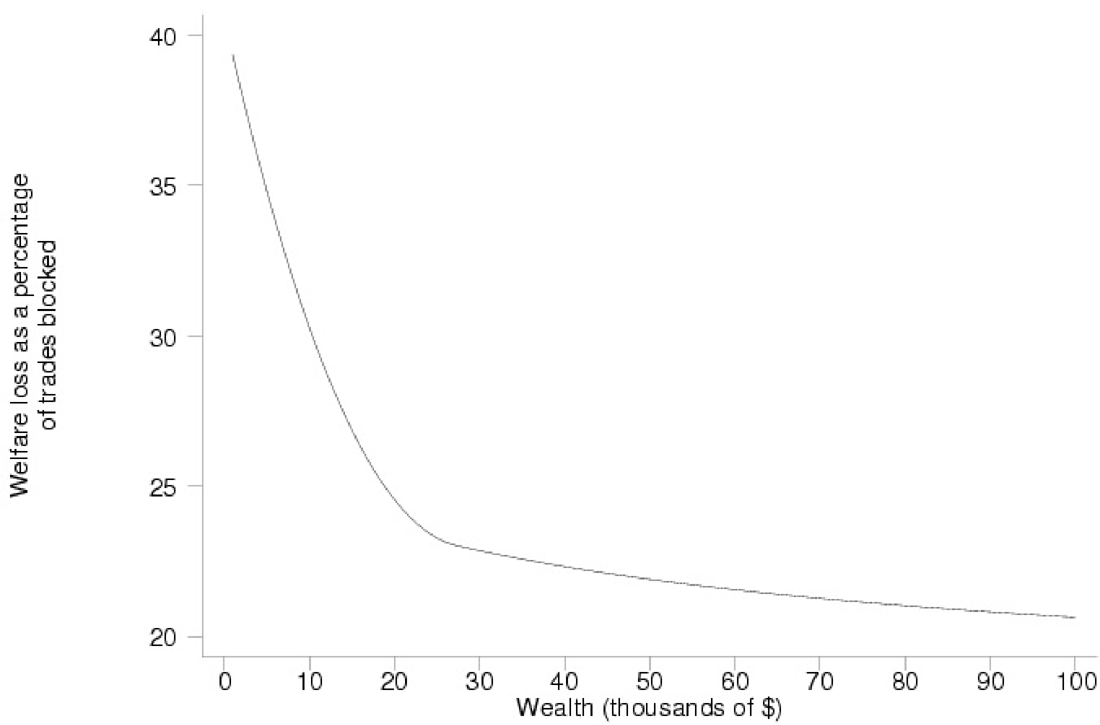
The budget set parameters of baseline model are calibrated using the sample means from the HCSUS data--wealth is $50,000, face value of life insurance is $80,000, and life expectancy is 7.5 years (π = 0.5). For the base case, we set the preference parameters to α = 0.5 (that is, people value money spent on consumption twice as much as they value money spent on bequests), and β = 0.6 (which reflects a yearly discount rate of approximately 10%).

While we use these parameters for our base case, we examine how the welfare loss from binding price regulations change as these parameters change as well.

4.5.3 Welfare Loss Simulation Results

Figure 4.5 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.

Figure 4.5: Welfare Loss from Regulation and Initial Wealth



In addition, the figure shows that the relationship between wealth and welfare loss is non-linear--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 sell life insurance 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 4.6: Welfare Loss from Regulation and the Bequest Motive

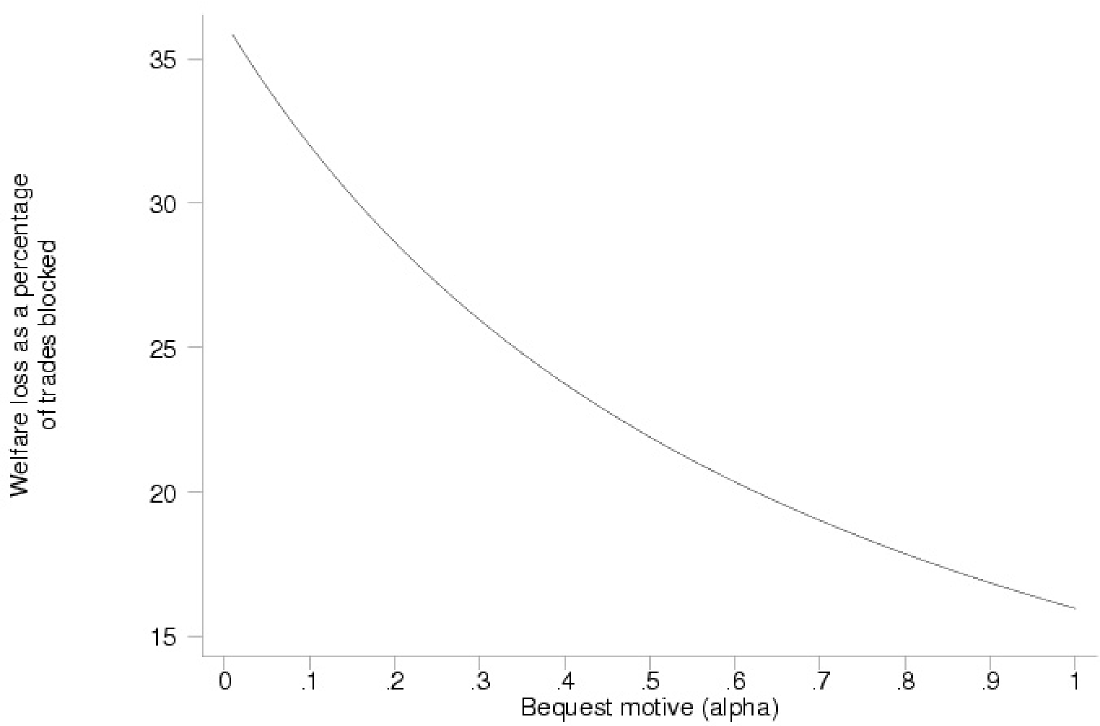


Figure 4.6 shows that the welfare loss from binding price regulation is inversely related to the strength of bequest motive (α). The intuition for this result is that binding price regulation forces consumers to leave higher immediate bequests than optimal. Therefore consumers who have a stronger bequest motive suffer a lower welfare loss, as they derive higher utility from these bequests than consumers with weak bequest motives.

Figure 4.7: Welfare Loss from Regulation and Time Preference

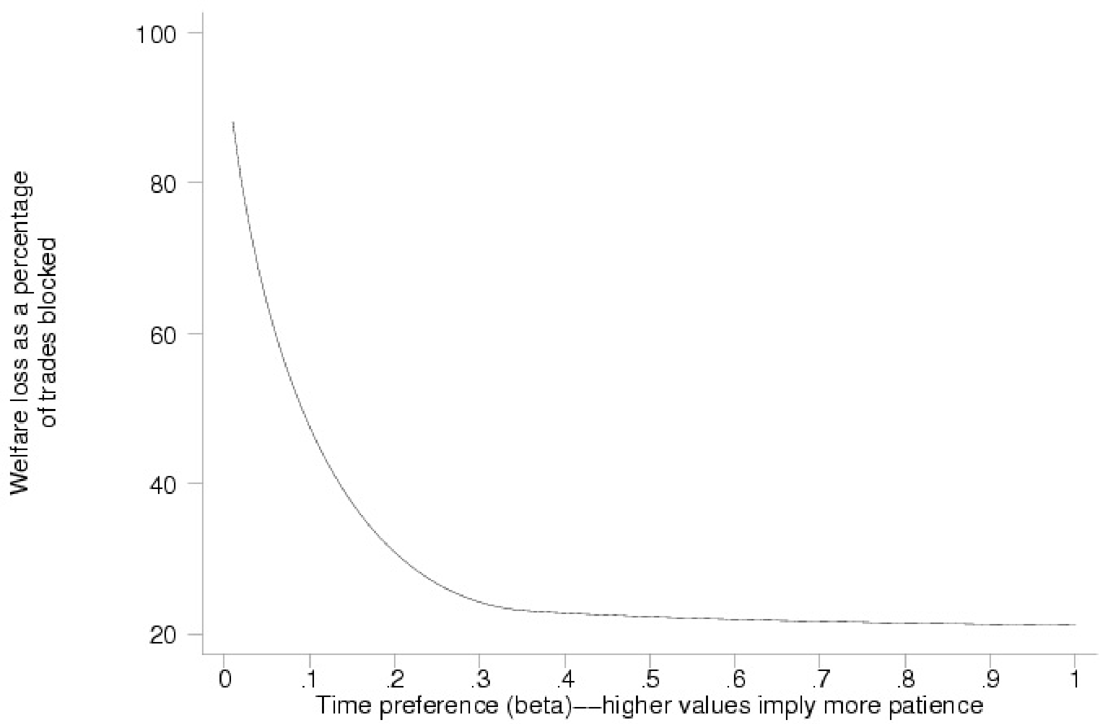
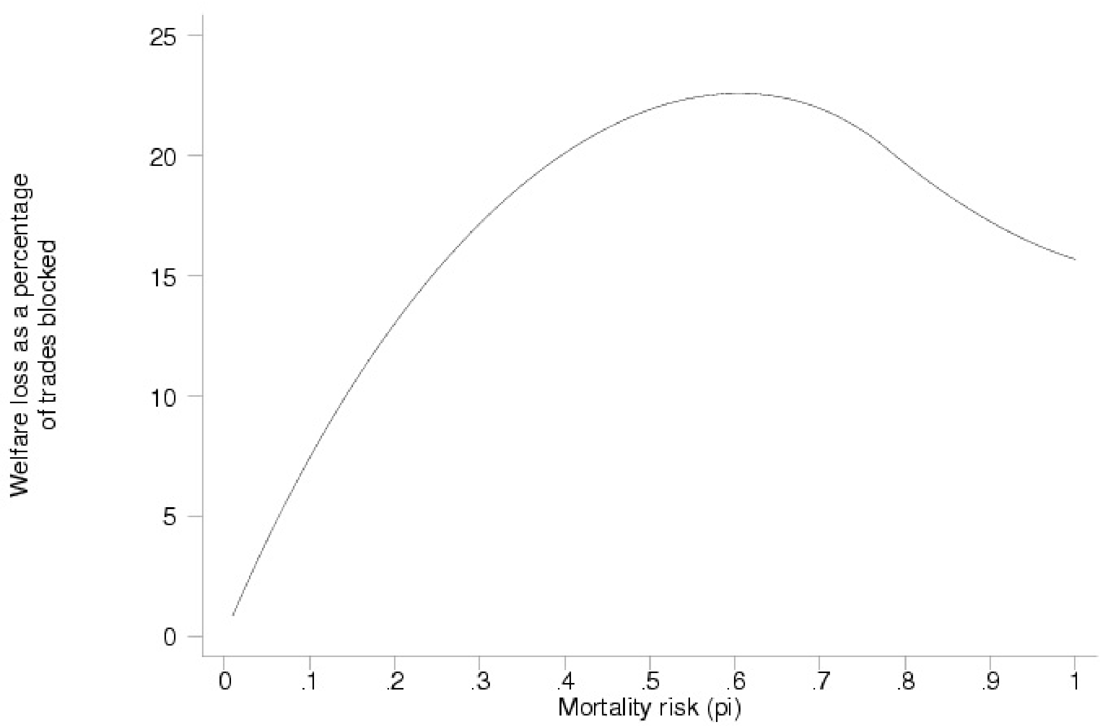


Figure 4.7 shows the relationship between time preference and welfare loss from binding price regulation. More impatient consumers suffer higher welfare loss. This result can be explained by the fact that impatient consumers want to use a larger proportion of wealth for current consumption, and are therefore 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.

Figure 4.8: Welfare Loss from Regulation and Mortality Risk



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

Figure 4.8 shows this non-monotonic 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, the welfare loss rises monotonically with increase in mortality risk, as one might expect given our discussion in the previous paragraph.

4.6 Conclusions

The existing price regulation in the viatical settlements market 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.

The welfare losses from these restrictions could be large if they continue to promulgate. Indeed, the estimates of welfare loss are conservative since they 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 like 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).

Chapter 5. Consumer Decisions in the Viatical Settlements Market

5.1 Introduction

Making insurance and savings decisions can be difficult in a highly uncertain environment. Traditional economic models of insurance decisions assume that consumers can solve two problems: (1) accurately assess the risks they face; and (2) interpret the information conveyed by market prices. But are these assumptions reasonable, especially in markets for unfamiliar risks?

This chapter uses data from the viatical settlements market to develop a market-based test of whether consumers make systematic mistakes in assessing their own mortality risks, and whether they are able to make "correct" price comparisons between insurance and credit markets. Viatical settlements transactions are a good candidate for such a test because they require consumers to assess risks regarding their own mortality accurately, as well as decode price signals in an unfamiliar environment.

To set up this test, in this chapter we first develop an economic model of the consumer decision to sell life insurance in the secondary market in the context of competitive pricing. This model of a sophisticated consumer produces two sharp predictions. First, the model predicts that consumers with higher mortality risk are more likely to sell life insurance. The reasoning is that an increase in mortality risk increases the market value of a consumer's life insurance policy. In response to this increase in wealth, consumers desire to increase both consumption and bequests. Thus consumers sell some or all of their life insurance policies and use some of the proceeds for current consumption and invest the remaining for future consumption or bequests. Second the model predicts that consumers with higher assets are more likely to sell life insurance.

Next the predictions from this (neoclassical) economic model are compared with the predictions from a model with two possible, mutually consistent interpretations motivated by the psychology and behavioral economics literature reviewed in chapter 2: that unhealthy consumers are systematically too optimistic about their mortality risks and that consumers focus on nominal price information in deciding to sell insurance, rather than on the real discounted expected price. This model also predicts a positive correlation between mortality and life insurance sales. However, in contrast to the economic model this model predicts (1) among healthier patients, those with more non-liquid assets should be *less* likely to sell life insurance and (2) among sicker patients those with significant non-liquid assets should be *more* likely to sell life insurance. Predictions from each of these models are tested using data on life insurance sales by HIV+ consumers.

5.2 An Economic Model of the Decision to Sell Life Insurance

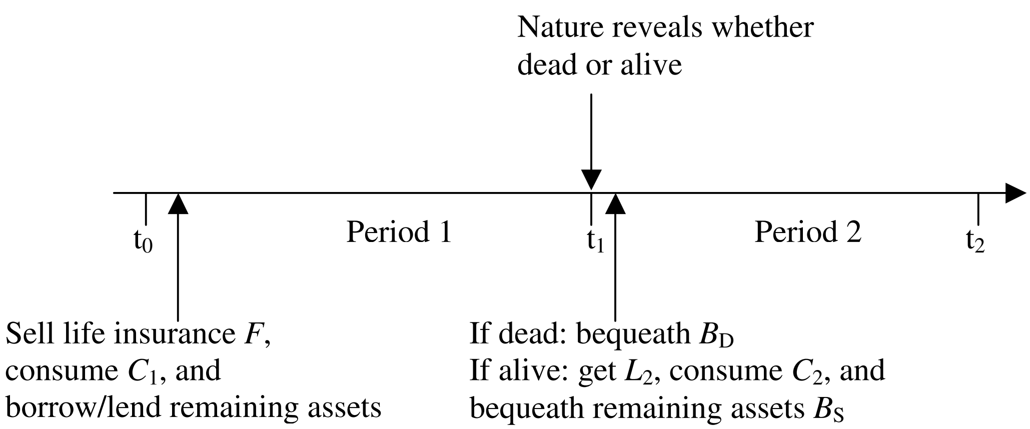
Consumers considering whether to sell life insurance are often too frail to work—due to life-threatening illness—and may need funds to finance consumption, including medical treatment. Though their liquid assets may be insufficient to support their consumption, these consumers have the option to borrow against their non-liquid assets, such as a house, thereby reducing bequests. Thus we model the consumers' decision as one of how to finance consumption.

The model presented in this section is similar to the model used for estimating welfare loss from binding price regulation, but with one important distinction. Rather than combining all assets into one category (wealth), the model presented below explicitly models the allocation of assets between liquid assets such as bank account and non-liquid assets such as a house. In this model consumers can sell or directly consume liquid assets without any costs. However, consumers cannot consume non-liquid assets directly, but can use them as a collateral to obtain loans for financing consumption. This distinction allows us to model consumer decisions to borrow against their non-liquid assets and sell their life insurance policy.

5.2.1 Model of Consumption and Bequests under Uncertainty about Mortality

Consider a consumer whose initial wealth includes a house with a market value of NL dollars (net of any outstanding loans against the house) and a life insurance policy with face value $\overline{F}$ dollars[10]. There are two periods: consumers survive the first period with certainty, and have a probability π of dying at the end of the first period, and if they survive to the beginning of the second period they die with certainty at the end of the second period. Figure 5.1 is the timeline of events in this two-period model.

Figure 5.1: Timeline for Two-Period Model



At the beginning of the first period the consumer earns income L_1, sells an amount F of his life insurance policy at the actuarially fair price, $P(\pi)$, consumes an amount C_1 and borrows or lends his remaining liquid assets. At the end of the first period the uncertainty about the length of the consumer's life is resolved—he knows then whether he will survive to the second period. If the consumer dies he leaves assets B_D as bequests in the beginning of period two. Equation 5.1 shows that B_D is the value of the consumer's initial endowment less consumption in the first period. Thus, B_D

[10] For simplicity, we assume that there are no premium payments on the policy.

includes savings or debt from the first period, net value of the consumer's house, and the remaining life insurance policy.

$$B_D = \left(L_1 + P\left(\pi\right) * F - C_1\right) * \left(1 + r\right) + NL + \overline{F} - F \qquad (5.1)$$

The first term in the parenthesis is the consumer's net lending or borrowing, the second term is the value of the consumer's house and the third term is the value of the remaining life insurance policy.

If the consumer survives then, in the beginning of period two he earns income L_2 and consumes an amount C_2. In the beginning of the second period itself, he bequeaths the remainder of his wealth B_S to his heirs and to the buyer of his life insurance policy. Since all uncertainty is resolved at the beginning of the second period, we assume that the consumer gives the bequest at the beginning of the second period rather than when he dies at the end of the second period[11]. Equation 5.2 shows that bequests if the consumer survives to the beginning of the second period (B_S) include savings from the first period, life insurance that has not been cashed out, non-liquid assets, and unspent earnings from the second period.

$$B_S = \left(L_1 + P(\pi) * F - C_1\right) * \left(1 + r\right) + (NL + \overline{F} - F) * \left(\frac{1}{1+r}\right) + L_2 - C_2 \qquad (5.2)$$

We assume that the market for viatical settlements is competitive and both viatical settlement firms and consumers observe the true mortality risks. Let $P(\pi)$ be the perfectly competitive market price a viatical settlement firm is willing to pay per unit face value to a policyholder with mortality risk π. Let r be the market rate of interest at which the firms can borrow funds. The present value of the expected profit from the purchase of the policy is:

$$Profits = \left(\left[\frac{\pi}{1+r} + \frac{1-\pi}{\left(1+r\right)^2}\right] - P\left(\pi\right)\right) F \qquad (5.3)$$

[11] 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

The first terms in equation (5.3) represents the present value of the expected revenue the firm would receive after the death of the policyholder, while the last term represents the cost to the firm of purchasing the policy. Therefore the zero-profit condition under perfect competition implies:

$$P(\pi) = \left[\frac{\pi}{1+r} + \frac{1-\pi}{(1+r)^2} \right] \tag{5.4}$$

The above condition can be viewed as the demand for life insurance (by viatical settlement firms) given the mortality risk of the consumer and the cost of funds for the firm. In equilibrium, the prices are actuarially fair and the firms are willing to buy all life insurance policies supplied by consumers at $P(\pi)$. The consumer's problem is to choose the optimal value of consumption and the financing of the consumption through sale of life insurance or borrowing to maximize expected utility from consumption and bequests.

$$EU = U(C_1) + \pi\beta V(B_D) + (1-\pi)\beta U(C_2) + (1-\pi)\beta V(B_S) \tag{5.5}$$

Substituting equations (5.1), (5.2), and (5.4) for B_D, B_S, and $P(\pi)$ respectively, and then differentiating (5.5) with respect to C_1, C_2, F yields the following first order conditions.

$$\frac{U'(C_1)}{\left[(\pi)V'(B_D) + (1-\pi)V'(B_S)\right]} = \beta(1+r) \tag{5.6}$$

$$U'(C_2) = V'(B_S) \tag{5.7}$$

$$V'(B_D) = V'(B_S) \tag{5.8}$$

Equation (5.6) shows that 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 (5.7) shows that once the uncertainty about death is

bond of one-year maturity with his bequests. Abel (1986) uses a similar strategy for modeling consumption and bequests under uncertainty about mortality.

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 (5.8) shows that selling life insurance helps consumer reduce the "riskiness" of their bequest portfolio. As in other insurance markets, risk averse consumers sell life insurance to equalize the marginal utility of bequests whether the consumer dies at the end of the first period or survives to the second period. Notice that borrowing does not affect the "riskiness" of the bequest portfolio as the amount of repayment on loans taken in prior periods is not contingent on the mortality of the consumer. On the other hand, selling life insurance enables consumers to increase resources when alive at the cost of reducing near term bequests. In other words, the true cost (*ex post*) of obtaining funds from a viatical settlement (relative to borrowing) will depend on the timing of the consumer's death—if consumers die at the end of the second period then a viatical settlement will have lower costs than borrowing but if consumers die at the end of the first period then viatical settlement will be more expensive than borrowing.

5.2.2 Comparative Statics

Effect of Mortality Risk on Size of the Settlement

Appendix C solves the consumer's maximization problem and derives the key comparative statics. The results show that an increase in mortality risk increases the magnitude of life insurance sales.

$$\frac{dF}{d\pi} > 0 \qquad (5.9)$$

The intuition is as follows. An increase in mortality risk increases the consumer's wealth by increasing equity in the consumer's life insurance policy. In response to this increase in wealth, the consumer will demand both increased consumption and bequests, which are both assumed to be normal goods. Thus the consumer will sell some or all of the life insurance policy and use some of the proceeds for current consumption and invest the remaining proceeds for future consumption or bequests.

Effect of Income and Assets on the Size of the Settlement

The comparative static results show that an increase in the value of the consumer's house, or an increase in liquid assets, raises the magnitude of life insurance sales.

$$\frac{dF}{dNL} > 0 \tag{5.10}$$

$$\frac{dF}{dL_1} > 0 \tag{5.11}$$

The intuition for these results is as follows. Trivially, an increase in the value of the consumer's house or an increase in the current income increases the consumer's wealth. This increase in wealth increases the size of near-term bequests, B_D. To maximize utility under these changed circumstances and equate the marginal utility of bequests and consumption, the consumer will want to liquidate some of his life insurance holdings, effectively moving funds between from the early death state of the world (which is overly funded because of the nature of the increased wealth) to the current time period. Therefore, the consumer will increase life insurance sales and use some of his wealth to increase consumption and late term bequests, at the expense of the originally increased near term bequests.

In contrast, if the consumer experiences an increase in future income then that would reduce the magnitude of life insurance sales.

$$\frac{dF}{dL_2} < 0 \tag{5.12}$$

The intuition for this result is that an increase in future income increases future bequests but leaves near term bequests unchanged. Consumers reduce life insurance sales and increase borrowing to simultaneously increase current consumption and bequests and reduce late-term bequests, again equilibrating marginal utility across the states of the world and across time periods in accordance with the first order conditions (5.6)-(5.8).

5.3 A Model of Misperceived Price and the Decision to Sell Life Insurance

This section presents an alternative model of the decision to sell life insurance in which consumers have misperceptions about the real price (opportunity cost) of selling insurance. The key assumption in this model is that relatively unhealthy consumers perceive a higher return from selling life insurance relative to borrowing than actually exists, and that the opposite is true for relatively healthy consumers. This assumption can be motivated in at least two ways, both consistent with the spirit of the papers cited in the literature review in chapter 2.

The first motivation is that relatively unhealthy consumers overestimate their life expectancy while relatively healthy consumers underestimate their life expectancy. This "optimism bias" of relatively unhealthy consumers leads them to view actuarially fair viatical settlement offers more favorably than they would if they correctly perceived mortality risk. The second motivation is that consumers with limited analytic capabilities use a simple rule of thumb to calculate the present value of expected costs (in terms of forgone bequests) of a viatical settlement. In particular, consumers incorrectly mistake the discount to face value (nominal price) on the viatical settlement for the true cost of a viatical settlement—which is the net present value of foregone bequests. Since in competitive markets the discount to face value rises with life expectancy this view also leads consumers to view actuarially fair viatical settlement offers more favorably if they expect to live a long life. For example, if the cost of capital facing viatical settlement firms is 15% per annum, then under a constant mortality hazard assumption the actuarially fair price of a life insurance policy held by a consumer with life expectancy of 6 months is 95% (or 5% discount on face value) of the face value and for a consumer with a life expectancy of 2 years is 79% (or 21% discount on face value). We argue that consumers focus on the discount to face value rather than the true cost (15% per annum) of the viatical settlement. Thus, consumers with life expectancy of 6 months prefer selling life insurance to borrowing at an interest rate of 15% per annum, and the opposite holds for consumers with life expectancy of 2 years.

Thus in this case even though prices are actuarially fair unhealthy consumers choose selling life insurance and healthy consumers choose borrowing.

As in the economic model of the previous section, consumers hold three distinct assets: a life insurance policy, other non-liquid assets such as housing, and liquid assets such as income. They can finance consumption in three ways. They can consume liquid assets directly, borrow against other non-liquid assets at a given interest rate r, or sell part or all of their life insurance policy at a price p per dollar of coverage. Each action has costs in terms of foregone bequests. Liquid assets cannot be bequeathed once spent, loans must be repaid, and heirs cannot collect on life insurance that has been sold.

Unlike in the economic model, consumers in this model solve a static optimization problem of distributing wealth between consumption and bequests to maximize utility[12]; in particular, such consumers do not discount bequests. Firms, on the other hand, live forever and are risk neutral and thus discount future income at the market rate of interest. This simple model generates sharp predictions that we can test with the available data.

5.3.1 Comparative Statics

Effect of Mortality Risk on the Size of the Settlement

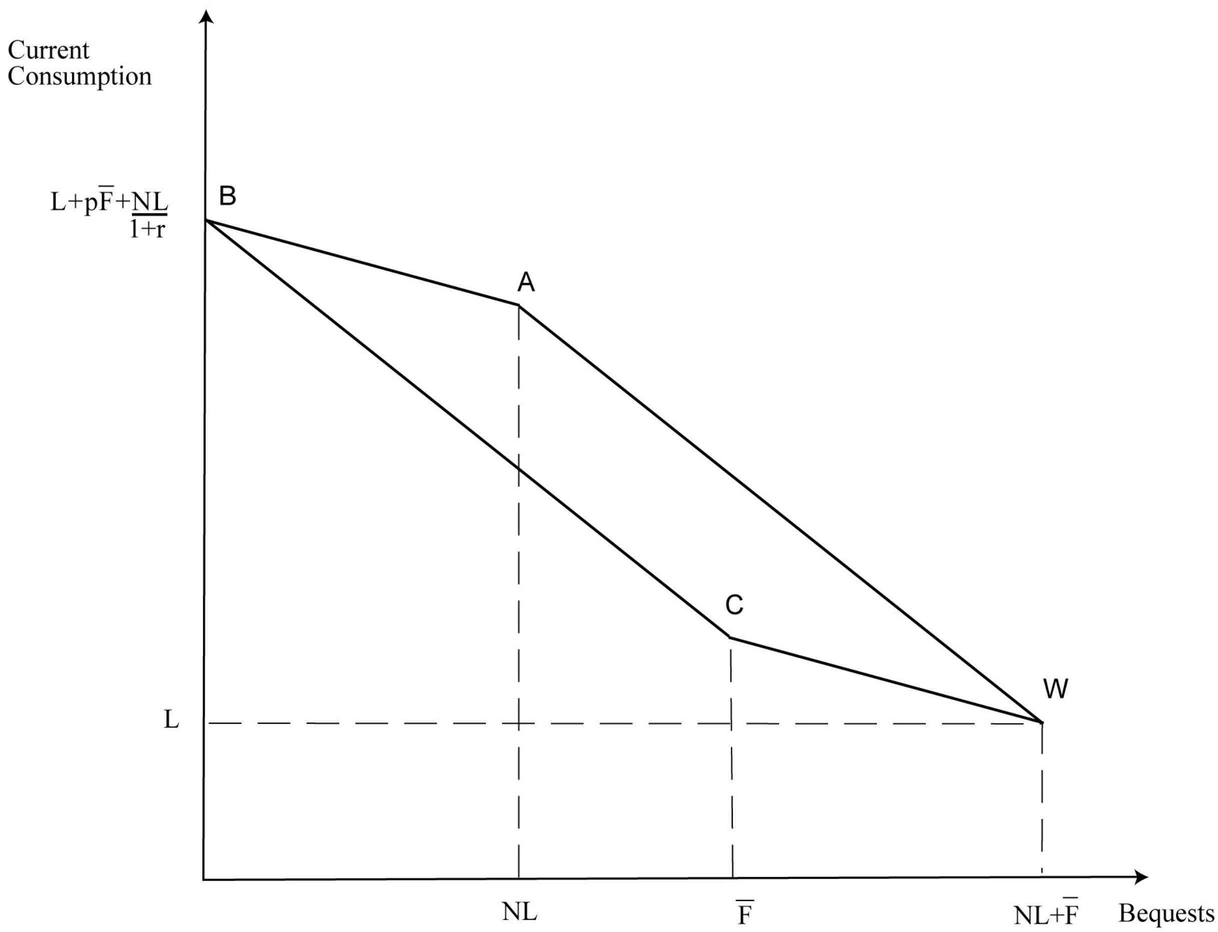
The discount to face value of life insurance offered by viatical settlement firms depends on life expectancy. For example, for life insurance policies with the same face value, firms will require lower discounts to consumers closer the end of life since firms are more likely to collect earlier. Since consumers incorrectly perceive the discount to face value as the true price of the viatical settlement, they trade off the discount to face value against the annual interest rate for borrowing. Assuming that the market interest rate for borrowing is the same for everyone, relatively unhealthy consumers will perceive terms of trade to be more attractive in the viatical settlements market than in the credit market.

[12] We also abstract away from consumers who are not 'cash-constrained'—that is, those who save liquid assets to finance future consumption or bequests—because such individuals would never be interested in viaticating at the actuarially fair price.

More formally, let a_i reflect consumer *i*'s risk of death, and let $H_1 = \{i \mid a_i < \overline{a}\}$, $H_2 = \{i \mid a_i = \overline{a}\}$, and $H_3 = \{i \mid a_i > \overline{a}\}$ for some cutoff level $\overline{a}$ so that H_1 consists of healthier consumers than H_3. We choose a cutoff value $\overline{a}$ such that for consumers in H_2, the perceived costs of financing current consumption through the credit and viatical settlement markets are equal. H_1 consumers perceive better opportunities in the credit market, while H_3 consumers perceive the viatical settlements market to be more attractive.

Figure 5.2 shows the *perceived* budget constraint for H_3 consumers. The vertical axis represents current consumption, the horizontal axis represents bequests, and *W* represents the initial endowment, $(L, NL + \overline{F})$. *B* represents the net present value of the endowment—$L + p\overline{F} + \frac{NL}{1+r}$, where *p* is the actuarially fair unit price of life insurance sales. Selling all of $\overline{F}$ moves consumers from W to A, where consumers have only non-liquid assets left to fund bequests. To increase current consumption past A, consumers must turn to the credit market, where they borrow at interest rate *r*, represented by the line segment AB. At point B, consumers leave no bequests, consuming everything in the current period. The kink in the budget constraint is caused by consumer's misperception about the relative prices of borrowing and selling life insurance. A consumer who correctly observed that the real prices of the two activities are the same would have a straight line connecting points W and B for a budget constraint since the policy is discounted by firms at the market rate of interest, the same rate at which consumers can borrow.

Figure 5.2: Budget Constraint when Perceived Terms of Trade Favor the Viatical Settlements Market



Another strategy that consumers could pursue would be to borrow first and then sell their life insurance after their credit is exhausted. WCB is the perceived budget constraint for this strategy, where C represents the exhaustion of non-liquid asset collateral and B represents the sale of $\overline{F}$ as well. Since H_3 (the unhealthiest) consumers perceive that the terms of trade favor the viatical settlements market; the slope of WA is greater (in absolute value) than the slope of WC and WAB is the operational budget constraint for H_3 consumers. Therefore, this graphical representation of consumer misperceptions shows that H_3 (unhealthy) consumers will viaticate first and then borrow only if $p\overline{F}$ is insufficient to finance current consumption. Similarly H_1 (the healthiest) consumers will perceive that the terms of trade favor credit markets and will choose to borrow first (i.e. the slope of WA is less in absolute value than the slope of WC). These consumers will borrow first and viaticate only if their liquid and non-liquid assets are insufficient to finance current consumption. Therefore this model also predicts that consumers with higher mortality risks are more likely to viaticate[13].

Effect of Assets on the Size of the Settlement

Changes in non-liquid assets lead to a parallel shift in the consumer's perceived budget line and do not affect the perceived terms of trade in the two markets. Increasing non-liquid assets raises both the value of the endowment and maximum possible bequests, since consumers either leave additional non-liquid assets as bequests or use them for borrowing.

For healthy H_1 consumers, these additional assets will induce them to substitute borrowing for life insurance sales, since these consumers perceive more favorable terms of trade in the credit market. Figure 5.3a illustrates the effect of increase in non-liquid assets on the decision to viaticate for H_1 consumers. H_1 consumers initially borrow fully against their non-liquid assets and also sell life insurance and are at point E on the perceived budget line. For the indifference curves as drawn, increasing *NL* shifts the perceived budget line from WAB to W'A'B'. At E', consumers have completely substituted borrowing for viaticating[14]. For other preferences, this complete

[13] This prediction is also consistent with the economic model presented in section 5.2. The comparative statics presented in section 5.2.2 show that even in the economic model consumers with higher mortality risks are more likely to viaticate.

[14] For H_1 consumers with an initial optimum in the lower part of the budget constraint, an increase in *NL* will have no effect on the supply of life insurance

substitution may not happen, but as long as consumption and bequests are normal goods, increased assets will decrease life insurance sales for H_1 consumers.

For (the sicker) H_3 consumers, the additional non-liquid assets can induce more life insurance sales. Figure 5.3b illustrates the effect of an increase in *NL* for H_3 consumers. For these consumers, perceived terms of trade favor the viatical settlements market. If consumption is a normal good, an increase in *NL* leads these consumers to sell a larger part of $\overline{F}$, as they can use the additional non-liquid assets to finance bequests. At G′ on the new perceived budget constraint, consumers sell the same amount of life insurance as at their initial optimum, E. Thus, the new equilibrium will lie on C′G′, where consumers sell a larger part of $\overline{F}$ than at E.

Increasing liquid assets also leads to a parallel shift in the consumer's budget constraint. Consumers use additional liquid assets to either finance increased consumption or to increase bequests by substituting for viatication or borrowing. If bequests are a normal good, increasing liquid assets will cause consumers to decrease their supply of life insurance, decrease their borrowing, or both. For H_1 consumers who do not initially sell life insurance, increasing liquid assets will reduce borrowing but have no effect on life insurance supply. For H_3 consumers who sell all of their life insurance and also borrow, the effects of increasing *L* depend upon the strength of the income effect. If the income effect is strong, consumers eliminate borrowing and reduce their supply of life insurance. If the income effect is weak, consumers continue to sell all of $\overline{F}$, but reduce borrowing. Hence, for H_3 consumers as well, increasing liquid assets will never increase the supply of life insurance.

Figure 5.3a: Increasing Non-Liquid Assets and the Supply of Life Insurance by H_1 Consumers

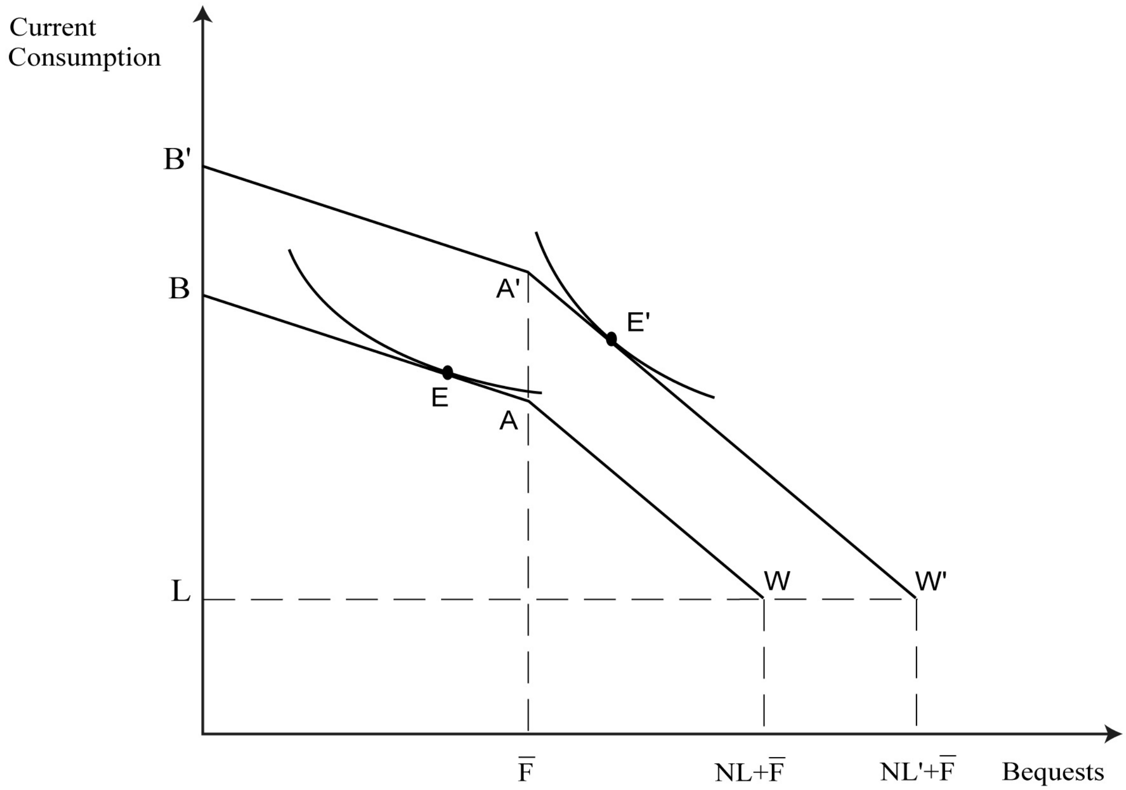
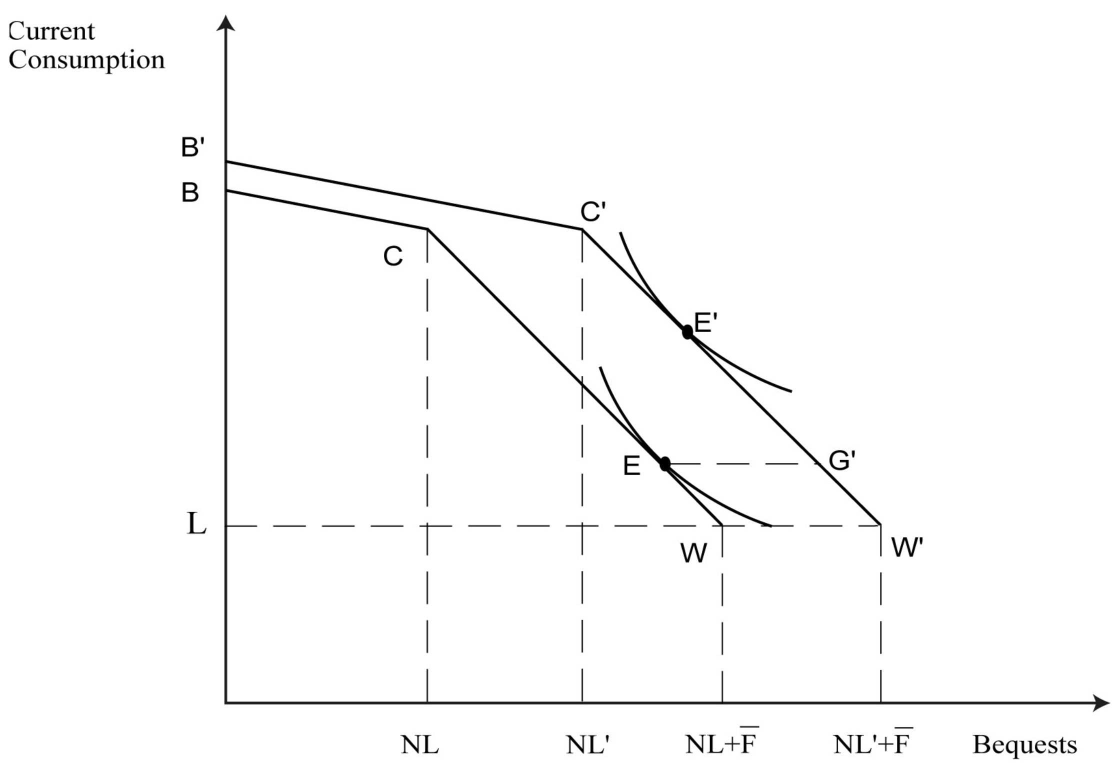


Figure 5.3b: Increasing Non-Liquid Assets and the Supply of Life Insurance by H_3 Consumers



5.4 Comparing Predictions from the Economic and Misperceived Price Model

Both the (neoclassical) economic model and the (behavioral) misperceived price model make sharp predictions regarding the behavior of consumers in the viatical settlement and credit markets.

Prediction 1: *Healthier consumers are less likely to viaticate.*

Although this prediction is consistent with the economic model and the misperceived price model, the mechanism through which mortality risks affect life insurance sales is very different across the two models. In the economic model an increase in mortality risk increases the value of the consumer's life insurance policy. This wealth increase induces consumers to increase life insurance sales to finance increased consumption at the cost of reduced bequests. In contrast, in the misperceived price model the negative correlation between health status and the decision to viaticate arises from a "price-effect." Unhealthy consumers perceive that the terms of trade are more favorable in the viatical settlements market and they choose to viaticate first and borrow only if the proceeds from their life insurance sales are insufficient to finance current consumption.

Prediction 2[E]: *Consumers with higher non-liquid assets are more likely to viaticate.*

This prediction is consistent with the economic model only and follows directly from the comparative static result shown in equation (10). In contrast, the misperceived price model makes the following prediction:

Prediction 2[M]: *Among the healthiest consumers, those with higher non-liquid assets are less likely to viaticate. Among the sickest consumers, those with higher non-liquid assets are more likely to viaticate.*

This follows from Figures 5.3a and 5.3b and is a rather stringent test of the misperceived price model. It requires that the impact of non-liquid assets on the decision to viaticate in our empirical specification have different signs depending on the underlying health status of the consumer.

Prediction 3[E]: *Consumers with higher liquid assets or current income are more likely to viaticate.*

This prediction is consistent with the economic model only. Thus, it would constitute evidence in favor of the economic model if we observe that people with higher incomes are more likely to viaticate than are patients with lower incomes. In contrast, the misperceived price model makes the following predictions.

Prediction 3[M]: *Consumers with higher liquid asset or current incomes are less or as likely to viaticate.*

Thus, a measured zero or negative correlation between the decision to viaticate (or borrowing) and amount of liquid assets, all else remaining the same, would be consistent with the predictions of the misperceived price model.

5.5 Empirical Tests

To test the predictions of these models, we use 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 dataset is appropriate because it contains extensive information on a sample of terminally ill patients who constitute a large share of the viatical settlements market. [NVA, 1999]. Chapter 3 describes the design of the data set, including sampling, in detail.

5.5.1 Analysis Sample

Questions about life insurance holdings and sales were asked in the first follow-up (FU1) survey in 1997 and the second follow-up (FU2) survey in 1998. Of the 2,466 respondents in FU1, 1,353 (54.7%) reported life insurance holdings. These 1,353 respondents are our analytic sample as they are the only patients who could viaticate. We exclude 344 respondents with missing values for at least one of the key variables—diagnosis date, health status, liquid assets, or non-liquid assets. These excluded

Table 5.1: Descriptive Statistics at Baseline

Variables	Never sold life insurance (N=740)	Ever sold life insurance (N=146)	Entire sample (N = 886)
CD4 T-cell levels:			
< 50 cells per ml	9.36%	12.08%	9.83%
50 – 200 cells per ml	21.68%	40.00%	24.84%
201 – 500 cells per ml	43.32%	31.40%	41.26%
> 500 cells per ml	25.64%	16.52%	24.07%
Disease Stage:			
Asymptomatic	10.93%	11.85%	11.09%
Symptomatic	54.37%	38.61%	51.64%
AIDS	34.70%	49.54%	37.26%
Income and Assets:			
House ownership	29.38%	33.57%	30.11%
Monthly Income			
< $500	15.81%	13.57%	15.42%
$501 - $2000	39.85%	38.73%	39.66%
> $2000	44.34%	47.70%	44.92%
Bequest Motives:			
Any Children Alive	37.82%	29.18%	36.32%
Married	16.01%	12.30%	15.37%
Separated, Divorced, Widowed	25.55%	28.06%	25.98%
Never Married	58.44%	59.64%	58.64%
Demographics:			
Age	34.88 years	38.01 years	35.42 years
Male	84.19%	89.35%	85.08%
Black	25.41%	17.32%	24.01%
Hispanic	13.61%	4.18%	11.98%
White	56.68%	75.97%	60.01%
Other race	4.30%	2.53%	3.99%
Have college degree	24.52%	36.38%	26.57%

respondents were similar to the sample with complete data in terms of their observed covariates. We also exclude 123 respondents who resided in states with minimum price regulation of viatical settlements as these regulations distort the viatical settlements market by restricting settlements by relatively healthy consumers [see chapter 4]. In the remaining analytic sample of 886 respondents, 146 (16%) respondents had sold at least some of their life insurance by the FU1 or FU2 interview dates.

HCSUS respondents report whether they sold their life insurance by the first or second follow-up interview. Given these responses, we estimate an empirical model of the decision to viaticate that allows for time-varying covariates. Because we do not observe quantity sold, our focus is necessarily on the decision to sell at all. The empirical strategy for modeling the hazard of viaticating is described in detail in section 4.3.1.

Table 5.1 compares summary statistics from the baseline interview of respondents who sold their life insurance at some point with those who had not sold their life insurance by FU2. Viators are more likely than never-viators to be male, white, college-educated and older. They also have higher incomes and are more likely to own a house. They are also less likely to be married or have any children alive. Finally, viators are typically in poorer health than never-viators, with lower CD4 T-cell levels at the baseline survey and more progressive HIV disease.

5.5.2 Measuring Health, Income and Assets

We model the hazard of viaticating as a function of demographics, health status, income, and a full set of interactions between non-liquid assets and health status. The model also includes marital status, living alone, and whether the respondent has at least one living child as proxies for the strength of bequest motive.

Ideally, we would like to classify HCSUS respondents into groups H_1 and H_3 that are based upon their subjective mortality risks, but these data are not available. Instead, we construct a one-dimensional indicator of mortality risk by regressing one-year mortality after the baseline survey on the two clinical health measures – indicators for CD4 cell levels and CDC definition of stage of disease. This probit regression is shown in Table 5.2. Not surprisingly, respondents with lower CD4 T-cell levels or with more advanced disease are more likely to die. Using these results, we predict one-year mortality rates $(\hat{p})$ for each respondent at each time point when we have new CD4 T-cell levels and clinical stage indicators. Finally, we use a cutoff value of $\hat{p} = 0.04$ for predicted mortality to divide our sample into respondents with high mortality risks (25% of respondents at baseline) and respondents with low mortality risk (75% of respondents at baseline). Based upon this division we create two dummy variables, *Unhealthy* and *Healthy*, which are our main health status indicators. Because we do not know the true cutoff value we try different cut-off values for the health status indicator in other specifications to test the robustness of our results.

Table 5.2: One-Year Mortality Probit Regression

Variable	Coefficient	Standard Error
CD4 T-cell < 50	1.40	0.39
CD4 T-cell 51-200	0.50	0.39
CD4 T-cell 201-500	0.32	0.38
CD4 T-cell 500+*	-	
Asymptomatic	-0.51	0.47
Symptomatic	-0.41	0.22
AIDS*	-	
Intercept	-2.25	0.38

* Reference categories

We use house ownership as the measure of non-liquid assets as it was asked in all three surveys (The dollar value of non-liquid assets was asked only in the baseline survey). Respondents who owned a house at baseline reported having higher non-liquid assets as compared to respondents who did not own a house at baseline ($66,740 vs. $25,832). This relationship between non-liquid assets and house ownership persist even after controlling for health status. For both healthy and unhealthy consumers house ownership is associated with significantly higher non-liquid assets. We designate the indicators for house ownership and non-ownership as *House* and *NoHouse*, respectively. We use income, which was asked in each interview, as a measure of liquid assets. Because many HCSUS respondents report their income only within ranges, we enter income in our models as a series of indicator variables: 1(*Income* < \$500 per month), 1(\$501 ≤ *Income* < \$2,000), and 1(*Income* ≥ \$2,000).

Table 5.3: Summary of Hypothesis

Prediction	Test†
Misperceived price Model	
Prediction 1: Negative correlation between health status and the decision to viaticate.	$\lambda(t \mid Unhealthy, House) > \lambda(t \mid Healthy, House)$ $\lambda(t \mid Unhealthy, NoHouse) > \lambda(t \mid Healthy, NoHouse)$
Prediction 2a: Among healthy consumers, negative correlation between the decision to viaticate and the amount of non-liquid assets	$\lambda(t \mid Healthy, House) < \lambda(t \mid Healthy, No\ House)$*
Prediction 2b: Among unhealthy consumers, a positive correlation between the decision to viaticate and the amount of non-liquid assets	$\lambda(t \mid Unhealthy, House) > \lambda(t \mid Unhealthy, No\ House)$
Prediction 3: Zero or negative correlation between liquid assets and the decision to viaticate	$\lambda(t \mid Income$ \$2000+$) \le \lambda(t \mid Income$ \$500 to \$2000$)$ $\le \lambda(t \mid Income$ below \$500$)$
Economic Model	
Prediction 1: Negative correlation between health status and the decision to viaticate.	$\lambda(t \mid Unhealthy, House) > \lambda(t \mid Healthy, House)$ $\lambda(t \mid Unhealthy, NoHouse) > \lambda(t \mid Healthy, NoHouse)$
Prediction 2a: Among healthy consumers, positive correlation between the decision to viaticate and the amount of non-liquid assets	$\lambda(t \mid Healthy, House) > \lambda(t \mid Healthy, No\ House)$*
Prediction 2b: Among unhealthy consumers, a positive correlation between the decision to viaticate and the amount of non-liquid assets	$\lambda(t \mid Unhealthy, House) > \lambda(t \mid Unhealthy, No\ House)$
Prediction 3: Positive correlation between liquid assets and the decision to viaticate	$\lambda(t \mid Income$ \$2000+$) > \lambda(t \mid Income$ \$500 to \$2000$)$ $> \lambda(t \mid Income$ below \$500$)$

† $\lambda(t \mid \cdot)$ is the hazard of viaticating at time *t*.

5.5.3 Summary of Hypothesis

Table 5.3 maps the predictions from the economic and misperceived price models into testable hypotheses. To evaluate them, we include in the model interactions between health status (*Unhealthy*) and house ownership (*House*). The first prediction implies that the hazard of viaticating should be higher for the unhealthy, regardless of home ownership.

Prediction 2[M] implies that home ownership should have an opposite effect on the healthy than it has on the unhealthy. For the unhealthy, home ownership should increase the probability of viaticating; for the healthy, it should reduce it. We consider this a strong test of the misperceived price model, since the effect of assets should reverse sign based on the classification of health from the one-year mortality regression. In contrast, Prediction 2[E] implies that the hazard of viaticating should be higher for homeowners, regardless of health status.

Prediction 3[M] implies that high income consumers with will be *less* likely to viaticate to finance consumption, while Prediction 3[E] implies that high income consumers will be *more* likely to viaticate.

5.6 Results

Table 5.4 reports the average hazard ratios at $t = 1$ (the first year when consumers were at risk to viaticate) and baseline hazard rates for four different specifications of the empirical model. 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 methods for computing the hazard ratios and their confidence intervals.

The second column (Model 1) in Table 5.4 reports the results for the simplest empirical model needed to test the hypotheses presented in Table 5.3. The results show that among healthy consumers homeowners are significantly less likely to viaticate. In contrast, among unhealthy consumers homeowners are significantly more likely to viaticate. These results are consistent with prediction 2[M] of the misperceived price model, and inconsistent with prediction 2[E] of the economic model. The results are also consistent with prediction 1 from both the economic and misperceived price model. Regardless of home ownership, unhealthy consumers are significantly more likely to viaticate. Figure 5.4 plots the predicted survivor functions—that is, cumulative probability of <u>not</u> viaticating—implied by the results in Model 1 for each house ownership and health group from $t = 1$ year to $t = 9$ years. It demonstrates an ordering of viatication hazards that are consistent with the misperceived price model. Income has no statistically significant effect on viatication probabilities, which is also weak evidence favoring Prediction 3[M] of the misperceived price model.

Figure 5.4: Proportion Not Viaticated by Health Status and House Ownership

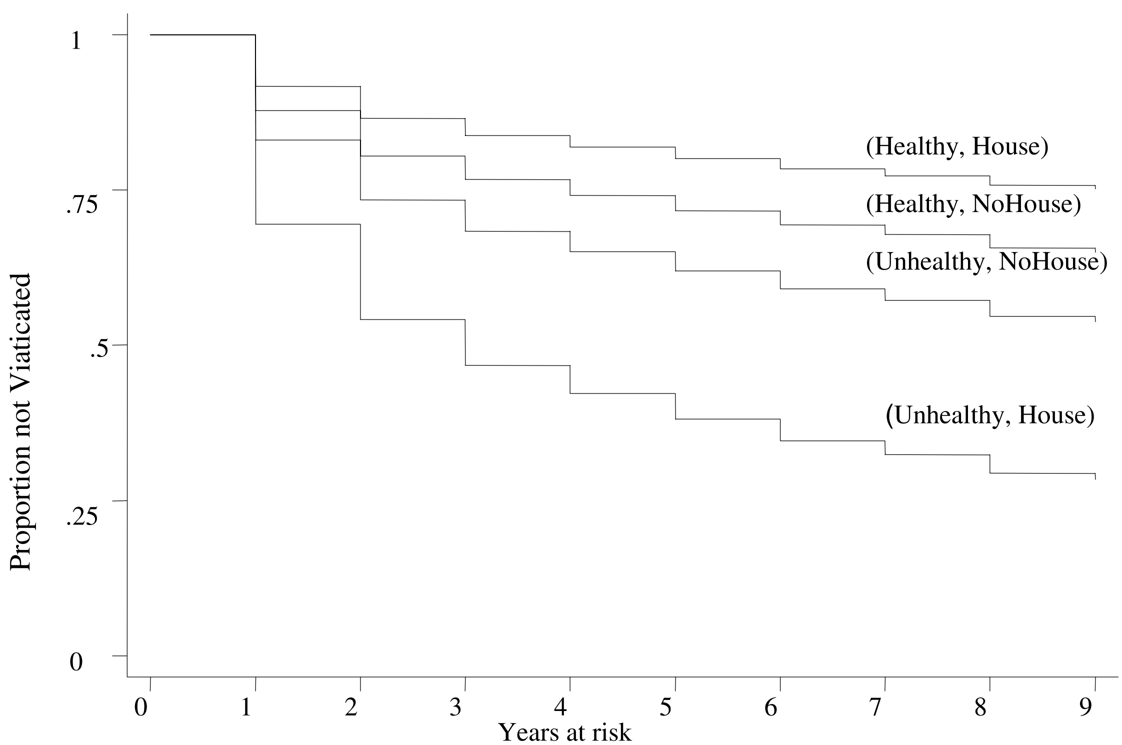


Table 5.4: Results of Empirical Models of the Hazard of Viatication

Variables	Model 1 Haz. Ratio (Conf Int.)	Model 2 Haz. Ratio (Conf Int.)	Model 3 Haz. Ratio (Conf Int.)	Model 4 Haz. Ratio (Conf Int.)
Income				
Income < $500	1.00	1.00	1.00	1.00
	(Ref Cat)	(Ref Cat)	(Ref Cat)	(Ref Cat)
Income $500 –2000	1.08	0.90	1.05	0.88
	(0.69 – 1.64)	(0.55 – 1.43)	(0.69 – 1.56)	(0.54 – 1.38)
Income > $2000	1.42	1.02	1.35	0.98
	(0.91 – 2.14)	(0.60 – 1.64)	(0.88 – 2.00)	(0.58 – 1.55)
House ownership and Health Status				
Healthy*House	1.00	1.00	1.00	1.00
	(Ref Cat)	(Ref Cat)	(Ref Cat)	(Ref Cat)
Unhealthy*House	3.90	4.35	2.71	2.93
	(2.37 – 6.24)	(2.50 – 7.13)	(1.62 – 4.39)	(1.64 – 4.90)
Unhealthy *NoHouse	2.16	2.46	2.25	2.60
	(1.31 – 3.41)	(1.39 – 4.03)	(1.35 – 3.60)	(1.45 – 4.35)
Healthy*NoHouse	1.55	1.83	1.31	1.56
	(1.00 – 2.36)	(1.11 – 2.84)	(0.77 – 2.12)	(0.87 – 2.61)
Bequest Motives				
Never Married	-	1.00	-	1.00
		(Ref Cat)		(Ref Cat)
Married	-	1.12	-	1.07
		(0.63 – 1.83)		(0.62 – 1.70)
Separated, Widowed, Divorced	-	1.02	-	1.09
		(0.71 – 1.42)		(0.76 – 1.50)
Atleast One Child Alive	-	0.73	-	0.73
		(0.47 – 1.08)		(0.48 – 1.07)
Living Alone	-	1.02	-	1.01
		(0.75 – 1.37)		(0.75 – 1.34)
Demographics				
White	-	1.00	-	1.00
		(Ref Cat)		(Ref Cat)
Black	-	0.67	-	0.73
		(0.44 – 0.98)		(0.48 – 1.04)
Hispanic	-	0.32	-	0.33
		(0.13 – 0.62)		(0.13 – 0.66)
Other Race	-	0.55	-	0.60
		(0.20 – 1.17)		(0.21 – 1.25)
Age	-	1.21	-	1.21
		(1.10 – 1.34)		(1.10 – 1.33)
Male	-	1.03	-	1.08
		(0.61 – 1.70)		(0.65 – 1.77)
Education				
Less Than High School	-	1.00	-	1.00
		(Ref Cat)		(Ref Cat)
High School	-	0.65	-	0.66
		(0.33 – 1.20)		(0.34 – 1.21)
Some College	-	1.54	-	1.64
		(0.84 – 2.66)		(0.91 – 2.80)
College	-	1.24	-	1.30
		(0.61 – 2.31)		(0.64 – 2.41)

Model 2 in Table 5.4 adds demographic, bequest motive, and education variables to Model 1. Whites have significantly higher hazards of viaticating than do Blacks, Hispanics, and respondents of other races. Older respondents are significantly more likely to viaticate. Respondents with no children alive are more likely to viaticate, though the effect is statistically significant at only the 90% confidence level. There are no statistically significant differences between high school dropouts, high school graduates and college educated respondents in viatication hazards, though the point estimates indicate college graduates and those with some college education are more likely to viaticate.

The results of Model 1 are robust to adding these additional covariates. In particular, we find that among healthy consumers those with houses are significantly less likely to viaticate than those without, which is consistent with prediction 2[M] of the misperceived price model, but inconsistent with prediction 2[E] of the economic model.

In Models 3 and 4, we check the robustness of our results to a change in the definition of health status. Instead of a cutoff value of 0.04 for predicted mortality, we use a value of 0.012 to divide our sample differently into unhealthy (50% of respondents at baseline) and healthy respondents (50% of respondents at baseline). Except for the change in definition of health status, the specification of Models 3 and 4 are identical to Models 1 and 2. As with Models 1 and 2, the estimates from Models 3 and 4 are also consistent with the misperceived price model. We find that among the healthy, those with houses are less likely to viaticate than those without, which is consistent with Predictions 2[M], although the difference in the viatication hazards is not statistically significant.

5.7 Alternate Theories

The evidence presented here is consistent with the misperceived price model and inconsistent with the economic model. Here, we consider four alternate explanations that could, under certain conditions, give rise to similar findings.

One important factor that we did not model is means-tested programs such as Medicaid. In most states, proceeds from viatical settlements are counted as assets for the purposes of means-testing, but life insurance polices themselves are excluded. Clearly, this might reduce incentives to viaticate for individuals who would otherwise be eligible for these programs. However, the bias here goes the wrong way. Such program rules make the unhealthy *less* likely to sell insurance—contrary to what the data show—since they tend to be more indigent and thus more likely to be eligible for Medicaid or other public programs.

A related alternative explanation concerns the tax treatment of viatical settlements. The 1996 Health Insurance Portability and Accountability Act, which came into effect in January 1997, exempts proceeds derived from a viatical settlement from federal taxes as long as the seller is certified by a physician to have a life expectancy of 24 months or less or to be chronically ill. Several large states, such as California and New York, have also passed similar provisions exempting viatical settlement transactions from state taxes (Sutherland and Drivanos, 1999). Although these laws might lead to a negative correlation between health and the hazard of selling insurance after 1997, the vast majority of our data refer to the period before the HIPAA implementation. Most respondents in our study reported that they sold their life insurance by the first quarter of 1997 – thus there is only a 2-3 month overlap in the time when these laws were effective and the period of life insurance sales in the HCSUS sample.

As in any insurance market, asymmetric information (patients know more than firms about their mortality risks) could be an important determinant of market outcomes in the viatical settlements market. As Akerlof (1970) and Rothschild and Stiglitz (1976) demonstrate, 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 high unobserved mortality risks rather than the healthier patients are driven out of the market. However, the institutional details of this industry argue against the importance of adverse selection in these markets. In particular, there are good reasons to believe that viatical settlement companies have accurate information on patient's mortality risks. Unlike other insurance markets, viatical settlement firms often use the services of independent physicians and actuaries to determine the life expectancy of the seller (NVA, 1999). Furthermore, companies scrutinize patient medical records before making an offer to buy, and they have access to the mortality experience of a large pool of patients[15].

Finally, consider the role of transaction costs. Transaction costs in credit markets might be systematically different for healthy and unhealthy consumers; in particular, unhealthy consumers might face a higher cost of borrowing against their house as compared with healthy consumers. For example, lenders might charge higher prices to unhealthy consumers if they expect to incur significant costs in collecting loan repayments from the estates of unhealthy consumers and but do not expect such costs for healthy consumers (as they might be more likely to repay their loans before they die). In this case, it would be likely that unhealthy consumers would prefer the viatical settlement market, while healthy consumers would prefer the credit market to finance their consumption needs. However, this explanation is based on two assertions that are unlikely to be true. First, this explanation assumes that lenders know the health status or life expectancy of borrowers. This is unlikely since credit applications do not usually require borrowers to disclose their health status. Second, this explanation assumes that transaction costs in the viatical settlement market do not systematically depend on the life expectancy of the sellers. However, it seems likely that unhealthy consumers, who have little time left to live, might view the sometimes lengthy process of searching and negotiating with viatical firms in this relatively new market as particularly onerous,

[15] Of course, these efforts may not completely eliminate asymmetric information—patients may still have private information about their health status and the efforts they will undertake to avoid poor health.

relative to healthier consumers. Therefore, it seems unlikely that our results are completely driven by differences in transaction costs in credit markets for healthy and unhealthy consumers, although we cannot rule out this explanation.

5.8 Conclusions

The empirical findings indicate that, among healthier chronically ill consumers, homeowners are less likely to sell their life insurance than are non-home owners. In contrast, among unhealthy consumers, homeowners are more likely to sell their life insurance policies. These empirical findings cannot be reconciled with a straightforward economic model of savings, consumption, and bequests. Instead, these findings are consistent with two mutually consistent interpretations motivated by the psychology and behavioral economics literature: (1) relatively unhealthy consumers overestimate their life expectancy and this "optimism bias" leads them to view actuarially fair viatical settlement offers more favorably than they would appear to someone correctly perceiving mortality risk, and (2) consumers mistakenly believe that the discount to face value on the viatical settlement is a good approximation to the true price of the viatical settlement. Since in a competitive market the discount to face value rises with life expectancy, this mistaken view leads long-life-expectancy consumers to view actuarially fair viatical settlement offers less favorably than do their unhealthier counterparts.

Chapter 6. Conclusions and Policy Implications

6.1 Minimum Price Regulations

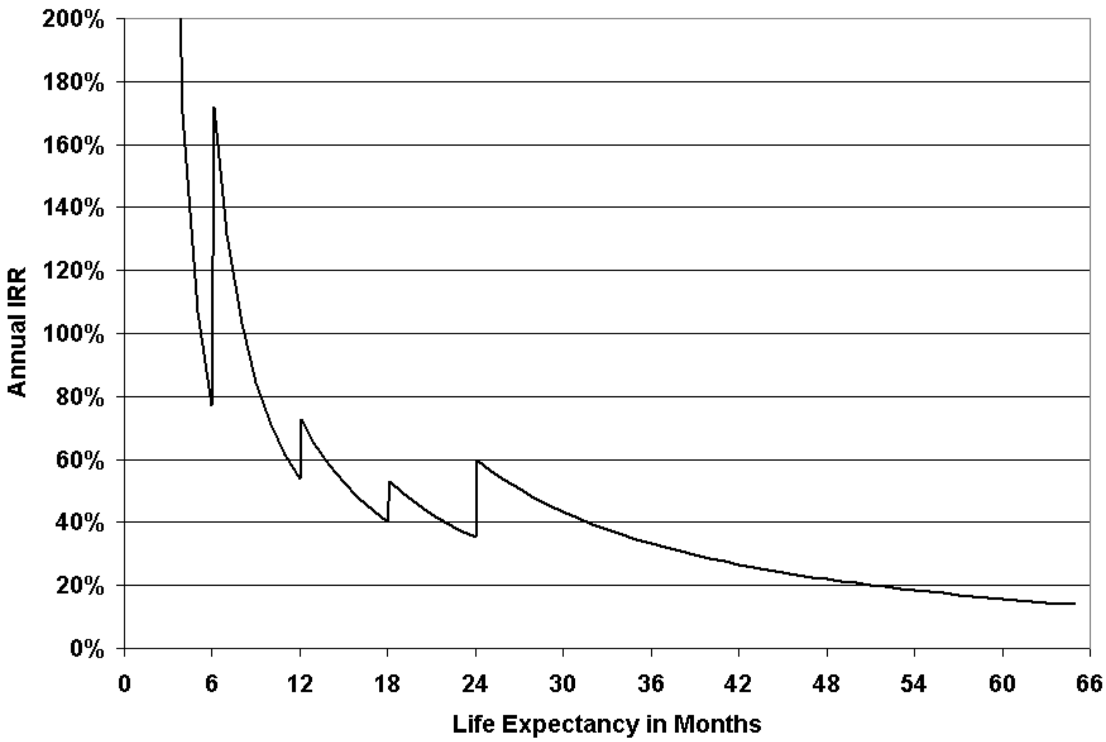
This dissertation makes a contribution by analyzing various facets of the emerging viatical settlements market. The results of the first analysis (Chapter 4) illustrate that existing price regulations in this market might do more harm than good. In particular, the analysis shows that existing price regulations restrict viatical settlements by relatively healthy consumers (those with life expectancy of more than 4.5 years) but have no effect on market outcomes for relatively unhealthy consumers. Thus, the regulatory scheme imposes a significant welfare loss for consumers who would like to sell their life insurance to finance medical treatment and other basic needs but are unable to find buyers for their policies at the regulated prices.

The unintended consequences of these regulations stem from the inadequate gradation of minimum prices with respect to life expectancy. As shown in Table 1.1, minimum prices are constant within six-month life-expectancy bands and are set at 50 percent of the face value for all consumers with life expectancy greater than 2 years. This implies that if firms were to trade at the minimum price schedule they would earn a much lower internal rate of return (IRR) or profit on policies of consumers with life expectancy well beyond 2 years compared to consumers with life expectancy close to 2 years[16]. Figure 6.1 shows the IRR firms would earn if firms bought policies at the regulated price from consumers with different life expectancies[17]. The figure illustrates several problems with the existing minimum price schedule.

[16] Internal rate of return (IRR) is the discount rate that equates the present value of the expected death benefits to the minimum price. Clearly, given a constant minimum price, polices with a higher life expectancy will enjoy a lower IRR. I report the internal rate of return as it can be easily compared to the interest rate or cost of capital for viatical firms. If the IRR is lower than the interest rate than firms would make a loss and vice versa.

[17] For the purposes of this illustration I assume that consumers have an infinite term life insurance policy with premiums of $238 per $100,000 of face value. The premium calculation assumes that premiums are actuarially fair and that the consumer had a life expectancy of 35 years when he originally purchased his life insurance. For details on the methods used to calculate premiums and actuarially fair

Figure 6.1: Life Expectancy and IRR at Minimum Prices



First, the 6-month life expectancy bands in the minimum price schedule cause discrete jumps in the IRR at each 6-month interval. This creates an incentive for firms to misclassify the life expectancy of consumers at the border of each life expectancy interval. Second, the regulatory standard is not uniform – the IRR firms would earn at the minimum prices depends on the life expectancy of the consumers. If firms were to buy policies at the regulated prices they would enjoy huge profits on policies bought from consumers with low life expectancy[18]. In contrast, firms would make a loss if they

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prices see chapter 4. I also assume that consumers have a constant mortality hazard (λ) so that their life expectancy is simply the inverse of their mortality hazard $\left(\frac{1}{\lambda}\right)$.

[18] If the markets are competitive then prices would be actuarially fair (and higher than the regulated price) and firms would make zero (economic) profits. Table 4.4 in chapter 4 shows that this was

bought policies from consumers with life expectancy greater than 54 months as the IRR is lower than the estimated cost of capital (16.5%) for these firms. Thus, the regulatory scheme prevents viatical settlements by consumers with relatively high life expectancy.

There are several avenues for improving the existing price regulations. At a minimum, the existing price schedule should be revised to include more life expectancy bands beyond 24 months. This is especially important if similar regulations are passed for the life settlements market (the secondary life insurance market for elderly), where a majority of the sellers would have a life expectancy of well beyond 24 months. The minimum price schedule should also be revised for life expectancies below 24 months. Ideally, the minimum price schedule should promise the same IRR irrespective of the life expectancy of the seller. This can be achieved if the minimum prices are determined by using actuarial formulas that explicitly model the mortality profile of the terminally ill population and the unique features of life insurance policies. A continuous price schedule would also mitigate (although not completely eliminate) the incentives to misclassify the life expectancy of consumers at the border of life expectancy bands. In addition, the IRR set by the minimum price schedule should be pegged to the cost of capital for viatical settlement firms. A well-designed price schedule would set an IRR that offers viatical settlement firms a "reasonable" rate of return over the cost of capital for the industry. These changes in the minimum price schedule would mitigate the welfare loss from existing price regulations and ensure that consumers enjoy a reasonable return on viatical settlements. The exact design and parameters of the new (or revised) legislation is left to further research[19].

Another policy option is to repeal price regulations and simply require firms to disclose the actuarially fair price of a policy to consumers and let consumers (rather than the department of insurance) decide whether they want to sell their policy in the

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the case in Texas – market prices were higher than the regulated minimum price for consumers with life expectancy less than 4.5 years.

[19] Another policy option is to simply require firms to disclose the actuarially fair price of a policy to consumers and let consumers (rather than the department of insurance) decide whether they want to sell their policy at the market price.

viatical settlements market. The evidence presented in chapter 4 (especially table 4.4) suggests that these markets are competitive and thus argues for minimal regulation.

6.2 Consumers Decisions under Uncertainty about Mortality

This dissertation also makes a contribution to the field of behavioral economics. In Chapter 5, I use data from the viatical settlements market to evaluate whether consumers can (1) accurately assess their own mortality risks; and (2) interpret the information conveyed by market prices. The empirical findings from this market-based (high-stakes) test cannot be reconciled with a straightforward economic model of savings, consumption, and bequests. Instead, the findings are consistent with two possible and mutually consistent interpretations motivated by the psychology and behavioral economics literature: (1) relatively unhealthy consumers overestimate their life expectancy and this "optimism bias" leads them to view actuarially fair viatical settlement offers more favorably than they would appear if they correctly perceived their mortality risk, and (2) consumers mistakenly believe that the discount to face value on the viatical settlement is a good approximation to the true price of the viatical settlement. Since in a competitive market the discount to face value rises with life expectancy, this mistaken view leads long-life-expectancy consumers to view actuarially fair viatical settlement offers less favorably than their unhealthier peers.

This conclusion raises the question of whether can such mistakes persist in the long run? The standard argument against persistence of consumer mistakes in the long run is that they lead to mispriced or imperfect markets that in turn create arbitrage opportunities. For example, consider the case where the price of an asset is higher than its fundamental value and that this deviation is brought about by the presence of traders who are not fully rational. This deviation from fundamental value will create an attractive opportunity for rational traders who will quickly sell their stock of this asset till its price reaches its fundamental value – resulting in losses for the irrational traders. Thus, according to this view such mistakes cannot persist in the long run as irrational traders will always lose and will be disciplined by rational traders who will immediately correct the mispricing in any competitive market.

However, Barberis and Thaler (2002) in their review of the literature on consumer mistakes in financial markets argue persuasively that while the statement "prices are right" implies "no free lunch," the converse does not necessarily hold. They argue that mispricing does not always lead to arbitrage opportunities, as strategies designed to take advantage of mispricing—especially in financial markets—can be costly or risky. The analysis presented in this dissertation adds a new dimension to this debate; I find that "prices are right" does not imply "no mistakes." In other words, irrational traders do not always lead to mispricing. In fact, the results presented in Chapter 5 are consistent with the view that despite consumer mistakes, there is no substantial mispricing in this market—the only mistakes are in consumer perceptions not in market prices. Thus, since prices are actuarially fair (firms make zero profits), such mistakes are likely to persist. In related work, Gaynor and Kleindorfer (1991) consider the sustainability of misperceptions in a model of a group or organization where agents have misperceptions about the production technology. They also find that an equilibrium with misperceptions in which misperceptions are "rational" and can be sustained.

The above discussion leads to the policy implication that consumer mistakes might be reduced if buyers in these markets are required to "decode" prices for sellers in a way that is more easily understandable. Such regulations have recently been implemented in other mortality contingent claims markets such as the reverse mortgage market. Reverse mortgage markets allow consumers to take loans against equity in their homes. The loan proceeds can be taken as an immediate cash advance or a credit line that allows one to take cash advances whenever one chooses. However, unlike normal loans, reverse mortgages are "non-recourse" loans and limit the loan repayment to the value of the house and require no repayment for as long as the borrower is alive. The amount of cash one can get from a reverse mortgage depends on the life expectancy of the borrower (homeowner), interest rates, the value of the home and its expected appreciation. Thus, just like viatical settlement markets, the true cost (*ex post*) of obtaining funds from a reverse mortgage will depend on the timing of the borrower's death—if the borrower lives well past his life expectancy then a reverse mortgage will have low costs but if he dies sooner than expected then a reverse mortgage will be expensive. Recognizing that consumers typically find it difficult to compare the costs of a reverse mortgage with other credit instruments, the Home Owner Equity Protection Act (HOEPA, 1994) subjects all reverse mortgages to a Truth-in-Lending disclosure. This provision requires lenders to project and disclose the total annual average cost of these loans if they were repaid after two years, at the borrower's life expectancy and 40% beyond the borrower's life expectancy.

The findings in this dissertation suggest that similar regulations might be beneficial for consumers in secondary life insurance markets. However, further research is needed to evaluate the extent to which such laws change the market behavior of consumers.

Appendices

Appendix A: Monte Carlo Computation of Hazard Ratios

We use Monte Carlo simulations to calculate the hazard ratios and confidence intervals reported in Table 4. Let $\mu_{est} = \begin{pmatrix} \beta_{est} \\ \lambda^0_{est} \end{pmatrix}$ be the maximum likelihood estimates of $\beta = (\beta_1, \beta_2, ...\beta_k)$ (where k is the number of covariates) and $\lambda^0 = (\lambda^0_1, \lambda^0_2, ...\lambda^0_9)$ from equation (4.3), and let $\sum_{est}$ be the estimated variance covariance matrix of •, 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:

(A1) $$hazard\ ratio_{i,k} = \frac{1}{N}\sum_{j=1}^{N}\frac{\lambda_j\left(1 \mid X_k = 1, X_{k+1} = 0, ...X_{k+m} = 0, \mu = \mu^{(i)}\right)}{\lambda_j\left(1 \mid X_k = 0, X_{k+1} = 0, ...X_{k+m} = 0, \mu = \mu^{(i)}\right)}$$

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

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

(A2) $$hazard\ ratio_{i,k} = \frac{1}{N}\sum_{j=1}^{N}\frac{\lambda_j\left(1 \mid X_k = X_k + \theta, \mu = \mu^{(i)}\right)}{\lambda_j\left(1 \mid X_k = X_k, \mu = \mu^{(i)}\right)}$$

where, • is an arbitrary offset. For the hazard ratio corresponding to age, we set • = 5 years. We repeat 10,000 iterations. Finally, we calculate the mean and standard error and confidence intervals of (A2-1)-(A2-2) over all the iterations.

Appendix B: Closed form solutions for simulations

B.1. The unregulated consumer problem

Assuming that consumption and bequest are strictly non-negative the Kuhn-Tucker for the consumer's problem are:

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

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

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

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

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

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

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 consumption and bequests are strictly non-negative then the constraint on life insurance sales is binding at the optimum.

Proof: Assume that the insurance sales constraint is non-binding ($F<\bar{F}$ and $\lambda_3=0$). Notice that $\lambda_3=0$ and equation (B3) imply $B_D=B_s$. Solving $B_D=B_s$ for *F* yields:

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

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

Also notice that $F=\bar{F}$ and $B_D>0$ implies that constraint on first period consumption (equation (B4)) is non-binding. Similarly $F=\bar{F}$ and $B_S>0$ implies that constraint of second period consumption (equation (B5)) is non-binding. Therefore at an optimum where consumption and bequests are strictly non-negative $\lambda_1=0,\lambda_2=0$ and $\lambda_3>0$ and the Kuhn-Tucker conditions for this case reduce to:

(B8) $U'(C_1)-(1+r)\beta(\pi V'(B_D)+(1-\pi)V'(B_s))=0$

(B9) $\beta(1-\pi)\left(U'(C_2)-V'(B_s)\right)=0$

(B10) $\overline{F}=F$

(B11) $\left(V'(B_s)-V'(B_D)\right)>0$

(B12) $W+P_1F-C_1>0$

(B13) $\left(W+P_1F-C_1\right)(1+r)+P_2(\overline{F}-F)-C_2>0$

To obtain closed form solutions, we assume $U(C)=\ln C$ and $V(B)=\alpha\ln B$. Solving equations (B8) to (B10) for C_1, C_2 and F yeilds the following possible solutions.

Solution A

(B14) $C_{1A}^{*}=\dfrac{-A2+\sqrt{A2^2-4A2A3}}{2*A1}$

(B15) $C_{2A}^{*}=\dfrac{1+r}{1+\alpha}\left(W+P_1\overline{F}-C_{1A}^{*}\right)$

(B16) $F_A^{*}=\overline{F}$

Solution B

(B17) $C_{1B}^{*}=\dfrac{-A2-\sqrt{A2^2-4A2A3}}{2*A1}$

(B18) $C_{2B}^{*}=\dfrac{1+r}{1+\alpha}\left(W+P_1\overline{F}-C_{1B}^{*}\right)$

(B19) $F_A^{*}=\overline{F}$

where,

(B20) $A1=(1+r)^2\left(1+\beta(1+\alpha-\pi)\right)$

(B21) $A2=(-1)(1+r)\left(W+P_1\overline{F}\right)\left(2+\beta(1+\alpha-\pi)\right)$

(B22) $A3=\left(W+P_1\overline{F}\right)^2$

Finally we choose as the optimum the solution that satisfies the remaining Kuhn-Tucker conditions (equations B11 to B13) and which yields strictly non-negative values for consumption and bequests. Inputting the optimal solution values in the expected utility function (equation (5)) yields the indirect utility function $EU_{nc}^{*}(W)$

B.2 The regulated consumer problem

Assuming that consumption and bequest are strictly non-negative the Kuhn-Tucker for the consumer's problem in the regulated case $(F=0)$ are:

(B23) $U'(C_1)-(1+r)\beta(\pi V'(B_D)+(1-\pi)V'(B_s))-\lambda_1-(1+r)\lambda_2=0$

(B24) $\beta(1-\pi)(U'(C_2)-V'(B_s))-\lambda_2=0$

(B25) $W-C_1\geq 0 \quad \text{if } >, \lambda_1=0$

(B26) $(W-C_1)(1+r)+P_2\overline{F}-C_2\geq 0 \quad \text{if } >, \lambda_2=0$

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 $(\lambda_1=0,\lambda_2=0)$. However, notice that $B_s>0$ implies that the constraint for second period consumption is non-binding therefore $\lambda_2=0$. In the following section we derive the closed form solutions for the remaining two solutions for the Kuhn-Tucker conditions

Case 1 $(\lambda_1=0,\lambda_2=0)$: Constraints on first period consumption (B25) and second period consumption (B26) are non-binding at the optimum.

Again to obtain closed form solutions, we assume $U(C)=\ln C$ and $V(B)=\alpha\ln B$. Solving equations (B23) and (B24) for C_1 and C_2 yields the following possible solutions.

Solution A

(B27) $$C_{1A}^{*}=\frac{-A2+\sqrt{A2^2-4A2A3}}{2*A1}$$

(B28) $$C_{2A}^{*}=\frac{1+r}{1+\alpha}\left(W+\frac{\overline{F}}{(1+r)^2}-C_{1A}^{*}\right)$$

Solution B

(B29) $$C_{1B}^{*}=\frac{-A2-\sqrt{A2^2-4A2A3}}{2*A1}$$

(B30) $C_{2B}^{*}=\frac{1+r}{1+\alpha}\left(W+\frac{\overline{F}}{(1+r)^{2}}-C_{1B}^{*}\right)$

where,

(B31) $A1=(1+r)^{2}\left(1+\beta(1+\alpha-\pi)\right)$

(B32) $A2=(-1)(1+r)\left(W+P_{1}\overline{F}\right)\left(2+\beta(1+\alpha-\pi)\right)$

$$A3=(\pi\beta\alpha)\left(W(1+r)+\frac{\overline{F}}{1+r}\right)+\beta(1+\alpha)(1-\pi)\left(W(1+r)+\overline{F}\right)-\left(2(1+r)^{2}W+\overline{F}(2+r)\right)$$

We choose as the optimum the solution that satisfies the remaining Kuhn-Tucker conditions (equations B25 and B26) and which yields strictly non-negative values for consumption and bequests. If none of the above solutions satisfy the Kuhn-Tucker conditions then we consider the remaining solution described in case 2 below.

Case $2(\lambda_1>0,\lambda_2=0)$: Constraints on first period consumption (B25) is binding and constraint on second period consumption (B26) is non-binding at the optimum.

Assuming that consumption and bequest are strictly non-negative the Kuhn-Tucker for this case are:

(B33) $\beta(1-\pi)\left(U'(C_2)-V'(B_s)\right)=0$

(B34) $W-C_1=0$

(B35) $U'(C_1)-(1+r)\beta\left(\pi V'(B_D)+(1-\pi)V'(B_s)\right)>0$

(B36) $(W-C_1)(1+r)+P_2\overline{F}-C_2>0$

Solving (B34) and B(35) for C_1 and C_2 yields the following possible solution

Solution C

(B37) $C_{1C}^{*}=W$

(B38) $C_{2C}^{*}=\left(\frac{\overline{F}}{(1+r)(1+\alpha)}\right)$

If *solution C* satisfies the remaining Kuhn-Tucker conditions (B36) and B(37) then *solution C* is the optimum. Inputting the optimal solution values in the expected utility function yields the indirect utility function $EU_c^*(W)$.

Finally for each simulation we measure the welfare loss γ by numerically solving the following equation.

(B39) $EU_c^*(W+\gamma) = EU_{nc}^*(W)$

Appendix C: Deriving the Comparative-Statics for the Economic Model

The first order conditions from expected utility maximization are:

(C1) $U'(C_1) = \beta(1+r)[(\pi)V'(B_D) + (1-\pi)V'(B_S)]$

(C2) $U'(C_2) = V'(B_S)$

(C3) $V'(B_D) = V'(B_S)$

Rearranging terms and simplifying yields:

(C4) $U'(C_1) = \beta(1+r)V'(B_D)$

(C5) $U'(C_2) = V'(B_D)$

(C6) $C_2 = L_2 - (\bar{F} - F)\left(\frac{r}{1+r}\right)$ as $\left[V'(B_D) = V'(B_S) \Rightarrow B_D = B_S\right]$

C1.1 Comparative Statics w.r.t. π

Totally differentiating (C4), (C5) and (C6) and setting changes in all exogenous parameters except mortality risks equal to zero implies:

(C7) $\left[U''(C_1) + (1+r)^2 \beta V''(B_D)\right]dC_1 + \left[r(1-\pi)\beta V''(B_D)\right]dF = \left[rF\beta V''(B_D)\right]d\pi$

(C8) $\left[(1+r)V''(B_D)\right]dC_1 + \left[\left(\frac{r}{1+r}\right)U''(C_2) + \left(\frac{r}{1+r}\right)(1-\pi)V''(B_D)\right]dF = \left[\left(\frac{r}{1+r}\right)FV''(B_D)\right]d\pi$

Solving (C7) and (C8) with respect to the endogenous variables yields:

(C9) $$\frac{dF}{d\pi} = \frac{U''(C_1)V''(B_D)F\left(\frac{r}{1+r}\right)}{U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right) + U''(C_1)V''(B_D)(1-\pi)\left(\frac{r}{1+r}\right) + V''(B_D)U''(C_2)\beta r(1+r)}$$

(C10) $$\frac{dC_1}{d\pi} = \frac{U''(C_2)V''(B_D)F\beta\left(\frac{r^2}{1+r}\right)}{U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right) + U''(C_1)V''(B_D)(1-\pi)\left(\frac{r}{1+r}\right) + V''(B_D)U''(C_2)\beta r(1+r)}$$

C1.2 Comparative Statics w.r.t. NL

Totally differentiating (C4), (C5) and (C6) and setting changes in all exogenous parameters except NL equal to zero implies:

(C11) $$\left[U''(C_1)+(1+r)^2\beta V''(B_D)\right]dC_1+\left[r(1-\pi)\beta V''(B_D)\right]dF=\left[(1+r)\beta V''(B_D)\right]dNL$$

(C12) $$\left[(1+r)V''(B_D)\right]dC_1+\left[\left(\frac{r}{1+r}\right)U''(C_2)+\left(\frac{r}{1+r}\right)(1-\pi)V''(B_D)\right]dF=\left[\left(\frac{r}{1+r}\right)U''(C_2)+V''(B_D)\right]dNL$$

Solving (C11) and (C12) with respect to the endogenous variables yields:

(C13) $$\frac{dF}{dNL}=\frac{U''(C_1)V''(B_D)+U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right)+V''(B_D)U''(C_2)\beta r(1+r)}{U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right)+U''(C_1)V''(B_D)(1-\pi)\left(\frac{r}{1+r}\right)+V''(B_D)U''(C_2)\beta r(1+r)}$$

(C14) $$\frac{dC_1}{dNL}=\frac{V''(B_D)U''(C_2)\beta\left(\frac{r}{1+r}\right)(1+\pi r)}{U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right)+U''(C_1)V''(B_D)(1-\pi)\left(\frac{r}{1+r}\right)+V''(B_D)U''(C_2)\beta r(1+r)}$$

C1.3 Comparative Statics w.r.t. L_1

Totally differentiating (C4), (C5) and (C6) and setting changes in all exogenous parameters except L_1 equal to zero implies:

(C15) $$\left[U''(C_1)+(1+r)^2\beta V''(B_D)\right]dC_1+\left[r(1-\pi)\beta V''(B_D)\right]dF=\left[(1+r)^2\beta V''(B_D)\right]dL_1$$

(C16) $$\left[(1+r)V''(B_D)\right]dC_1+\left[\left(\frac{r}{1+r}\right)U''(C_2)+\left(\frac{r}{1+r}\right)(1-\pi)V''(B_D)\right]dF=\left[(1+r)V''(B_D)\right]dL_1$$

Solving (C15) and (C16) with respect to the endogenous variables yields:

(C17) $$\frac{dF}{dL_1} = \frac{U''(C_1)V''(B_D)(1+r)}{U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right) + U''(C_1)V''(B_D)(1-\pi)\left(\frac{r}{1+r}\right) + V''(B_D)U''(C_2)\beta r(1+r)}$$

(C18) $$\frac{dC_1}{dL_1} = \frac{U''(C_2)V''(B_D)\beta r(1+r)}{U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right) + U''(C_1)V''(B_D)(1-\pi)\left(\frac{r}{1+r}\right) + V''(B_D)U''(C_2)\beta r(1+r)}$$

C1.4 Comparative Statics w.r.t. L_2

Totally differentiating (C4), (C5) and (C6) and setting changes in all exogenous parameters except L_2 equal to zero implies:

(C19) $$\left[U''(C_1) + (1+r)^2 \beta V''(B_D)\right]dC_1 + \left[r(1-\pi)\beta V''(B_D)\right]dF = [0]dL_2$$

(C20) $$\left[(1+r)V''(B_D)\right]dC_1 + \left[\left(\frac{r}{1+r}\right)U''(C_2) + \left(\frac{r}{1+r}\right)(1-\pi)V''(B_D)\right]dF = \left[-U''(C_2)\right]dL_2$$

Solving (19) and (20) with respect to the endogenous variables yields:

(C21) $$\frac{dF}{dL_2} = -\frac{U''(C_1)U''(C_2) + (1+r)^2 \beta V''(B_D)U''(C_2)}{U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right) + U''(C_1)V''(B_D)(1-\pi)\left(\frac{r}{1+r}\right) + V''(B_D)U''(C_2)\beta r(1+r)}$$

(C22) $$\frac{dC_1}{dL_2} = \frac{U''(C_2)V''(B_D)\beta r(1-\pi)}{U''(C_1)U''(C_2)\left(\frac{r}{1+r}\right) + U''(C_1)V''(B_D)(1-\pi)\left(\frac{r}{1+r}\right) + V''(B_D)U''(C_2)\beta r(1+r)}$$

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