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AN ECONOMIC ANALYSIS OF LIFE CARE

Jonathan S. Feinstein

Edward G. Keating

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ABSTRACT

Life care communities offer long term care to the elderly in the context of a residential community. Residents move into a life care community while still relatively young (though typically past age 65), initially occupying an independent living unit situated in a living complex similar to a retirement community. Later, when a resident requires more intensive care, she moves to an on-site nursing facility.

We present an economic analysis of the life care industry. Our model includes a detailed specification of elderly couples' utility, a description of elderly morbidity and mortality experiences, and a formulation of the life care contract. Using extensive computer simulations we show that life care offers two main advantages to elderly as compared with stand-alone nursing homes: (i) reduced mobility costs and nearness to spouse and friends when sick; and (ii) insurance, linked to a rebate paid to the couple's heirs. We also investigate regulation of life care and the effects stemming from the risk of operator bankruptcy.

Jonathan S. Feinstein
Yale School of Organization
and Management
Yale University
Box 1A
New Haven, CT 06520
and NBER

Edward J. Keating
The RAND Corporation
1700 Main Street
P.O. Box 2138
Santa Monica, CA 90406-2138

Section 1: Introduction

The costs of long term care for the elderly have increased sharply in recent years, and are projected to continue to increase over the next several decades, as the elderly become a larger proportion of the total United States population. While stand alone nursing homes continue to be the most common choice for long term care, several new care arrangements have begun to gain prominence. One of these is life care; see for example Prosper (1985). Residents move into a life care community while still relatively young (though typically past age 65) and still healthy, initially occupying an independent living unit situated in a living complex reminiscent of a retirement community. Later, when a resident requires more intensive care, he or she moves to an on-site nursing facility; because the nursing facility is located next to the independent living units, the psychic cost of moving to the facility is likely to be low and the resident's spouse (if alive) and other friends remain nearby.

In this paper we present an economic analysis of life care. Our model of life care includes a description of household behavior and of the life care living arrangement which captures the benefits of life care described above, low moving costs and nearness to spouse. The model also includes a specification of the costs of supplying life care, the characteristics of the elderly population likely to be interested in life care, and a formulation of the life care contract which emphasizes a variety of financial considerations introduced below and returned to throughout the paper. The complete model turns out to be quite complex, so we rely almost entirely on computer simulations to analyze it, using these simulations to gain insight into life care industry performance and regulation.

Our analysis suggests three broad conclusions about life care. First, we find that life care can provide important benefits to the elderly, including not only those mentioned above which derive from living arrangments, but also other benefits related to insurance, which we discuss at length later in the paper. Thus reasonable parameterizations of elderly utility and health experience indicate that life care can provide a consumer surplus of anywhere from \$20,000 to \$80,000 to a typical elderly couple of age 65 faced with the alternative of remaining in their own home and entering a stand-alone nursing home when necessary. Second, our "base case" simulations suggest that the life care contract offered by a profit-maximizing operator will charge residents a substantial monthly fee, and offer a large rebate to the elderly person's estate upon the elderly person's death. Finally, and in contast to our second finding, when we introduce even a modest risk of operator bankruptcy into the model, a modification which is consistent with the history of life care reviewed in the next section, we find that the equilibrium contract involves a substantially smaller rebate, and resembles actual life care contractual terms reasonably closely.

Our model is constructed from three basic components: a specification of elderly couples' utility functions; a description of elderly morbidity and mortality experiences; and a formulation of the life care contract. We assume that an elderly couple's utility is the sum of each elderly person's lifetime utility plus a term which depends upon the size of the bequest left to the couple's heirs. In computing lifetime utility we assume that at any given time a person may be in one of two states, health or sickness, and that when sick a person earns lower utility and must stay in a nursing home. Our definition of utility includes several terms meant to capture the benefits of residence in a life care community. One set of terms refers to the psychic costs of moving, including both the costs of moving from one's own home to a life care community initially and the costs of moving to a nursing home at any later date, with the costs of moving to a life care community's nursing home assumed to be lower than the costs of moving to a stand alone nursing facility. A second set pertains to a spouse's status and location; thus for example we assume that utility is lower if a person's spouse has died, and that when one member of a couple is sick and residing in a nursing home, both members of the couple earn higher utility if they live in a life care community than if not.

Much of the complexity of our model derives from the fact that we must track a person's health status from the age of 65 until death, so as to be able to estimate a couple's expected lifetime utility as of age 65, and in particular so as to determine how this utility depends upon whether or not the couple joins a life care community. We describe health status by means of a simple probability model, and, as part of this specification, we also specify probability distributions for the duration of nursing home spells and for nursing home discharge status. In developing our model of health status, we rely on several published studies of nursing home entry, utilization, and discharge statistics, most especially data from the *National Nursing Home Survey* and from a study by Cohen, Tell, and Wallack (1988).

Although our model of the elderly is rather complex, it is far simpler than reality. In particular, in our model an elderly couple makes only a single decision, whether or not to join a life care community at age 65; were we to extend the model to include other decisions, such as those about consumption and savings, it would become intractable.

The third building block of our model is the life care contract. If a life care contract were to cover all possible future contingencies and provide optimal risk-sharing between an elderly couple and a life care operator, it would be quite complex, even under the simplifying assumptions of our model. In section 4 we discuss the form such a complete contract might take, but point out that "real world" contracts are much simpler than this and are incomplete, in the sense of Williamson (1985) and Grossman and Hart (1986). For our formal analysis we rely on a simple contract, similar to many we have encountered in actual life care communities, which specifies four fundamental numbers: an entry fee; a daily fee levied as long as a person is alive and residing in the life care community; a supplemental fee levied each day a person resides in the community's nursing facility; and a rebate parameter, which determines how much money will be returned to a couple's (or single person's) estate when the last surviving member of the couple (or the person) dies.

We use our model of household behavior and life care contracting to address several substantive issues. First, we determine the contractual terms which will be set by a profit maximizing life care operator who is a monopolist. We find that the profit maximization solution entails setting high daily fees (well above marginal cost), a low entry fee (to attain large market share), and a large rebate. The high daily fee is similar to what we observe in actual life care contracts, but the entry fee is somewhat lower and the percentage rebate considerably higher than we observe. In interpreting these results, we emphasize that by setting high daily fees the life care contract indirectly provides insurance to the elderly. In particular, the daily fee is set approximately equal to the average daily income of the elderly, so that the total size of their bequest will not be affected by the length of their life. In turn, the fact that the daily fee is so high leads to a large rebate as a way for the life care operator to offer sufficient inducement for prospective residents to join the life care facility. Next we determine the contractual terms which maximize consumer surplus. As compared with the terms which maximize operator profit, the contract which maximizes consumer surplus involves even higher daily fees and a higher rebate parameter; under these contractual terms, the entire elderly population joins the life care facility, earning substantial benefits. Of course, a contract in which the operator promises a large rebate may leave the elderly quite vulnerable if the operator is at risk of declaring bankruptcy, so we explore the implications of bankruptcy risk in section 5. We find that introducing bankruptcy into the model substantially lowers the rebate offered by a profit-maximizing monopolist, bringing our results quite close to the terms set in actual life care contracts; however, bankruptcy also eliminates most of the benefit to consumers (and market share) of life care.

Our analysis represents the first formal analysis of life care using the standard tools of economics. The most extensive earlier analysis is by Winklevoss and Powell (1984), who adapt traditional financial accounting and insurance methods to the life care context. There have been several insightful empirical studies of life care in the last few years, including studies by Bishop (1988) and Cohen, Tell, and Wallack (1988) on nursing home utilization within life care communities, and further work by Bishop (1985) on the cost of life care, with special focus on the variability in costs across different life care communities. We view these earlier studies as complementary to our own.

The remainder of our paper is organized as follows. Section 2 briefly describes the history and current status of the life care industry, including current regulatory practices. Section 3 presents our model of household behavior. Section 4 presents our analysis of life care contracts, the derivation of the contractual terms which maximize operator profits, and the derivation of the contract terms which maximize consumer surplus. Section 5 presents the results of the computer analysis of our basic model. Section 6 discusses a few relevant extensions of the basic model, especially bankruptcy, and section 7 concludes the body of the paper. Two appendices provide further information about our data sources and computer program.

Section 2: Description of the Life Care Industry

The life care communities originated early in the Twentieth Century when certain religious and fraternal organizations sought ways to offer stable retirement experiences and basic health services to their members. Since that time the number of communities has steadily increased, growing to somewhere between 500 and 1,000 communities by 1990; concurrently, the number of persons residing in life care communities has also grown, reaching several hundred thousand by 1990, or between $\frac{1}{2}$ and 1 percent of all individuals in the United States over the age of 65. Historically, the life care industry was dominated by non-profit providers. In recent years, however, most entrants have been for-profits, including several large national firms which manage (though they have not necessarily built) numerous communities around the country; we believe that for the life care industry to continue to grow and to emerge as an important living alternative for older persons, for-profits must play a key role. Accordingly, in this paper we restrict our attention to the analysis of for-profit operators.

Cypress Point is a proposed life care community in California which is representative of many recent for-profit communities.[1] When completed, the community will include 100 independent living units, designed for healthy couples and single persons, 15 assisted care units, and 29 beds in an on-site skilled nursing facility. Cypress Point is located on desirable beach front property in Santa Barbara, and features many amenities intended to provide a high quality of life to healthy elderly persons. According to documents on file at the California State Office of Life Care, residents will be expected to pay a $500,000 entry fee to purchase an independent living unit, monthly fees of between $1300 and $2800 for maintenance and upkeep of the grounds, and, in addition, some fraction of the costs of nursing care they receive while living in an assisted living unit or the on-site nursing facility. Based on these figures, we believe that the monthly fees are well above the marginal cost of supplying services to healthy residents, but that the supplemental nursing care fees are below marginal cost. Cypress Point's proposed life care contract also offers a rebate to a couple's (or individual person's) heirs upon the death of the last surviving member of the couple (or, for a single person, upon the death of that person), equal to 80% of the original entry fee plus 20% of any capital gains accruing on the resale of the couple's membership (which includes the couple's independent living unit). Though this rebate is substantial, it is calculated in nominal terms, and therefore, when inflation is taken into account, is likely to be well below the real value of the couple's initial entry fee; for example, if inflation were to be 3% a year and the couple's longest surviving member were to die 20 years after the couple joins the community, with nominal appreciation but no real appreciation of the membership price, the rebate would be worth 53% of the original fee in real terms.[2]

Our review of the files of approximately 6 other California life care for-profit communities, and of background literature describing some 20 other facilities in the state, suggests that Cypress Point's financial charges are typical of recent for-profit communities, but well above the charges at most older, non-profit communities. In particular, at recently constructed for-profits entry fees and monthly fees tend to be high and nursing care fees low; rebates are normally expressed in terms of two numbers, the first being the fraction of the original sales price which will be returned to the couple's estate – this fraction tends to be high but below 1 – and the second being the fraction of any capital gains appreciation which will be awarded to the estate – a fraction which tends to be small.

Although the life care industry has grown since its inception, it has not been without its trials and tribulations, most of which have involved operator fraud and bankruptcy. The experiences of New York and California illustrate some of these problems. During the early 1960's New York encouraged the construction of life care communities. Unfortunately, several communities proposed and approved by the State were run by fraudulent operators, who absconded with prospective residents' deposits (monies which had been paid to the operators while the communities were still under construction in order to reserve a membership in the proposed community), leaving some elderly persons destitute. New York State responded by outlawing life care communities, making it illegal for residents to sign any contract for nursing home or long-term care which extended beyond a one year time horizon. Recently, however, New York has moved to reinstitute life care, hoping to control potential fraud or financial mismanagement with comprehensive regulation.[3]

Life care has never been outlawed in California. However, during the 1960's and 1970's several communities in the State experienced financial difficulties, and in 1977 a large non-profit life care community went bankrupt, turning more than 1,000 residents out on the streets to fend for themselves, without financial compensation. In response, California has gradually established a more rigorous regulatory system, including a comprehensive body of new regulatory statutes which went into effect in January of 1991, and a separate Office of Life Care Regulation.

In an effort to understand how states have responded to the potential problems associated with life care, we have examined regulatory statutes and procedures at California, New York, and Minnesota (we have also briefly discussed these issues with regulators in Arizona, Florida, and Illinois).[4] In all three states a large proportion of regulatory attention focuses on financial oversight of life care operators, in order to guard against fraud, mismanagement, and bankruptcy.[5] However, the states differ in the specific financial requirements they impose on an operator.[6] In contrast to financial regulation, several other aspects of life care community operation generally receive less scrutiny from these states' regulators, though the degree of scrutiny differs across the states. Thus life care nursing facilities are normally subject only to a state's general nursing home regulations; while enforcement of these regulations may be sufficient to ensure adequate quality of care at life care nursing homes, they are not sufficient to address certain other subtleties regarding nursing home care which are specific to life care communities. One such subtley is the issue of how close a life care community's nursing home must be to its independent living units; because this issue is not addressed in California's regulations, some life care facilities in that state have not built on-site nursing facilities, but instead have contracted with nearby off-site stand alone nursing homes for services. A second aspect of life care operation which has thus far received little attention from some state regulators is the terms on which a life care contract can be terminated by the operator; in some states, such as California, it is current practice for life care contracts to contain a clause stating that the operator can ask a resident to leave under certain conditions, such as if the resident is diagnosed with Alzheimer's Disease.

We believe regulation of the life care industry could be improved; hence one important motivation for our work is to propose and compare some alternative regulatory policies, a task we begin to address later in this paper.

Section 3: Model of the Household

In this section we describe our model of the household, which lies at the heart of our analysis of life care. The model follows an elderly couple from the age of 65 to the death of the last surviving member. Within this context, the model focuses on a single decision, which the couple must make at age 65: whether to enter a life care facility, or remain in its own home. This decision depends on a careful assessment of the costs and benefits of each option, which in turn requires a specification of several aspects of the couple's future life history. We specify a model of life experience which is rich enough to capture the main factors affecting this calculation, but which is simple enough to be tractable for computer analysis.

In what follows we first briefly discuss the model in qualitative terms, drawing attention to those aspects of life experience which we do include and those which we omit in the interests of simplification. We then provide a more detailed and formal presentation of the model, together with the numerical parameterizations which we have chosen for our computer simulations.

Our model of the household focuses attention on three main issues: (i) morbidity and mortality; (ii) moving costs; and (iii) bequests. Issues related to morbidity and mortality enter our model in two main ways. First, morbidity affects utility. In particular, we assume that an individual accrues less utility from one year of sick life than from one year of healthy life, and that an individual's utility is lower if his or her spouse is sick or dead.[7] Second, we provide a relatively detailed characterization of the risk of illness and an associated nursing home spell, and of the risk of death. Our characterization specifies a probability distribution referring to the chances that a given individual becomes sick and requires nursing home care, as a function of the individual's age and prior health history. We also specify probability distributions specifying the length of each nursing home spell, the given individual's status upon discharge from a nursing home, and the individuals's likelihood of a relapse and readmission in the future; all of these probabilities are a function of the individual's age, sex, and prior history. Finally, we specify the risk of death, as a function of age and sex.

In incorporating moving costs into our model we follow a large body of empirical research which has shown that moving imposes a considerable burden on an elderly person, especially when he or she is sick. Our model includes two different kinds of moves, for both of which we specify costs. The first kind is the move an elderly person makes to a nursing home when sick. We distinguish between the financial cost of such a move and the psychic cost (related to stress), and assume that both kinds of costs are lower inside a life care facility, where the nursing home is adjacent to the individual's domicile, than in the general community. The second kind of move is a couple's initial move to a life care facility, which we assume also involves both financial and psychic costs. Since the members of the couple are both in reasonable health when they make this move, we assume the costs involved are lower than those associated with a move to a nursing home. However, we note that although the costs associated with this kind of move are low, they have as large an impact on elderly decision-making as those associated with moves to a nursing home, because the move to a life care facility is made during the first period of our model whereas moves to a nursing home are typically made many years later and are therefore significantly discounted.[8]

The bequest motive is the third major component of our specification of household utility. We assume the elderly couple's overall utility to be the sum of two components: the couple's lifetime utility; and a nonlinear function of the size of the bequest the couple leaves to its heirs.[9] Further, we assume that (except for bankruptcy risks which have little effect in our model) financial expenditures enter utility only through the size of the bequest. Thus in our formulation the elderly consume a fixed consumption bundle each period they are alive, which does not vary across persons or by health status and does not enter explicitly into our model.

As our discussion of bequests indicates, there are many aspects of household decision-making which we do not include in our model. Most importantly, we do not allow the household to make any consumption (and savings) decisions, despite the fact that such decisions are commonplace, have been the subject of a large economics literature (see Hurd (1990) for a general review in the context of the elderly), and undoubtedly do interact with the decision whether to enter a life care facility. In addition, we do not allow elderly persons to choose whether or not to enter a nursing home when sick, but instead simply assume that when an elderly person falls into what we call the "sick" state, he or she must enter a nursing home. Though empirical evidence on the decision to enter or exit from a nursing home is sparse, it seems likely that elderly do have some latitude about this (see Garber and MaCurdy (1991) for some evidence of this); again, therefore, it would be better to be able to incorporate such decision-making into our model.

The reason we do not include these different decisions in our model is complexity. Even as specified, our model turns out to be extremely complex, involving each elderly person in the consideration of a large number of hypothetical future life paths, which differ from one another in the timing and duration of illness, and age at death, and each of which has slightly different implications for the decision whether or not to enter a life care community. In fact, we are able to solve our model only by means of computer intensive Monte Carlo simulations. Were we to include further kinds of decision-making, such as those described above, our model would be transformed from one in which the household makes a single decision in period 1 (at age 65), into an intractable dynamic programming problem involving many subsequent decisions in addition to the original decision; we do not believe such a model could be solved in any reasonable fashion with the kinds of computer resources we have available.

Formal Model Development and Parameterization

Consider a married couple of age 65. The couple must decide whether to enter a life care community or remain in their own home. If the couple chooses to enter the life care facility, both members remain at the facility for the rest of their lives; in contrast, if the couple chooses to remain living in its own home, neither member can enter a life care facility in the future. The couple chooses whichever of these two options offers a higher discounted expected utility. As discussed above, utility depends both on the life experiences of each member of the couple and on the size of bequest which the last surviving member leaves to his or her heirs. We now describe in greater detail the life experiences of each member of the couple, the couple's financial situation and bequest, and our parameterization of the utility function.

On each day in which an individual remains alive he or she is in one of two states, either health or sickness. We assume that when an individual is sick he or she requires skilled nursing care, and must reside in a nursing home; as discussed above, the need for nursing care is not subject to individual discretion or choice. We also assume that the individual faces the same risks of sickness and death, described below, whether living at home or in the life care community. Thus we do not allow for the possibility that residence in a life care facility improves (or worsens) health, and we do not address the differences between stand-alone nursing homes and life care community nursing facilities in admissions criteria.

As currently operated, life care communities in the United States typically screen all applicants for significant illness or limitations of daily living. Hence it is a reasonable supposition that no couple one or both of whose members are sick (as we define it) at age 65 is eligible for admission into the life care community. Nonetheless, we believe there are important heterogeneities in health status amongst potential life care admits. To capture these heterogeneities, we assume that each member of the couple possesses an initial health status which is either "good" or "poor", where poor status indicates an individual capable of independent living at present, but at higher than average risk of becoming sick in the future (this notion is made more precise shortly). We assume that the husband's health status is uncorrelated with the wife's status, and that each individual has a 50% chance of being in poor health and realizing this fact, and an additional 5% chance of being in poor health but believing himself to be in good health. Initial health status is unobservable to the life care operator.

We now describe the most complex part of our model, which is our specification of the transition probabilities governing each individual's movements into and out of the states of health and sickness, and into the state of death.

Consider an individual who is either (i) age 65; or (ii) of a more advanced age and has been healthy at the end of the preceding year (if the individual has been sick at the end of the preceding year, he or she has been in a nursing home, in which case his or her transitions to a new state are governed by the nursing home length-of-stay and discharge probabilities discussed below). This individual has some probability of becoming sick, which in our model is equivalent to the probability of entering a nursing home. Table 1 depicts what we will call the baseline probability of sickness and nursing home entry, as a function of the individual's age; this probability begins at .0158 at age 65 and rises monotonically to .11 by age 90 and above. For this table and all following tables, appendix .1 describes our sources in more detail; here we simply note that the probability of entry into a nursing home does not depend on sex.

Certain individuals face an elevated risk of becoming sick and entering a nursing home. Table 2 lists the factors which lead to an elevated risk, and, for each factor, a number (the multiplier) by which the baseline probability (at the relevant age) is multiplied. Amongst the factors we include are poor initial health status (multiplies the baseline by 1.88), a prior nursing home admission (multiplies the baseline by 2.0), having been widowed (multiplies the baseline by 1.3), having been widowed recently (multiplies the baseline by 2.0), and certain combinations of these factors (each of which multiplies the baseline by more than 2.0).

An individual who is either of age 65 or has been healthy in the preceding year also faces a risk of death. Table 3 lists these probabilities, as a function of both age and sex. We note that the risk of death does not depend on initial health status or other risk factors. An individual who neither becomes sick nor dies remains healthy throughout the given year.

Once an individual becomes sick, he or she moves to a nursing home, incurring a moving cost, and facing a variable length-of-stay and uncertainty about discharge status. For now, we postpone our description of moving costs, so as to be able to present these in the context of our discussion of the form and parameterization of the couple's utility function, and instead focus our attention on the probability distributions governing length-of-stay and discharge status.

In order to facilitate our computer analysis, we assume that there are a discrete number of possible lengths-of-stay (lengths-of-illness) facing an individual once he or she becomes sick and enters a nursing home: 14 days, 40 days, 120 days, 240 days, 2 years, 3 and $\frac{1}{2}$ years, and seven years; these lengths-of-stay are similar to those recorded in the Center for Disease Control's **National Nursing Home Survey** (1990) discharge statistics, and provide a reasonable characterization of the heterogeneity in stays facing nursing home admits. In addition to facing uncertainty over his or her length-of-stay, the patient also faces uncertainty over his or her discharge status. In the simplest characterization (which we modify below), the patient may be discharged either alive or dead. Hence overall the patient faces 14 possible outcomes when he or she enters a nursing home: a stay of 14 days with a live discharge, a stay of 14 days with death at the end of the stay, and so on. Table 4 displays the probability associated with each of these possible pairs of length-of-stay outcome and discharge status, as a function of the patient's age and sex; as this table makes clear, for most age and sex categories the relative likelihood of a live discharge, as opposed to death, diminishes as a patient's length-of-stay increases.

A careful inspection of nursing home records shows that many live discharges face a substantial risk of immediate death or relapse: many live discharges go directly to a hospital and die shortly thereafter, while others simply transfer to a new nursing home.[10] To reflect these facts, we introduce two further steps into our description of nursing home discharge status. First, we allow for the possibility that a live discharge may suffer "rapid death." Table 5 lists this probability of rapid death (conditional on a live discharge), as a function of the patient's length-of-stay (we have not found any readily interpretable sources which would indicate that this probability depends on age or sex). Second, we assume that, conditional on having been discharged alive and having escaped rapid death, an individual faces a .1 probability of immediate readmission into a nursing home; in the case in which the individual resides in the life care community we simply assume that the individual is readmitted into the same nursing home from which he or she just departed (that is, the life care nursing facility), while in the case in which the individual resides in the general community we do not specify which nursing home he or she moves to.

We have now completed our description of the risk of sickness and nursing home entry in a given year, and of the possible lengths-of-stay and outcomes of a nursing home spell. Figure 1 depicts the logic of our argument, as it pertains to a couple, in terms of a probability tree (or flowchart) which shows the different possible states of health and sickness each member of the couple can experience in a typical year.

Much of the complexity of our model derives from the fact that a full analysis of a person (or a couple) must link many years together into a complete life history, with the risk of sickness and the flowchart depicted in figure 1 recurring in each year in which an individual is alive. The resulting analysis involves a probability tree for a couple which contains approximately 2^{30} different possible life paths or final endpoints, which differ from one another in terms of the timing, duration, and outcome of ill health. To further emphasize the richness of tree, tables 6a and 6b provide examples of two sample life histories. In the first life history the wife spends 40 days in a nursing home in year 1 and is discharged alive, the husband spends 14 days in a nursing home in year 2 and dies, the wife experiences additional nursing home spells in years 3, 14, 25, and 27, and dies on discharge in year 27 at age 91. In the second life history the wife experiences a 7 year nursing home spell beginning in year 8 and is dead on discharge, while the husband experiences a 7 year nursing home spell beginning in year 17, a 40 day spell in year 25, and another 40 day spell in year 28, from which he is discharged dead. In reviewing these life histories it is important to bear in mind that each represents only a single path through the probability tree facing a couple at age 65, and that the complete tree which a couple must analyze to determine whether or not to join a life care community consists of very many such paths.

In conclusion, we make two final points about our model of life histories. First, because the probability of sickness depends on a person's age and history, the probabilities which "hang" on a couple's complete probability tree change from year to year and branch to branch - hence for many parts of the tree (such as those pertaining to probability of sickness or length-of-stay outcomes), two successive branches will, in general, possess different probabilities, which suggests that it is not possible analytically to simplify the full branching structure, so that a correct analysis must work with the entire tree. Second, our formal analysis must take into account two possibilities which we have not fully discussed above. One possibility is that an individual will experience multiple nursing home spells in a given year, a situation which arises in our model when an individual is discharged alive from a first nursing home stay but falls into the category "immediate readmission". The other is the existence of spells which extend over the end of one year and into the beginning of the next; we note that our model assumes that individuals who experience such spells are not eligible for a new nursing home spell in this second year, except when they are discharged into the category "immediate readmission", as just described.

We now describe that part of a couple's utility which derives from the couple's life experiences, and which we call lifetime utility; we discuss the second part of utility, which relates to the bequest, below. The couple's lifetime utility is the discounted sum of the utilities accruing in each year in which at least one member of the couple is alive. We determine utility in each year in two steps, first specifying baseline levels of utility corresponding to the states of health and sickness, and then adding and subtracting values from these baseline levels depending on a person's location, mobility during the year, and the status of the person's spouse. In discounting utilities, we restrict most of our attention in the formal computer analysis to two discount rates, .95 and .97087 ($\frac{1}{1.03}$, referring to one over (one plus) a real interest rate of 3%).

One full year of health is worth 1 unit of utility to an individual, a value which we treat as a normalization. In contrast, one full year of sick life is assumed to be worth 0.3. If an individual is healthy part during part of a year, sick during a second part of the year, and dies during the year, his or her utility in that year is a weighted average of 1 and 0.3, with the weights corresponding to the fraction of the year spent in health and sickness.

If a couple decides to move to the life care community at age 65, the move entails a psychic cost in utility terms of .05 to each member. If an individual lives at home, becomes sick, and moves to a nursing home, this entails a psychic cost of .1. Finally, if an individual lives in the life care community and must move to the on-site nursing facility, he or she incurs a cost of .005 in utility terms. Our choice of these values reflects our belief that the move from one's own home to a nursing facility when sick is quite difficult, whereas the move from within a life community to an adjacent facility is relatively easy.

Utility is also affected by the status and location of one's spouse. If an individual is healthy and his or her spouse has died, utility is decremented 0.2 units from 1. If an individual is sick and his or her spouse has died, utility is decremented 0.1 units. If an individual lives at home and his or her spouse is sick and in a stand-alone nursing home, the individual's utility is decremented 0.2, a value which is as large as the decrement applied when the spouse is dead, reflecting our belief that the individual will have little meaningful contact with the spouse. In contrast, if an individual lives in the life care community and his or her spouse is sick and in the life care nursing facility, utility is decremented by only 0.1, indicating that the individual will have more contact with the spouse since he or she is close by. If a couple has continued to live in their own home and an individual becomes sick and moves to a nursing home, while his or her spouse remains healthy, the individual's utility is decremented 0; however, if a couple lives in the life care community and an individual becomes sick and moves to the life care nursing facility, while his or her spouse remains healthy, the individual's utility is incremented by 0.1, reflecting the benefits of having a healthy spouse close by. Thus residence in a life care community brings benefits whenever one's spouse is alive and in a different health state than oneself, precisely because the community's nursing facility is adjacent to its domestic accomodations.

Table 7 provides a summary of the utility values we use in our computer analysis. It is important to note that our analysis of household decision-making, and of the contract terms set by a profit-maximizing life care operator, do not depend on the absolute numerical values we have assigned to these various aspects of utility, but depends only on the difference between the utility the couple realizes at home and the utility it realizes in the life care facility (thus for example setting the utility of one year of sickness to 0.3 has no impact on this decision). In contrast, our evaluation of expected consumer surplus does depend on these numerical values.

Having completed our discussion of a couple's life experiences and lifetime utility, we next describe the couple's financial situation, including the determination of the size of bequest. As of age 65 the couple has a certain level of wealth and an annual income. The income remains the same each year as long as both members of the couple remain alive; but once one member dies, the other receives 60% of the original income thereafter, until he or she also dies. Table 8 depicts the discrete wealth and income distributions we use in most of our model simulations. There are 11 eleven wealth levels, ranging from \$325,000 to \$1,000,000, with probability mass weights chosen to approximate a log-normal distribution. We have chosen the wealth distribution to mimic the middle and high end distribution of wealth among the elderly in the U.S., since it is this part of the population which is able to afford life care; in particular, our distribution parallels the statistics presented in Radner and Vaughan (Chapter 5 in Wolff (1987)) on the wealth distribution of older Americans. In addition, we have chosen to concentrate on a life care facility for which housing units cost \$300,000, and therefore in our model this number serves as a lower bound on the level of wealth a couple must possess to be able to afford life care. As a check on the sensitivity of our results to our assumption that the upper tail of wealth follows a log-normal distribution, we have also analyzed the case in which wealth is uniformly distributed between \$325,000 and \$1,000,000; we report these results below.

For each wealth level there are two income levels, which are equally prevalent in the population, and both of which increase gradually with wealth, with the higher income category beginning at \$1800 (at wealth level \$325,000) and increasing to \$3000 (at wealth level \$1,000,000), and the lower income category beginning at \$1200 (at wealth level \$325,000) and increasing to \$1600. We have chosen the income levels to reflect the prevalence of social security and private pension incomes.[11]

Each day an individual is alive and healthy there is a financial cost, which includes outlays for food, clothing, and other consumption goods. We set this cost to \$25 (for a couple, \$50), in accordance with what we know costs to be at several representative life care and retirement communities. Note that the individual exercises no choice over this amount, a point we discussed earlier, and an assumption which greatly simplifies our analysis. We assume that this daily cost accrues whether the individual lives at home or in the life care complex. If the individual lives at home, he or she must pay this cost out of pocket; if he or she resides in the life care facility, he or she will not pay the cost directly, but instead will pay the life care operator according to the terms of the life care contract, which we discuss in detail in the next section.

Each day an individual is sick and in a nursing facility entails an additional cost, which we set to \$50, corresponding to an annual cost of \$18,250, which is in line with current actual nursing home costs in the United States. As above, if the individual has moved to a stand alone nursing home we assume he or she pays this cost directly out of pocket, though we recognize that issues of insurance status may lead to a more complicated arrangement[12]; if he or she resides in the life care community, however, and as a result is in the life care nursing home, he or she does not pay this cost directly, but instead pays according to the life care contractual terms.

Regardless of where the individual resides, we assume that if he or she exhausts all available financial resources (for example, because of an unusually long nursing home stay), meaning that he or she has borrowed to the point where the accumulated debt exhausts all wealth or all funds which will be available on the death of the individual (or the longest lived member, if the individual's spouse is still alive), all of the person's costs over the remainder of his or her life span are paid for, either by the life care community or the state. In particular, a life care community will not evict a member whose financial resources are exhausted, an assumption which corresponds with actual life care practices in the U.S.

Moving involves financial costs, in addition to the psychic costs outlined earlier in our discussion of lifetime utility. We assume that a couple's initial move to a life care facility costs \$500, that a move from a person's own home to a stand alone nursing home costs \$1,000, and that the move to the life care facility's nursing home from within the life care community costs only \$10. We have chosen these numbers to strongly favor residence in a life care facility. As above, only the difference between moving costs matters for the couple's decision whether or not to enter the life care community.

Finally, in any year in which the couple has positive financial assets available, it invests them, earning a return of $1+r$ in the following year for each 1 invested. In our computer analysis we generally take r to be .03; since we do not include inflation in our model, this may be taken as the real riskless rate of interest.

As we have mentioned repeatedly, in our formulation financial assets benefit the couple only by increasing the size of the bequest left to the couple's heirs. At the time when the last surviving member of the couple dies, all accounts are settled, and, if the couple has lived in the life care community, any rebates are paid out by the life care operator to the couple's estate. We denote the total wealth then accumulated as W, and specify the value of a bequest of size W to the couple to be

$$(\gamma W)^{\alpha}$$

where γ is a scaling parameter and α is a risk aversion parameter. In our empirical analysis we set α to .5 and γ to .00002. At these values, a bequest of \$1 million is worth approximately 4.5 years of healthy life; a bequest of \$100,000 is worth slightly less than 1.5 years of healthy life. However, we also have performed sensitivity analyses of both of these parameters, in order to examine the effect of changing them on life care contractual provisions and consumer welfare, and have found the qualitative nature of our findings to be relatively robust to changes in them.

We close our description with three final comments. First, the bequest utility must be discounted back to year 0 (age 65); hence the longer the last surviving member of a couple lives, the less impact the bequest has on the couple's initial decision whether or not to join the life care community. Second, total utility is given by the sum of the couple's discounted lifetime utility plus the discounted bequest utility. Finally, we note that our formulation does not address the issue of estate taxes; presumably, however, such taxes would simply reduce W by a proportionate amount, which is equivalent to a reduction in the value of γ.

Section 4: Life Care Contracts, Operator Behavior, and Social Regulation

In this section we discuss the form of life care contracts, derive the formula describing a life care operator's expected profits, present a measure of consumer surplus which can be used to evaluate industry performance, and review possible strategies for regulating the life care industry. We begin by describing the form a "complete" life care contract would take under certain simplifying assumptions about the risks of resident and operator bankruptcy, the risk of operator nonperformance, and residents' access to financial markets; we also discuss how this contract might be modified, and substantially complicated, if some of these assumptions fail to hold. We then contrast the form of such complete contracts with the form of actual life care contracts offered by operators in the United States, and introduce our own formulation of a "real world" contract, which forms the basis for the rest of our analysis. Next we derive the objective function facing a life care operator who uses our real world contract and wishes to offer contractual terms which will maximize the net present value of his or her discounted expected future profits. Following this we turn our attention to social welfare, first discussing the calculation of consumer surplus, and then reviewing possible strategies which a regulator might adopt in an effort to improve industry performance.

Throughout this section and the remainder of the paper, we assume that the life care operator is a local monopolist, drawing residents from a population of elderly who do not have access to any other life care facility. We recognize that restricting our analysis to a situation in which the operator enjoys this kind of monopoly power neglects many important issues related to competition in the life care industry. Nonetheless, we believe that this restriction can be defended on the grounds that we wish to focus attention on a host of pricing, welfare, and regulatory issues which are unique to this industry and which therefore deserve to be studied initially in a (relatively) simple framework. In future work we intend to extend our analysis to a model of spatial competition.

Complete Life Care Contracts

As we discussed in the introduction, a life care community offers its residents a bundle of services, including living quarters and access to an on-site nursing facility, as part of a contract which contains various financial provisions and lasts until the last surviving member of a couple (or an individual, if a person joins such a community by him or herself) dies and the individual's heirs inherit his or her estate. As we will show shortly, a life care contract might in theory be very detailed. In practice, however, actual life care contracts are relatively simple, and, despite this, are rarely formally renegotiated.[13] We will not attempt to resolve the question of why life care contracts take the simple form they do. Instead, in what follows we first sketch out the form a complete life care contract might take, and then contrast this with a specification which resembles actual life care contracts.

The simplest kind of complete life care contract arises when the following conditions apply. First, both the prospective residents and the life care operator share the same discount rate, and both have access to financial markets in which they can borrow and lend funds at a real interest rate r which equals one over this discount rate. Second, both the prospective residents and the life care operator are known to face no risk of bankruptcy at any time, under any conceivable (and reasonable) payments the contract may specify. Third, the life care operator is certain to provide all life care services contracted for, so no terms need be included in the contract specifying what recourse the residents will have if the operator breeches the contract. Under these conditions a complete contract will specify only one value, the amount of bequest to be left to the couple's heirs; it will define this bequest amount to be a function of the couple's initial wealth level and daily income, both of which are observable to the life care operator, the year in which each member of the couple dies, the total discounted lifetime utility of the couple, and the discounted value of all nursing home costs which the life care operator has borne over the couple's lifetime.

Why is this contract so simple? A major reason is that, under our assumptions, neither the prospective residents nor the life care operator care about when financial remuneration is made for the life care services; as a result the financial payment may be made as one lump sum at the end of the couple's lifetime, as part of the bequest.[14] In addition, the contract need not address the exact sequence or timing of nursing home hospitalizations experienced by the couple, since the couple's total lifetime utility is a sufficient indicator of their well-being. Finally, the total discounted costs which the life care operator has borne during the couple's healthy residence in the community can be implicitly calculated from the dates at which each member of the couple dies, and hence need not be separately mentioned in the contract.

Before going on to discuss the ways in which this contract may become more complicated when one or more of the three assumed conditions fails to hold, we make two further comments. One qualitative feature which the complete contract is likely to exhibit, and which it shares with all of the complete and real world contracts we discuss next, is risk-sharing, which will arise whenever the life care residents are risk averse (with regard to size of bequest) and the life care operator is risk neutral (an assumption we maintain throughout the paper). A contract which offers risk-sharing will essentially do so by guaranteeing a couple that its heirs will receive a bequest of a certain (approximate) size; providing such a guarantee will in part require subsidizing unusually large nursing home costs, so that a couple which experiences an unusually long period of sickness does not bear the full cost of this sickness in financial terms.

The complete contract we have outlined above does not address the problem of adverse selection, which arises because the initial health status of prospective residents is not observable to the operator. To address this problem, the operator might extend the complete contract to make the final bequest depend on the couple's actual health experience in the life care facility: thus particularly poor health might lead to a lower bequest. The advantage of tying the bequest payment to health outcomes is that it may help to separate out couples of differing health risk; however, whenever the bequest depends on health, risk-sharing will be incomplete. Presumably, an optimal contract will weigh the benefits of sorting against the demand for risk-sharing.[15]

The three conditions specified above which simplify the terms of a complete contract will not hold in all situations. In fact, all of the conditions are problematic. Most especially, the history of the life care industry, which we reviewed in section 2 above, suggests that potential bankruptcy of a life care operator is a relevant concern. In addition, this history of life care also indicates that residents are occasionally at risk of bankruptcy. Finally, it is unlikely that prospective elderly residents are able to borrow funds at the same interest rate at which they lend funds, and it is unclear whether these rates bear any simple relationship to the elderly's discount rate.

When one or more of the three conditions fails to hold, the contract may become significantly more complex. We will not review all the possible ways in which the conditions may fail and the contract may need to be extended. Instead, we will focus on a few issues which are most salient to our overall discussion. One simplifying assumption made above is that the operator's discount rate equals one over the interest rate at which he or she can borrow and lend funds, so that the operator is indifferent about the timing of payments he or she receives. If instead the life care operator's discount rate falls short of one over the interest rate, it will be optimal to pay as much money to the operator "up front" as possible, since the couple does not gain any utility from its financial resources until its last living member dies. In this situation, the couple's initial wealth becomes an important constraint on the contract. If the couple's inital wealth is too low to afford as large an up front payment to the operator as he or she desires, the remainder of the payment must be shifted into the couple's residency, in the form of annual (in our simulations, daily) fees which cannot exceed the couple's income.

A second important assumption is that the life care operator faces no risk of bankruptcy and can be relied upon to fulfill all service obligations incurred in signing the contract. When the contract specifies the only financial payment to be made at the time of bequest, the risk of life care operator bankruptcy or nonperformance may not significantly alter the form of the optimal contract, since residents can simply withhold the agreed upon payment if problems arise. However, when the operator is at risk of going bankrupt or not performing his contractual obligations, and also desires a large up front payment as in the scenario described in the preceding paragraph, much more serious issues are raised: for if the residents pay money up front and the operator defaults on his or her obligations, the residents have no recourse.

Formulation of a Real World Contract

Actual life care contracts are considerably simpler than even the simplest complete contract outlined above. In particular, most contracts do not condition on a couple's initial wealth or income level (though most life care communities do offer a range of living units of differing size and cost), and do not directly tie the total payment made to the operator to a couple's ages at death or medical history. Nonetheless, most contracts do offer a coarse form of risk-sharing, as will become clear as our analysis proceeds.

We have reviewed contracts offered by life care operators in several different states and have found that, although contracts do vary in some details, most contracts share certain common central elements.[16] Accordingly, we focus on these core elements in our formulation of real world contracts. In particular, our model of a life care contract specifies four values. First, the contract specifies an entry fee payable upon admission into the life care community; we denote this fee by FEE. Second the contract specifies a daily fee, which we call $DAILY$, payable each day a person is alive and residing in the life care community; thus when both members of a couple are alive the couple pays a total daily fee of twice $DAILY$. Third, the contract specifies an additional fee which a person must pay for each day he is sick and resides in the life care's skilled nursing facility; we denote this fee by $NURSEDAY$. Finally, upon the death of the last surviving member of a couple, the contract specifies that the life care operator return to the couple's heirs the amount θFEE, where θ is a rebate parameter; the quantity θFEE then becomes part of the couple's bequest.

In our formal analysis we modify one aspect of this formulation, our specification of FEE, slightly. In particular, we divide FEE into two pieces. One piece is the cost of the living unit which a couple occupies; the other piece is the amount a couple pays for the life care services offered by the community, which includes the benefit of having an on-site nursing facility nearby. We assume the operator's cost of constructing living units is exogenously fixed. In our simulations, we generally assume this cost to be $\$300,000$ per unit, with no overhead cost for the complex itself; but since overhead costs can be a substantial component of total construction costs, we also consider scenarios in which there are fixed overhead costs and the cost of individual units is below $\$300,000$. In all cases, we assume the couple pays $\$300,000$ for the unit, an amount which is identical to the value of the couple's original home (or to the rent foregone by not moving and renting the home out), and that this charge is not subject to choice in the operator's specification of the life care contract.[17] The second piece of the fee is subject to operator choice, and is the part we focus on, as it captures the unique value inherent in the life care concept. In what follows we denote this second piece as F, and write $FEE = \$300,000 + F$; our analysis aims at determining F, which then implicitly determines FEE.

Our "real world" life care contract thus includes four fundamental parameters: F, $DAILY$, $NURSEDAY$, and θ. As compared with the kinds of complete contracts outlined above, this real world contract has several important differences. One is that it does not allow F to depend on the couple's initial wealth; this matches empirical facts.[18] Another important difference is that θ does not depend upon the year in which a member of a couple dies, most especially the year in which the last surviving member dies; again, this matches empirical facts. Taken together, these two simplifications suggest that a real world contract provides a much coarser degree of risk-sharing than an optimal complete contract would.

Operator Profit Maximization

Consider now the behavior of a life care operator seeking to maximize discounted expected profits. This operator must make two fundamental choices: (i) how many units to construct; and (ii) the specification of F, $DAILY$, $NURSEDAY$, and θ in the contract he or she will offer prospective residents. We assume the operator makes these choices so as to maximize expected profits.

In deriving the formula for the operator's expected profits, we make several simplifying assumptions. First, we assume that the operator must commit to the number of units to construct and to the values of F, $DAILY$, $NURSEDAY$, and θ before beginning construction and selling units; thus we do not allow for the possibility that the operator might renegotiate contractual terms in the future, once certain residents are "locked in" to residency in the life care facility. Second, we assume the operator will face the same population of prospective residents at each date in the future as he faces in the current period. Third, we assume that the units, once constructed, will never depreciate.

Finally, we make both a comment and an assumption about the issue of vacancy, which arises both in period 1 and in subsequent periods when the last surviving member of a couple dies. In period 1 no units will remain vacant, as long as the life care operator recognizes that his or her choice of the values of F, $DAILY$, $NURSEDAY$, and θ determines the effective demand for units. In particular, for each choice of these 4 parameters, the operator can compute the effective demand for units, and construct exactly enough units to meet demand (of course, demand can never exceed the total population of potential residents), in which case all units offered for sale will be filled in period 1. Regarding vacancy in future periods, we assume that, once constructed, the life care living units are never vacant, in the sense of not being owned (of course, if both members of a couple or the sole surviving member are sick and in the community's nursing facility, the unit will be empty, but it will not be vacant in the sense in which we are using that word); this assumption will be valid only if a unit turns over to a new couple immediately upon the death of its previous owners.

Under the assumptions we have made, operator expected profits are determined as follows. For each unit the operator constructs, first occupancy commences immediately, and terminates at an unknown (stochastic) future date which we denote $\tilde{T}$, where $\tilde{T}$ is a random variable with density function $f(T)$ which depends on the occupying couple's mortality profile. Suppose that the life care operator has discount rate β_{LCC}. Let $v(T)$ denote the expected discounted profits which the life care operator earns when the unit is occupied by a couple whose last surviving member dies in year T. The function $v(T)$ cannot be computed explicitly, as it requires evaluating the couple's entire life history, which, as we discussed in the last section, involves very many alternative life paths; however, $v(T)$ can be determined through computer-assisted analysis, the approach we follow in our analysis in the next section. For now we simply note that $v(T)$ depends upon F, the discounted sum of daily fees and nursing fees, and the rebate θFEE.[19]

We may now compute the life care operator's expected discounted gross profits per unit in terms of $v(T)$, as

$$\frac{\int_0^{+\infty} v(T)f(T)dT}{1 - \int_0^{+\infty} \beta_{LCC}^T f(T)dt}$$

Total expected net profits are then given by this expression, multiplied times the number of units built, minus the costs of construction; when there are no fixed costs of construction, we can equivalently work with the operator's per unit expected net profits, which are given by the expression above minus the cost of constructing each unit. The operator chooses the number of units to build and the parameters F, $DAILY$, $NURSEDAY$, and θ to maximize expected net profits.

Social Regulation

As we discussed in section 2, at the present time there is considerable heterogeneity across states in the methods and rules used to regulate the life care industry, and, as far as we are aware, there has been little effort made to compare these different regulatory regimes to one another. An important goal of our analysis is to provide such comparisons, and, more generally, to evaluate the social benefits which may accrue from a well functioning life care industry. In our analysis we measure social benefit in terms of expected consumer surplus, computed as follows. Given values for F, $DAILY$, $NURSEDAY$, and θ, we determine how much each couple in the population would be willing to pay at date 65 for the privelege of joining the life care community, as opposed to remaining in their own home; we then define total willingness-to-pay, or expected consumer surplus, to be the sum (or, equivalently, average) of these values.

We use this measure of social welfare to examine several alternative regulatory policies. Most fundamentally, we determine which values of F, $DAILY$, $NURSEDAY$, and θ maximize expected consumer surplus, subject to the proviso that the life care operator earn non-negative expected net profits. In addition, we evaluate two specific policies which have been proposed by certain states. One policy requires that $NURSEDAY$ be set to zero, so that all nursing home utilization is subsidized. The other policy requires that θ be set to 1, providing a full rebate (but not corrected for inflation) of a resident's original fee to the person's heirs. In section 5, we explore the issue of bankruptcy of the life care operator in greater depth, and, in that context, explore various policy options which have been proposed to protect residents from this risk.

There are two policy options which we do not explore, but which we believe could be fruitfully examined using our model. The first of these is the impact of stand alone nursing home spenddown provisions on the life care industry. Current nursing home regulations require that a nursing home resident whose assets are depleted be allowed to remain in the nursing home, with the cost of residency shared between medicaid, medicare (in some cases and to a limited extent), any private insurance the patient has, and the nursing home itself. Further, in many states some of the resident's assets are protected – most especially his or her family home. We believe these nursing home regulations may exert an impact on the viability of the life care industry, which also must face the prospect of resident's running out of funds. The second concerns the rules governing when a life care operator can expropriate the independent living unit of an individual who has moved permanently to the nursing home, selling the unit and terminating the agreement with the individual, often by placing whatever rebate is due to the individual's estate in an escrow account. Many life care contracts specify these conditions carefully, often in a way which tends to give the life care operator control over any proceeds from the resale of the independent unit as long as the individual remains alive in the nursing home.[20]

Section 5: Analysis of the Model

In the previous sections we have set forth a model of the life care industry which includes a specification of household behavior, including both life experiences and the financial considerations which culminate in a bequest to a couple's heirs, contractual forms, and operator and regulator pricing strategies. In this section we present the results of an extensive computer analysis of this model. We divide our presentations into three subsections. First we briefly ouline the computer methodology used to analyze the model. Then we present results from a base case scenario, provide intuition for the results we find, and discuss implications. Finally, we summarize results from alternative scenarios and sensitivity analyses.

Description of Methodology

To analyze our model, we rely on computer simulations, performed by means of a largescale PASCAL program written for DOS-compatible personal computers.[21] The logical structure of the program is outlined in appendix 2. Briefly, the program requires as inputs a complete set of numerical values for all exogenous parameters, including especially those describing household utility and the distribution of wealth, income, and initial health status in the population of prospective residents; we have enumerated our setting of these parameters in section 3 (see also table 5). The program also asks the user to specify what objective function is to be maximized: either expected profit maximization; or constrained consumer surplus optimization. The program then searches for the values of F, $DAILY$, $NURSEDAY$, and θ which maximize the objective function.

Throughout our analysis, we have eschewed complex nonlinear optimization routines, and instead have searched for optimum parameters using simple and adaptable grid searches. Within each grid search, each set of trial contract values requires integrating over 88 different types of couples (differing in wealth, income, and initial health status), for each couple type determining for each couple its total expected utility from staying at home, and comparing this with its total expected utility from joining the life care community. The main difficulty faced in computing these utilities arises from the sheer complexity of life paths which must be evaluated under each alternative choice – if one were to evaluate every sample path, it would not be possible to compute these utilities in a reasonable amount of computer time.

To overcome this complexity, we have relied on an adaptive Monte Carlo procedure of the following kind. For each couple type, the program first generates 100 sample paths, using standard random number algorithms to work through the couple's life tree. These 100 paths are then divided into 5 groups, and for each group the expected utility from joining the life care community is computed as the average of its values over these 20 paths and compared to the expected utility from remaining at home, which is computed in the same fashion. If either 4 or all 5 of the groups agree on which alternative is best, the program registers that decision as final and moves on the next couple type. If, however, only 3 of the groups agree on the best choice, the program samples an additional 400 paths, divides the full group of 500 paths into 5 groups of 100 paths each, and computes the expected utilities in each group just as above. Again, if 4 or all 5 of the groups agree on which choice is preferrable, the program registers that decision as final and moves on. If, however, only 3 of the groups agree, the program samples an additional 500 paths, computes the expected utility of each option averaged over the full 1,000 paths, registers whichever choice is preferred as the final decision, and moves on to the next couple type. While we believe this adaptive procedure is reasonably accurate, the possibility does of course exist for random error which can lead to a mistake in the decision we attribute to any particular couple.

The program records for later retrieval the average expected utility (averaged over all sample paths which were needed to determine the couple's decision) the couple derives from each choice, the average amount of nursing home utilization of each couple type, life duration of each person, bankruptcy (if it occurs), and expected size of bequest.

The Base Case

The scenario which we have analyzed most thoroughly and which we will present in considerable detail in this subsection makes the following assumptions: (i) that the real interest rate is 3%; (ii) that all prospective residents and the life care operator discount the future at the rate of .97087, which is one over (one plus) the real interest rate; (iii) that construction costs are $300,000 per unit; and (iv) that all other parameters are set according to the values in table 5. We choose to make this set of parameters our base case for several reasons. By setting the discount rates of prospective residents and of the life care operator equal to one another and also equal to one over the interest rate, we minimize the importance of discounting on the timing of payments from one party to the other, which allows us to more clearly evaluate the importance of other, more interesting, incentives on contract terms and household decision-making. By choosing construction costs to be equal to $300,000, we equalize the costs of life care dwelling units and residents' own homes; as with the assumption about discount rates, the advantage of doing this is that it helps us isolate the impact of other incentives on life care industry equilibrium. In the next subsection we explore how the results which we report here change when we analyze scenarios which use different assumptions about discount rates and construction costs.

For this base case scenario, our analysis reveals that a profit-maximizing life care operator will set $DAILY$ equal to 51, θ equal to 2.25, F equal to $18,000 (but see below), and $NURSEDAY$ equal to 0 (but see below), and will build sufficient units to house approximately 87% of the population, with the remainder of the population preferring to remain in their own homes. Figure 2 provides details on the expected consumer surplus which couples of varying income, wealth, and health status obtain by choosing to enter the life care community at these contract values; as one would expect, generally the sicker and wealthier couples earn a higher expected surplus. At the contract values described above, the operator earns expected profits of $32,000 per unit, and average expected consumer surplus is $26,000.

Several comments about our base case results are in order. First, the daily fee is set approximately twice as high as the marginal cost of daily care; this result is similar to, albeit slightly higher than, the kinds of daily fees we observe in actual life care facilities, such as the Cypress Point complex described earlier. The rebate parameter implies that the life care operator will return more than twice a resident's initial entry fee. This rebate is far higher than we observe in actual facilities, which typically set the rebate at or below 1; it appears particularly high relative to actual practice when it is recalled that there is no inflation in our model (actual rebates are not indexed to inflation).

Third, while $DAILY$ and θ are rather precisely determined in our computer analysis, the values of F and $NURSEDAY$ are far more difficult to pin down. In the case of $NURSEDAY$, the reason for this is particularly clear. On average, a person spends half of a year or less in a nursing facility, much of that time occuring at ages far older than age 65; hence the impact of cumulative nursing fees, particularly when discounted, is quite small. Careful grid searches, using Monte Carlo analysis involving 3,000 or more sample path evaluations per couple type, revealed that operator profits are relatively similar for all values of $NURSEDAY$ between 0 and 30, though they fall slightly for higher values. Intuitively, it would seem that $NURSEDAY$ should be set below the marginal cost of nursing care, in order to provide risk-sharing, and this intuition is somewhat confirmed by our findings.

In the case of F, careful Monte Carlo analysis involving 3,000 or more sample path evaluations per couple revealed that operator expected profit is relatively similar for all values of F between $\$6,000$ and $\$25,000$, diminishing noticeably for values below $\$6,000$ and diminishing very gradually as F is increased above $\$25,000$. Profits appear to be flat in this range largely because the rebate on death of the last surviving member of the couple is so high. If for example, the last surviving member dies 25 years after the couple enters the community (at age 90), the discounted value of the rebate as of year 1 amounts to 1.2 times the original fee. Thus the life care operator does not benefit, and may even lose money, when the entry fee is increased. Of course, as F is increased certain market segments are excluded from the life care community, since they do not have sufficient wealth to pay the up front entry fee (we assume the life care operator will not admit anyone who must borrow to meet this fee), and for this reason profits do eventually fall if F is increased too much.

Probably the most striking feature about the contract values which maximize operator profits is that the rebate is set so high. We believe the reason for this is risk-sharing, acting indirectly through the daily fee and, to a lesser extent, the nursing fee. To see the logic behind this argument recall that couples are risk averse over the size of bequest which they leave to their heirs. Since couples earn income every day at least one member is living, the life care community can guarantee a certain size bequest by setting the daily fee approximately equal to this daily income stream. Of course, since the life care community can only set one daily fee, and couples differ in their incomes, the daily fee chosen is simply a weighted average of these income levels – a daily fee of $51 corresponds to a monthly income of approximately $1500, which is approximately the average of the daily incomes among the population of couples who choose to move to the life care community. The life care community can further guarantee the bequest size by setting the nursing fee to zero, hence eliminating the risk that an unusually long nursing spell will deplete the couple's assets and income.

Once the daily fee and nursing fee are established, the rebate parameter is chosen by the operator to maximize profits. Since the daily fee is so high, the only way the operator can attract couples into the community is by offering a high rebate. This argument is supported by our finding, in many computer simulations, that a given level of the daily fee must be matched by a rather specific rebate parameter in order to offer the operator significant profits; a different way to make this point is to note that the operator's profit curve in daily fee – rebate space is quite steeply sloped around its optimum value, and traces a one-dimensional hyperplane through this space, which corresponds to the trade-off between the daily fee and rebate parameters.

Our conclusion that the life care contract offers the elderly significant insurance raises several further issues. First, it must be recognized that the life care contract hardly offers perfect, or even "efficient" insurance, because the same daily fee and rebate parameter are set for all couples. Second, there is an additional insurance function which we would expect the life care contract to offer in real life which is not part of our model, because of the utility function we have chosen. In particular, our utility function is linearly separable between a couple's life-utility and its bequest utility, which implies that the couple is risk neutral regarding trade-offs between these two sources of utility. In reality, we suspect that many elderly have risk averse preferences regarding this tradeoff, and will, given the choice, opt for a situation in which unusually short life duration is accompanied by an unusually large bequest, and unusually long life, in compensation, is accompanied by a smaller bequest. In general, life care can offer this kind of insurance, since the size of the rebate can be tied to when the last surviving member of a couple dies (though currently few actual life care communities write such detailed contracts). In our model, however, there is no scope for such insurance.[22]

Third, and related to the first point, we are lead to wonder whether the form of the profit-maximizing life care contract might be significantly altered in a world in which the elderly have access to a separate insurance contract, unrelated to life care. We have explored this issue by including in the model the opportunity for the elderly to buy an actuarially fair insurance policy which pays off on the death of the last surviving member of the couple. In computer analyses of this revised model, we have found that many elderly do choose to buy this policy, but that it does not radically alter the terms of the life care contract.

In the base case scenario, the contractual terms which maximize expected consumer surplus involve setting $DAILY$ at 100, θ at 4.3, and, as above, F at $18,000 and $NURSEDAY$ at zero. Under these terms, all potential residents choose to join the life care community, and expected consumer surplus, on average, is $70,000.

The life care contract which maximizes consumer surplus is in many ways similar to the contract which maximizes operator profit. The major difference is that the contract which maximizes consumer surplus sets an even higher daily fee, and a higher rebate. As in the contract which maximizes operator profit, neither F nor $NURSEDAY$ are determined with much precision in the contract which maximizes consumer surplus. However, there is now a strong intuitive argument for keeping F below $20,000, so that all potential residents have sufficient wealth to be able to enter the life care community, and for keeping $NURSEDAY$ at zero, to provide complete risk-sharing.

Overall, the contract which maximizes consumer surplus departs even further from real world life care contracts than the earlier contract based on profit maximization. While we think this result is of interest, we hasten to point out that a contract which offers such a large rebate may be subject to abuse if life care operators are able to declare bankruptcy or otherwise terminate a contract prematurely, an issue we return to in the next section.

Additional Cases and Sensitivity Analysis

We have examined the sensitivity of our basic findings by analyzing a variety of alternative scenarios. For the most part, we find that results change somewhat in quantitative terms, but that the qualitative nature of our findings hold up.

As we have mentioned above, discount rates can play an important role in the financial evaluation of life care contracts. To explore the impact of alternative assumptions about interest rates on our results, we examined two additional scenarios. In the first alternative scenario, we assumed the life care operator's discount rate continued to equal one over the discount rate, but that the elderly population discounted the future more steeply, at a rate of .95. In the second alternative scenario, we assumed both the operator and the elderly discounted the future at .95. As we discussed earlier, these alternative assumptions about discount rates affect the way in which the parties to the contract value cash flows at different future dates. Since the household values its financial resources only at the time of death of the last surviving household member, it is unconcerned about the timing of cash flows; however, as its discount rate rises, it becomes relatively more concerned about the size of bequest relative to discounted life utility. In alternative scenario one the life care operator is indifferent to the timing of cash flows; in scenario two, however, the operator perfers cash flow to be "front-loaded".

Under scenario one, a profit-maximizaing life care operator will choose to set θ and $DAILY$ slightly above their earlier values, while F and $NURSEDAY$ remain imprecisely indetermined, but fall in a range similar to that described above. Scenario two has the profit-maximizing oprator setting even higher values of θ and $DAILY$, with θ approximately 3.4 and $DAILY$ set at approximately 65. We have not explored how the contract parameters should be set to maximize consumer surplus under these two alternative scenarios.

A second important issue which we have explored with alternative scenarios is construction cost. Our base case assumes that costs are \$300,000 per unit, with no fixed costs. As compared with this, we have analyzed cases in which the marginal cost of each unit is \$200,000, \$100,000, and \$0. We do not specify the fixed cost, supposing that, if it is land, the monopolist has already expended this cost. Here we find that the contractual terms which maximize operator profits move smoothly as the marginal cost falls. The rebate parameter θ rises from 2.5 to 2.6 for costs of \$200,000, and to 2.7 for costs of \$200,000. In similar fashion, $DAILY$ rises from 57 to 58 as costs decrease to \$200,000, and to 59 as costs decrease further to $100,000. Neither $NURSEDAY$ nor F are precisely determined, but both continue to fall in a similar range as above. We have not yet explored how the contract terms which maximize consumer surplus vary with construction costs.

Finally, we have also explored the sensitivity of our original results to variations in the initial distribution of wealth, especially in order to see whether a different, flatter distribution might lead to changes in the optimal value of F. Recall that the wealth distribution used in all the scenarios described to this point is log-normal. To examine the sensitivity of our results to this distribution, we replaced it with a uniform distribution, defined over the same range of $300,000 to $1,000,000. Using this new distribution, we find that a profit-maximizing life care operator will set F at 95,000, considerably higher than previously, will continue to set θ at 2.25, and will set $DAILY$ at 54; under these contract terms the operator earns approximately $40,000 per unit in profits, expected consumer surplus averages $20,000, and the life care community garners 61% of the market. The reason the operator is now willing to increase F is that there are relatively fewer couples at the low end of the wealth distribution than previously. Hence the operator is now willing to reduce his or her market share by increasing F to a point at which many of these poorer couples cannot afford the initial entry fee, in return for earning higher profits on the remainder of the population, which can and does join the community.

Section 6: Extensions

In this section we briefly describe two extensions to our main analysis. One extension addresses the issue of operator bankruptcy. The other addresses the concern often raised that operators in life care communities may have an incentive not to provide adequate health care to their residents.

An issue which arises naturally from the equilibrium contract terms we have established in our simulations, which has been of considerable historical importance, and which has arisen in our informal discussions with individuals about life care, is operator bankruptcy. Operator bankruptcy looms especially large in light of the the kinds of contracts which emerged as optimal in our simulations and which we described in the last section, many of which call for the operator to refund a large rebate to a couple's heirs. Obviously, if an operator goes bankrupt, such a rebate will never be paid out, and the couple's heirs (and hence indirectly the couple) will suffer a sharp disutility.

To address the issue of operator bankruptcy, we have extended our model by including an exogenous risk of bankruptcy, which we denote ν, in each period. We assume that if an operator goes bankrupt, he or she defaults on all further payments and services to residents. We set ν to $\frac{1}{2}\%$ per year, which cumulates to approximately a 13% risk over the course of their remaining life for relatively long-lived residents. At this level, we find a profound effect on the contract terms which emerge in equilibrium. In particular, θ falls to between .6 and 1.0, market share plummets to 5%, $DAILY$ lies between 19 and 27 depending on θ, and F remains at about 20,000 to 30,000. We cannot determine θ more precisely because the market share is so low that a good deal of noise remains in our simulations. It is interesting to note that these values are quite close to the sorts of terms we observe in real world life care contracts, which suggests that bankruptcy may play an important role in industry structure, conduct, and performance.

In our informal conversations with our parents, other elderly, and state regulators, we have found that one concern which often arises is that a life care operator may have an incentive to "kill off the residents" in order to resell their unit sooner and increase profits. The following simple example explores this issue. Consider a life care unit occupied by a healthy widow or widower, and suppose that in this facility $F = 20,000$ and the operator has discount rate .95. Suppose also that once this unit becomes vacant, its continuation value (or the value of expected discounted profits at that point in time) has the value VAL. The question we address is: for a given level of VAL, for what combination of DAILY and θ does the life care operator prefer the widow to die this period instead of living one more year and dying next period?

If the widow dies this period, the life care operator's total expected profits are $-\theta(320,000) + VAL$; if the widow lives one more year and dies next period, total expected profits are $365(DAILY - 25) - .95\theta(320,000) + .95VAL$. Figure 3 depicts the answer to the question we have posed: for all values of the daily fee below the line, the operator prefers the widow to die. Thus if $VAL = 100,000$, the operator prefers the widow to die for all θ values below .88 for a daily fee of zero, and below .3125 for a daily fees of 25. For $VAL = 200,000$, the operator prefers the widow to die for all θ values below 1.2 when the daily fee is zero, and below .625 when the daily fee is 25. As this figure reveals, for the kinds of profit-maximizing values we have calculated, where the daily fee and θ are both high, the operator generally does not want the widow to die.

Section 7: Conclusion

In this paper we have formulated a model of the life care industry. Our model links together several different aspects of the industry. One important aspect is household behavior, to which we have devoted considerable attention, focusing on the utility advantages of a life care facility in terms of reduced moving costs and the benefits to an elderly couple of remaining in close proximity to one another should one member of the couple become sick and move to a nursing home. A second aspect is the form of life contracts; we have outlined what form a complete contract might take, but have then go on to formulate what we believe to be a "realistic" contract, which includes four basic parameters: an entry fee; a daily living fee; a nursing home daily charge; and a rebate to a person's heirs. Finally, we have used our model to explore issues of industry performance. In this regard we have compared the contractual terms and prices which will be set by a local monopolist with those terms which maximize consumer surplus, and have explored the impact of certain other regulatory policies and of bankruptcy on social welfare.

Appendix 1

Description of Sources and Calculations for Tables

Tables 3 and 4: Tables 3 and 4 are constructed directly from results presented in Cohen, Tell, and Wallach (1986), which compute the probability of entry into a (unattached) nursing home by age and a variety of health and marital status measures (note that in their results, sex has no significant impact on the probability of entry).

Table 5: Table 5 uses figures from **Discharges From Nursing Homes: 1985 National Nursing Home Survey**, part of the series in **Vital and Health Statistics** published by the National Center for Health Statistics, the U.S. Department of Health and Human Services, the Centers for Disease Control. The calculations draws upon detailed tables 3 and 14. Table 3 presents duration of stay, separately for live and dead discharges, by age category. Starting from these basic figures, the following steps were followed to construct the numbers in the text's table 2. First, the numbers were corrected so as to refer to age at entry rather than age at discharge. To make this correction, for those discharges who stayed 3 to 5 years in a NH, one half of the total number is imputed to the preceding age category, and one half to the current age (thus if 10,000 individuals aged 70-74 were discharged who had stayed 3 to 5 years, 5,000 were considered age 65-69 at entry, and 5,000 age 70-74). Those discharges who stayed 5 years or more were all imputed to the preceding age category. Next, two additional sets of numbers were computed. The first was percentage discharges of each sex, by length of stay (but not also by age at discharge), percentages in table 3. The second was percentage of discharges who had either own source or medicare as their primary form of payment during their first month of residency, again by length of stay (but not also by age at discharge), percentages obtained from table 14. The probability tables (for each age and sex category) in the text's table 5 were then computed by performing a simple division. For each age category and each sex, the denominator in the division, measuring total number of discharges (relevant to our simulation), was computed by multiplying the line aggregates by the aggregate sex and payment form percentages. The numerator of the division was computed, for each length of stay entry, as the table 3 entry multiplied by the relevant sex and payment form weight for that column. Throughout, imputations for missing values were used as needed.

An alternative means of calculating table 3 would be to use the results in Garber and Macurdy, "Nursing Home Discharges and Exhaustion of Medicare Benefits" (NBER working paper No. 3639). However, Garber and Macurdy do not distinguish live discharges from dead discharges.

Table 6: The numbers in the text's table 6 again come from table 3 in the **Discharges From Nursing Homes: 1985 National Nursing Home Survey**. All live discharges who went directly into a general, short-stay, or veteran's hospital, were considered to have died soon thereafter. These basic numbers (given by length of stay in the source table), were again weighted out by sex and payment source.

Table 7: The entries in the text's table 7 are computed from the identity

$$P(Death) = P(Death \mid not\ in\ NH)\ P(not\ in\ NH)\ +\ P(Death \mid in\ NH)\ P(in\ NH)$$

In particular, the $P(in\ NH)$ and $P(Death \mid in\ NH)$ were computed from the text's table 3, as described above. The unconditional $P(Death)$ was computed by the U.S. 1979-81 Life Tables. This allowed calculation of the $P(Death \mid not\ in\ NH)$.

Footnotes

[1]The material about Cypress Point and the other California life care communities comes from the California State Continuing Care Contract Program files.

[2]Cypress Point exhibits two other characteristics which are of some interest. First, its financial organization is quite complex: the company which will construct the community complex is a for-profit; but it will then lease the facility to a non-profit management company. We conjecture that the division between a for-profit and a non-profit may serve two purposes. On the one hand, it may shield the for-profit company from some of the financial risks associated with management or future liabilities. On the other hand, it enables Cypress Point to claim in its marketing advertisements that residents will be living in a community managed by a non-profit.
The second interesting feature pertains to the Cypress Point life care contract. The contract specifies that if a resident is living alone and must move to the on-site nursing facility, after 90 consecutive days in the nursing facility his or her stay there is called "permanent", at which point the resident must either sell his or her independent living unit or face heavy financial penalties; proceeds from the sale are placed in a trust fund for which all control vests with the Cypress Point management and all earnings accrue to management, until the resident dies.

[3]My information for this section is based on a conversation with Vera Prosper and Prosper (1985).

[4]It is worth noting that these three states differ markedly in the nature of their life care industries. Thus California has more than 70 communities in operation, and several more under review; Minnesota has 3 life care communities, all non-profit, and all three of which have been in existence for a significant length of time; while New York has only recently passed legislation allowing life care communities to form, and currently is restricting the industry to three demonstration projects.
The states also differ markedly in the formal organizational structures through which they regulate their life care industries. As noted in the text above, California has established a separate office specifically devoted to following and regulating the industry. New York has recently established a Life Care Community Council, but New York's actual regulations are being issued and will be enforced by three separate New York departments: Insurance, Public Health, and Social Services. Minnesota does not have a separate life care office, but instead relies on county records for data collection and the state consumer affairs office in the Office of the Attorney General for enforcement of statutes.

[5]In California, 3 of the 6 substantive articles devoted to life care focus exclusively on financial considerations, whle the remaining 3 articles also devote considerable space to the issue. In Minnesota, 8 of the 10 pages devoted to life care in the state code of regulations concern themselves with financial matters. In New York it is more difficult to quantify the percentage of attention devoted to finance, but it is assuredly very large.

[6]While all three states require life care owners and operators to establish a trust fund during construction and operation, they differ somewhat in the details of their requirements concerning these funds. Thus for example Minnesota imposes no requirements on how these

funds are invested, California requires that, if the funds are invested in stocks and bonds, these stocks and bonds be of sufficient investment grade, and New York allows at most 5% of these funds to be invested in stocks.

[7]In fact, the absolute values of these utility values do not affect the couple's choice of whether or not to enter the life care facility, which depends only the relative utilities from each choice; they do, however, affect our calculation of consumer surplus.

[8]In addition, an individual is not certain to enter a nursing home. The expected number of moves to a nursing home is somewhat less than one for males, and somewhat greater than one for females.

[9]Since utility is the sum of these terms, there is no risk aversion operating in the tradeoff between the couple's life-utility and its bequest.

[10]We are indebted to Edward Norton for pointing this out to us.

[11]As discussed below, the couple also earns income - at a specified real rate of interest - on its wealth; we keep track of this separately.

[12]We are focusing on a relatively well-off population for which medicaid is not an option; however, various private insurers do offer nursing home insurance.

[13]In fact, extenuating circumstances do occasionally arise where legal proceedings are used to resolve a dispute between the parties to the contract. Historically, such circumstances have most commonly involved the life care operator going bankrupt, an issue we return to in a later section of the paper.

[14]For the life care operator, this is because he or she can borrow or lend at a rate of interest equal to his or her discount rate. For the prospective residents, this is both because they can borrow or lend at an interest rate equal to their discount rate, and also because financial resources enter their utility function only through the bequest.

[15]We are indebted to Bengt Holmstrom for bringing the issues of this paragraph to our attention.

[16]This statement is based on a review we have made of contracts from numerous life care operators in California, proposed contracts from operators in New York, and discussion with regulators in Minnesota.

[17]Thus when the marginal cost is below $300,000, we are assuming that average costs remain near this level.

[18]The life care contracts we have examined, particularly in California, all have this feature. However, they do allow V to depend on the couple's age, which is not relevant for us, since all couples enter at age 65 in our model.

[19]Note that if a couple exhausts all its current and future assets, or is unable to borrow and exhausts its current assets, the life care operator must subsidize the couple; this fact must be taken into account in computing $v(T)$.

[20]An example of such a condition is the proposed Cypress Point contract, which mandates that when a resident has moved to the nursing home permanently (usually after 90 consecutive days there the visit is deemed permanent), the operator will (under certain restrictions) sell the unit and place the proceeds in a trust fund, which is controlled by the

operator; any earnings from the trust accrue to the operator. When the resident dies, the trust's principle is turned over to the heirs according to the usual rules (involving θ).

[21] A copy of the rather lengthy computer program we have written to perform these simulations is available from the authors on request.

[22] Doug Bernheim has pointed out to us that we might alternatively discount the bequest inside the α power-law, an approach which may also have implications for the way a life care community might offer insurance to its residents.

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Table 1

Probability of Entry into Nursing Home
By Age

Age	Probability
65-69	1.58%
70-74	2.02%
75	2.30%
76	2.48%
77	2.69%
78	2.92%
79	3.16%
80	3.45%
81	3.79%
82	4.20%
83	4.72%
84	5.25%
85	6.02%
86	6.82%
87	7.65%
88	8.55%
89	9.75%
90+	11.25%

Table 2

Elevated Probability of Admission into a Nursing Home

Table 3 lists the baseline probability of entry into a nursing home, by age. In any year, the individual's true probability of entry is equal to the maximum among the subset of probabilities listed below for which the individual satisfies the attached condition.

Condition	Probability of Entry
all individuals	Baseline
widowed	1.3 x Baseline
initial health status poor	1.88 x Baseline
have been in a nursing home previously	2.0 x Baseline
spouse died within the last 2 years	2.0 x Baseline
widowed and initial health status poor	2.5 x Baseline
spouse died within the last 2 years and have been in a nursing home previously	3.0 x Baseline
spouse died within the last 2 years and initial health status poor	3.5 x Baseline

Table 3

Probability of Death, Conditional on not Entering a Nursing Homes
By Age and Sex

Age	Male	Female
65	.015	.0013
66	.018	.0024
67	.020	.0037
68	.023	.0052
69	.026	.0069
70	.027	.007
71	.029	.0075
72	.033	.0087
73	.037	.011
74	.041	.014
75	.043	.015
76	.046	.016
77	.049	.017
78	.053	.020
79	.058	.023
80	.063	.027
81	.068	.030
82	.074	.034
83	.079	.037
84	.084	.041
85	.085	.042
86	.086	.044
87	.090	.046
88	.094	.047
89	.095	.047

Table 3 (continued)

Age	Male	Female
90	.098	.050
65	.015	.0013
91	.108	.057
92	.120	.0725
93	.139	.0895
94	.157	.106
95	.175	.124
96	.190	.140
97	.204	.156
98	.218	.171
99	.230	.185
100	1	1

Table 4

Nursing Home Length of Stay and Outcome Probabilities By Age (at entry) and Sex

	Males		Females	
	Live	Die	Live	Die
Age 65-69				
14 day stay	.359	.137	.343	.081
40 day stay	.173	.032	.197	.032
120 day stay	.074	.017	.074	.022
240 day stay	.086	.016	.080	.020
2 year stay	.058	.015	.078	.020
3.5 year stay	.013	.009	.020	.016
7 year stay	.011	0	.018	0
Age 70-74				
14 day stay	.329	.128	.302	.073
40 day stay	.142	.062	.155	.061
120 day stay	.112	.021	.109	.025
240 day stay	.066	.020	.059	.023
2 year stay	.062	.019	.080	.023
3.5 year stay	.013	.012	.018	.021
7 year stay	.013	.014	.021	.026
Age 75-79				
14 day stay	.308	.164	.290	.096
40 day stay	.162	.048	.181	.049
120 day stay	.073	.019	.073	.023
240 day stay	.064	.026	.059	.032
2 year stay	.055	.032	.073	.040
3.5 year stay	.012	.012	.018	.023
7 year stay	.008	.015	.014	.029

Table 4 (continued)

	Males		Females	
	Live	Die	Live	Live
Age 80-84				
14 day stay	.313	.129	.287	.074
40 day stay	.158	.043	.172	.042
120 day stay	.083	.020	.080	.025
240 day stay	.065	.034	.058	.039
2 year stay	.056	.037	.073	.044
3.5 year stay	.016	.015	.022	.026
7 year stay	.012	.019	.020	.036
Age 85-89				
14 day stay	.226	.159	.205	.090
40 day stay	.133	.066	.144	.064
120 day stay	.071	.030	.068	.036
240 day stay	.069	.040	.061	.046
2 year stay	.062	.067	.080	.080
3.5 year stay	.018	.019	.027	.034
7 year stay	.013	.026	.020	.047
Age 90-99				
14 day stay	.200	.180	.180	.120
40 day stay	.130	.100	.140	.090
120 day stay	.060	.030	.070	.050
240 day stay	.060	.040	.060	.050
2 year stay	.060	.070	.070	.080
3.5 year stay	.020	.020	.020	.030
7 year stay	.010	.020	.010	.030

Table 5

Probability of Rapid Death
Conditional on Discharge from Nursing Home
By Length of Stay prior to Discharge

Length of Stay	Probability of Death, Conditional on Live Discharge
14 days	.292
40 days	.304
120 days	.363
240 days	.485
2 years	.472
3.5 years	.525
7 years	.525

Table 6a
Simulated Life History

Age	Husband Status	Wife Status	Husband's Nursing Days	Wife's Nursing Days
65	Alive	Alive	0	40
66	Deceased	Alive	14	0
67	Deceased	Alive	0	14
68	Deceased	Alive	0	0
69	Deceased	Alive	0	0
70	Deceased	Alive	0	0
71	Deceased	Alive	0	0
72	Deceased	Alive	0	0
73	Deceased	Alive	0	0
74	Deceased	Alive	0	0
75	Deceased	Alive	0	0
76	Deceased	Alive	0	0
77	Deceased	Alive	0	0
78	Deceased	Alive	0	240
79	Deceased	Alive	0	0
80	Deceased	Alive	0	0
81	Deceased	Alive	0	0
82	Deceased	Alive	0	0
83	Deceased	Alive	0	0
84	Deceased	Alive	0	0
85	Deceased	Alive	0	0
86	Deceased	Alive	0	0
87	Deceased	Alive	0	0
88	Deceased	Alive	0	0
89	Deceased	Alive	0	14
90	Deceased	Alive	0	0
91	Deceased	Deceased	0	240
92	Deceased	Deceased	0	0

Table 6b
Simulated Life History

Age	Husband Status	Wife Status	Husband's Nursing Days	Wife's Nursing Days
65	Alive	Alive	0	0
66	Alive	Alive	0	0
67	Alive	Alive	0	0
68	Alive	Alive	0	0
69	Alive	Alive	0	0
70	Alive	Alive	0	0
71	Alive	Alive	0	0
72	Alive	Alive	0	365
73	Alive	Alive	0	365
74	Alive	Alive	0	365
75	Alive	Alive	0	365
76	Alive	Alive	0	365
77	Alive	Alive	0	365
78	Alive	Alive	0	365
79	Alive	Deceased	0	0
80	Alive	Deceased	365	0
81	Alive	Deceased	365	0
82	Alive	Deceased	365	0
83	Alive	Deceased	365	0
84	Alive	Deceased	365	0
85	Alive	Deceased	365	0
86	Alive	Deceased	365	0
87	Alive	Deceased	0	0
88	Alive	Deceased	40	0
89	Alive	Deceased	0	0
90	Alive	Deceased	0	0
91	Deceased	Deceased	40	0
92	Deceased	Deceased	0	0

Table 7

The Household Utility Function

Household Utility consists of 2 pieces which are summed:

(i) psychic utility, accumulated in each year one member of the couple remains alive, and computed separately for each household member, then summed;

(ii) bequest utility.

Psychic Utility

Baseline

utility when individual is healthy	1.0
utility when individual is sick	0.3

Additions and Subtractions

State	Increment or Decrement
individual healthy, spouse sick and in own home	-0.2
individual healthy, spouse sick and in LCC	-0.1
individual sick, spouse healthy and in own home	0.0
individual sick, spouse healthy and in LCC	0.1
individual healthy and spouse dead	-0.2
individual sick and spouse dead	-0.1

Psychic moving costs

initial move to LCC	0.05
move to a nursing home from own home	0.1
move to LCC nursing home from LCC	0.005

Table 7 (continued)

Bequest Utility

Form of bequest utility function: $(\gamma W)^{\alpha}$ where

W = total financial assets at time last living household member dies;

$\gamma = 0.00002$;

$\alpha = 0.5$.

Financial moving costs	Cost
initial move to LCC	$500
move to a nursing home from own home	$1,000
move to LCC nursing home from LCC	$10

Household discount rate: $\beta_H = .95$

Table 8

Initial Distribution of Households By Wealth, Income, and Health Status

Wealth (in $)	Probability Mass at Wealth Level	Monthly Income (in $)	
		High	Low
		(Each income includes ½ the probability)	
325,000	.134	1200	1800
350,000	.102	1250	1875
375,000	.074	1300	1960
400,000	.092	1360	2000
450,000	.104	1400	2100
500,000	.085	1420	2200
550,000	.070	1450	2300
600,000	.088	1500	2400
700,000	.083	1560	2600
800,000	.095	1580	2800
1,000,000	.073	1600	3000

At each income and wealth level, there are four health statuses:

Both sexes initially in good health
One spouse in good health, one in poor health (2)
Both spouses in poor health

Table A2

CCRDAT.
Contains starting values for parameter grid search.
Calls GRID.

↓

GRID.
Looks for best values of θ, V, S, Daily by integrating over the set of possible customers examining whether each decides to go to CCRC under the pricing scheme.
Calls POPULATION.

↓

POPULATION.
For each wealth, income, health level, it uses CHOICE to see whether such a person goes to CCRC. If so, CCRC expected revenue and costs are tabulated.

↓

CHOICE.
Couple of known health, wealth, income characteristics uses expected values from VECTOR to decide whether to go to CCRC.
Calls VECTOR.

↓

VECTOR.
Expected values of going to CCRc versus staying at home are computed from sets of life histories from FINDBEST. The number of such sets is endogenous. At first 100 sets are used. If they give a clear decision, the program stops. If not, 500 then 1000 sets of life histories are used to make the decision.

↓

FINDBEST.
The utility of going to CCRC versus staying at home is computed from a simulated life history provided by TRACE2. Also calculates discounted CCRC costs and revenue.

↓

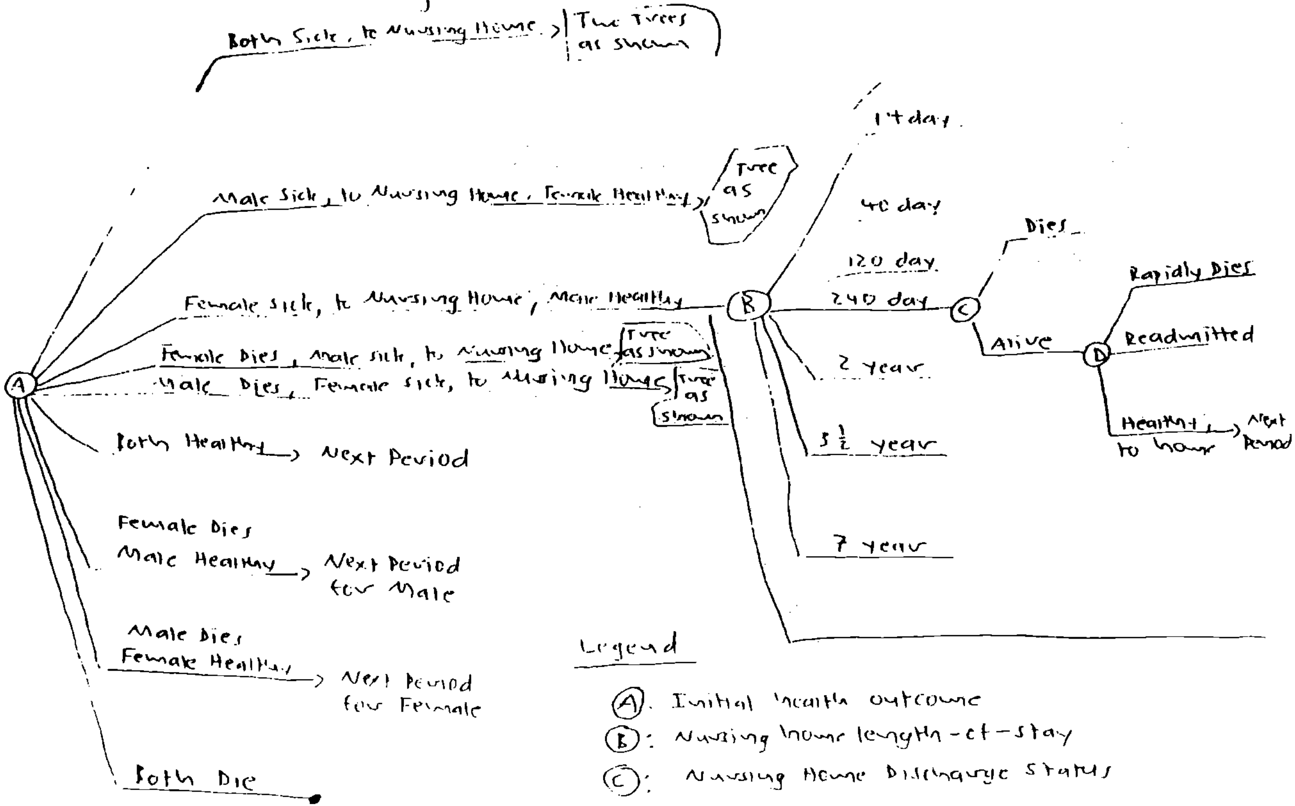
TRACE2. Traces through the entire life of a hypothetical couple through repeated calls to RESULT. Sicknesses, deaths tallied.

↓

RESULT.
Simulates what happens to one person in one year.

Figure 1

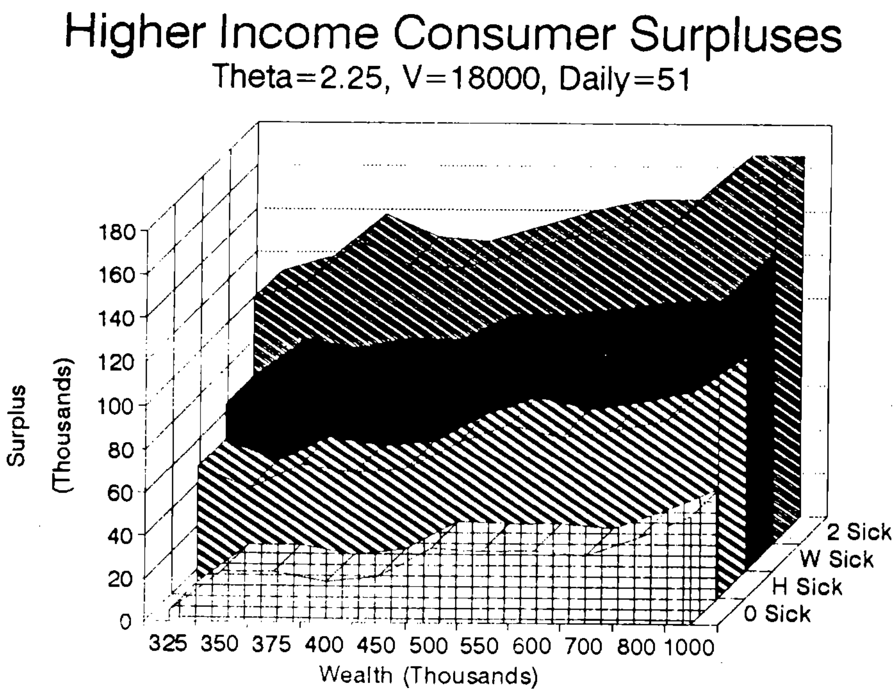
Probability Tree Depicting a Couple's Morbidity and Mortality Experience During a Single Period



Legend

- (A): Initial health outcome
- (B): Nursing home length-of-stay
- (C): Nursing Home Discharge Status
- (D): Post-Discharge events.

Figure 2a



Higher Income Consumer Surpluses
Theta=2.25, V=18000, Daily=51
180
160
140
120
100
80
60
40
20
0
Surplus
(Thousands)
325 350 375 400 450 500 550 600 700 800 1000
Wealth (Thousands)
2 Sick
W Sick
H Sick
0 Sick

Figure 2b

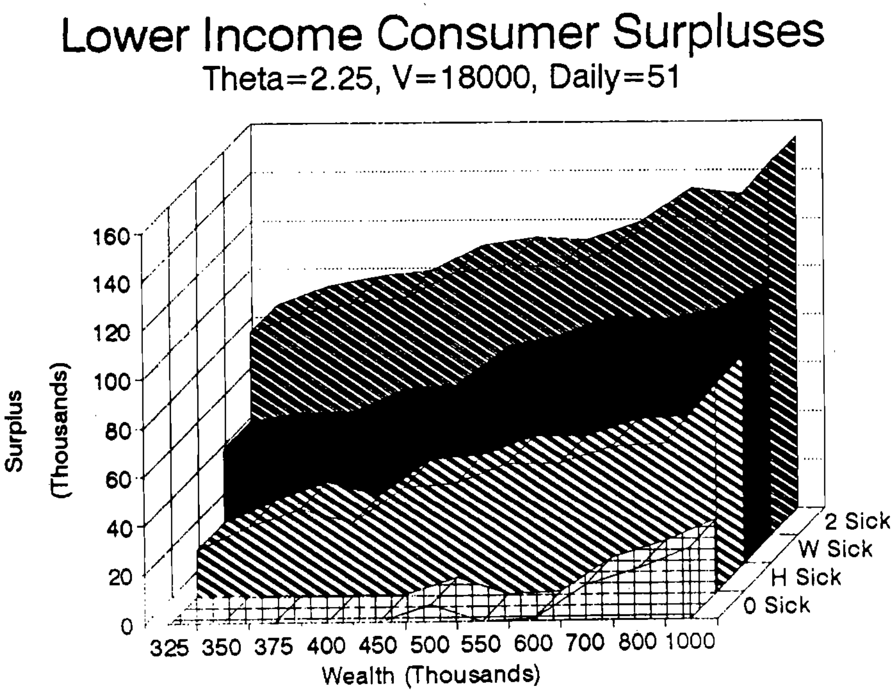

Lower Income Consumer Surpluses
Theta=2.25, V=18000, Daily=51
Surplus
(Thousands)
160
140
120
100
80
60
40
20
0
325
350
375
400
450
500
550
600
700
800
1000
Wealth (Thousands)
2 Sick
W Sick
H Sick
0 Sick

Figure 3

When the Life Care Operator Has Incentive to End a Life