1 Introduction

This is a revised proposal. Changes are denoted with italics. In this introduction, we list the major concerns of the previous proposal and explain how we have addressed them. We use "P" to indicate page of the summary statement and "p" to indicate paragraph number:

1.1 Critique 1

P2p3: [Policy questions section is cursory] We have added some intuition on how to perform the simulations discussed in the text. We have also added detail on some particular policy questions of interest. Details are provided in an enclosed paper, entitled "Simulation of Policy Effects when Corner Solutions are Prevalent."

P3p1: [More needed on variable description] We have added a table and text to provide detail.

P3p1: [More motivation for value of work needed] We have added a paragraph at the end of the Demographic Trends section that we hope motivates the work.

P3p4: [Unclear about the role of nursing home care] We provide much more detail about the issues associated with allowing for nursing home care.

P4p1: [Unclear about use of 1995 wave] We have explained in the Research Design section that we intend to estimate a series of models. We are currently completing estimation and testing of the model presented in the enclosed paper, entitled "Long-Term Care, Home Health Care, and Informal Care." This initial model uses only the 1993 wave. The other proposed models use either the 1995 wave or all three available waves.

P4p2: [Skip pattern in interview concerning time help is of concern] There is a selection problem. The respondent is asked about getting help from children only if she reports having an ADL or IADL problem and needing help most of the time. For the 1993 wave, there is no better alternative. However, it is probably reasonable to assume that parents needing help from children have ADL or IADL problems. In the subsequent waves, there is still a problem though slightly different. In particular, in the first wave, for each ADL problem, the respondent is asked who helps the most. The respondent also is asked who the two people are who help the most with IADL problems collectively. In subsequent waves, the respondent is asked about help for all ADL problems collectively. The respondent is asked who the six people are who help the most with IADL problems. Also, in subsequent waves, the respondent is asked about help even if the respondent needs only a little help. Thus, the selection problem is mitigated but not eliminated in subsequent waves. This is discussed in the proposal.

P4p3: [Need table with description of key variables] We have added a table to provide detail.

P4p3: [Confusion about H] We have included the units of measurement in the definition of variables table.

P4p3: [Confusion about G] G was never meant to correspond to any existing program. Rather it was in the model to allow us to simulate the effects of hypothesized programs affecting the cost of formal or informal care. This was explained in the previous draft in a footnote right below equation (4). We have since taken it out of the presentation.

P4p4: [Selection discrepancy] The numbers do not account for households with more than five living children (625 households). We exclude them to reduce computing costs. Also, we have fewer missing values now because we have reduced the number of covariates. The correct numbers are reported in the new table.

P5p1: [Mechanics of policy simulations] Some of the mechanics of policy simulation are explained in the Policy Questions section. The details are provided in an enclosed paper, entitled "Simulation of Policy Effects when Corner Solutions are Prevalent."

1.2 Critique 2

P6p4: [Some concern about modeling of leisure] The point of this proposal is to measure how families make decisions about long-term care. While it is important to give children the opportunity to have leisure time, it is not clear why it is necessary to model it as part of a household production problem. First, there really is not enough data about the children to provide much information about their household production functions. Second, probably the most important implications of modelling household production are the effects of dependent children

and correlation in the preferences of child and spouse, and we allow for both in our model. Thus, it is not clear there is much to be gained, theoretically.

P6p5: [Disagreement about value of asset data, cost of ignoring asset data] While the AHEAD dataset has many questions about assets, there are too many cases of missing information for the answers to the questions to be valuable to us. For example, approximately 65% of the households did not answer at least one asset question, and on average 10% of the households did not answer a particular question regarding their assets.

In fact, other published evidence suggests that it is not that critical to explicitly control for assets. Pezzin and Schone (1997) find that once they control for nonlabor income, adding additional measures of assets has almost no effect on the time allocation decisions of children or on the use of formal care by the parents. Using the 1989 Long Term Care Survey, Sloan and Shayne (1993) found that most disabled elderly were either eligible for Medicaid or became eligible soon after entering a nursing home. In addition, they found variation in state Medicaid asset eligibility rules did not explain variation in the spend-down process. Evidence presented by Liu *et al.* (1990) from the National Nursing Home Survey indicated that more than 90% of the persons discharged from nursing homes do not spend-down to gain eligibility or were eligible at the time of admittance. Finally, recent research by Gruber and Yelowitz (1999) examined the effects of variation in Medicaid eligibility on assets. They found that elderly individuals spend-down their assets to qualify for Medicaid. For example, in 1993 the Medicaid program lowered wealth holdings by 17.7%.

Some literature (e.g., Bernheim, Shleifer, and Summers, 1985) suggests that assets might affect child behavior in that parents would use assets to induce competition among kids. Neuharth and Stern (2001) provide empirical evidence that such a result is not empirically important. Nevertheless, we include some discussion on how to test the bequest competition hypothesis.

P7p2: [Poor wage equation] Our wage equation is limited by the variables we observe about each child. Nevertheless, it is well within the norms of the literature. For example, in a special issue of the *Journal of Human Resources* on "Women's Work, Wages and Well-Being," Shapiro and Mott (1994) have R^2s of 0.42 for whites and 0.47 for blacks, Klerman and Liebowitz (1994) have R^2s of 0.26 for women and 0.34 for men. Neumark and Korenman (1994) have much higher R^2s but with fixed effects applied to panel data.

P7p2: [Inconsistency in average wages] We have fixed this problem.

P7p2: [Better alternative for price of paid care] We have investigated this suggestion, and we agree that average wages paid to home health care workers by state is available. We intend to use it in further work. However, we also compared the statistical properties of our series with the proposed series. We found that the correlation of the two series is 0.8. The states with significant residuals (after regressing the new series on ours) are the southwestern states and Alaska. We hypothesize that the income distribution might be different in those states given the large number of poor Hispanic immigrants. This suggests the proposed series is better.

P7p3: [Intrahousehold correlation] We allow for intrahousehold correlation in leisure decisions and informal care decisions by allowing the relevant errors to be correlated within a household. This was done in equation (19). In our estimation, we find very large correlations.

P7p4: [Selection bias corrections] We assume the concern here is about the missing observations on people in nursing homes in the 1993 wave. The Heckman two step procedure, described in *Econometrica* 1979, relies upon a method of moments estimation strategy that does not apply here given our maximum likelihood framework. Furthermore, it requires observing the explanatory variables for the missing observations. We could condition on not being in a nursing home. But with no information in the 1993 wave about nursing home residents, this is very unlikely to be successful. In the work we are proposing, this is much less of an issue because nursing home residents are observed in the later waves. In our earlier work (using the NLTCS) discussed in the Literature Review section, we condition on living in the community in the first wave and then look at transitions in later waves.

1.3 Critique 3

P8p2: [Project ends in Sept 2003] We have reduced the project to a two year project.

P9p1: [Avg imputed wage seems low] The average wage of a person from the CPS with characteristics similar to an average AHEAD child is \$11.03 per hour (the average weekly earnings are \$430). Thus, the imputed earnings

of a child in the AHEAD sample are consistent with those found in the CPS sample.

P9p2: [No discussion of quality of proxies] We have added discussion in tables.

P9p2: [Only one specific aim is addressed in detail in proposal] We address the Specific Aim (a) by allowing parent and child characteristics to affect the quality of care (equations (1) and (15)), the burden associated with care (equations (2), (3), and (18)), and the opportunity cost of providing care (equations (4) through (6) and the wage equation in the paper). We address Specific Aims (b) through (d) by adding some detail in the "Policy" section. We show how to address Specific Aim (e) in the "Estimation Results" section.

P9p2: [No description of simulation mechanics] Some of the mechanics of policy simulation are explained in the Policy Questions section. The details are provided in an enclosed paper, entitled "Simulation of Policy Effects when Corner Solutions are Prevalent."

P9p4: [Commitment of Goeree and Byrne] Michelle Goeree and David Byrne are both committed to academic life in general and this project in particular. Michelle Goeree has accepted a tenure track assistant professorship at the University of Amsterdam starting September 2002. Though she will not have access to the data, she will still play an integral role in the research process. Her role is well defined in the "Timeline" below. David Byrne will be on the job market this year. He is a top graduate student of Stern's, and there is no doubt he will receive an offer at a good, research-oriented university. In the past, Stern has placed students at the University of Chicago, Vanderbilt University, Syracuse University, Ohio State University, SUNY Stony Brook, Western Ontario University, the University of Houston, the University of Colorado, UNC Greensboro, and Washington University in St. Louis. Byrne ranks highly among the students with such placements.

1.4 Other Critiques

P10p3: [Three years is too much] We have reduced the project to a two year project.

2 Specific Aims

The goal of this project is to develop and estimate realistic models of family decision making concerning long-term care of elderly parents. Our theoretical and empirical models are rich in the sense that family members face a wide range of options including nursing home care, formal care provided in the elderly individual's home (home health care), informal care, and no care. Despite the rich set of outcomes, our theoretical models are not mathematically complex. Each family member simply maximizes utility, which may depend on the welfare of the parent, subject to a budget constraint. Once we have estimated our models, we will use our results to address the following questions:

a) How do characteristics of family members affect decisions about long-term care such as time spent caring for the parent and financial transfers to the parent?

b) What secular changes in family structure explain secular changes in long-term care?

c) How do government funding rules associated with home health care and nursing home care such as Medicaid funding and tax credits affect family decisions and social efficiency?

d) How do families share the incidence of costs associated with caring for elderly parents?

e) How much of the variation in informal care provided by children may be attributed to variation in opportunity cost (wages), quality of care variation, variation in burden, and variation in other characteristics?

3 Background and Significance

3.1 Demographic Trends

In recent decades, the elderly population has grown substantially. For example, the elderly population increased by 28% between 1980 and 1993. Demographers predict that the elderly population will reach 60 million, or 20% of the total population, by 2025 (Morrison, 1990). Furthermore, as of 1983, the oldest old population, those 85 years and older, was growing faster than any other age-based segment of the American population. People are living longer than ever before and, as they grow older, the elderly experience increasing physical and mental impairments. Although disability rates among the elderly decreased between 1982 and 1994 (Manton, Corder, and Stallard, 1997), the number of disabled elderly individuals has remained approximately constant at 5.5 million (Spector, et al. 1999) because of population aging. Furthermore, the level of disability among those receiving long-term care has increased (Spector, et al. 1999) .

Concurrent with population aging has been a marked shift with regard to long-term care arrangements. Children have become less likely to care for elderly parents, while elderly parents have become more likely to remain independent, move to nursing homes (Boersch-Supan et al., 1988; Wolf and Soldo, 1988), or receive formal care in their homes. For example, only 7% of the oldest old lived in institutions in 1940, but in 1990 approximately 25% of the people in this age group were institutionalized (Kotlikoff and Morris, 1990). Between 1978 and 1991, the number of elderly living in institutions such as nursing homes grew from 1.2 million to 1.4 million (U.S., Bureau of the Census, 1980, 1995). Meanwhile the proportion of those who receive long-term care living with relatives other than spouses declined from 16.1% to 12.8% (U.S., Bureau of the Census, 1996).

Population aging and the trends toward institutional and home health care have significant economic, social, and psychological implications. The high cost of institutional care often exhausts the resources of nursing home residents. Thus, many elderly individuals and their families rely on Medicaid to cover their long-term care expenses. At the aggregate level, nursing home care has accounted for an increasing share of health care costs which, in turn, have accounted for an increasing share of the national budget. Between 1960 and 1980, nursing home care's share of health care expenditures more than doubled from 3.5% in 1960 to 7.1% in 1980. However, its share of health care expenditures has grown more slowly since then, increasing only to 7.6% in 1994 (U.S. Bureau of the Census, 1982; National Center for Health Statistics, 1996). Not only does nursing home care typically create a greater drain on private and public funds than does care by a family member, but institutionalization is likely to involve greater social and psychological costs for an elderly individual (Macken, 1986).

Home health care's share of health care expenditures has also increased dramatically in recent years. For example, it rose from 1% in 1980 to 2.8% in 1994 (U.S. Bureau of the Census, 1982; National Center for Health

Statistics, 1996). By 1992, .9 million individuals were receiving home care (National Center for Health Statistics, 1994a, 1994b). Those receiving home care are generally younger than those in nursing homes. They are predominantly female and disproportionately black.

Despite the trends toward institutional and home health care, adult children remain a factor enabling elderly parents to live in the community. Researchers demonstrate that a majority of the elderly who remain in the community do so with the assistance of familial and social networks (Shanas, 1979a, 1979b, 1980; Cantor, 1983, Streib, 1983, Noelker and Wallace, 1985; Matthews and Rosner, 1988).

Although informal care and family-supported formal care remain important modes of care for the elderly, more families are relying on institutional care for elderly relatives. The trend away from care provided by family members in favor of institutional care has implications for both the welfare of the elderly and for government budgets. Thus, we need to develop policies that 1) encourage families to make caregiving decisions that promote the welfare of their elderly relatives and 2) provide appropriate financial incentives. In order to inform policy makers, we propose estimating a rich model of family caregiving using a proven econometric methodology. Our model allows us to ask relevant questions concerning the relationships among public policy, environmental factors, caregiving behavior, and the welfare of elderly individuals and their families.

3.2 Literature Review

Although predominantly empirical, the long-term care literature offers several theoretical models. These models vary along several dimensions: which family members participate in the decision-making process, which types of care and/or living arrangements are considered, whether family members have common preferences, and whether other decisions are determined jointly with long-term decisions.

Several of the existing theoretical models involve only one child in the decision-making process. For example, Kotlikoff and Morris (1990) restrict their attention to families consisting of an elderly parent and only one child. Pezzin and Schone (1997, 1999) and Sloan, Picone, and Hoerger (1997) present models that apply to families of any size, but only one child plays a role in the family's long-term care decision. As part of an effort to develop more realistic models of family decision making, Hoerger, Picone, and Sloan (1996), Hiedemann and Stern (1999), and Engers and Stern (2001) present models that accommodate a variable number of children and the possibility that all children play a role in long-term care decisions.

Given the variety of long-term care arrangements and the connection between care and living arrangements, one model cannot capture all possible aspects of a family's long-term care and living arrangements. Depending on the focus of the paper, the choice variables in these models involve living arrangements (Kotlikoff and Morris 1990, Hoerger, Picone, and Sloan 1996), care arrangements (Sloan, Picone, and Hoerger 1997, Hiedemann and Stern 1999, Engers and Stern 2001), or both (Pezzin and Schone 1999). Kotlikoff and Morris (1990) present a model where parent and child decide whether to form an intergenerational household or to maintain separate households. In Hoerger, Picone, and Sloan (1996), the family faces a third possible living arrangement for the parent: nursing homes. In Hiedemann and Stern (1999) and Engers and Stern (2001), the family decides whether the parent will continue to live independently without care, receive care from one of the children, or move to a nursing home. Pezzin and Schone (1999) jointly model living arrangements with the provision of care by the child (in this case, a daughter). In Sloan, Picone, and Hoerger (1997), the choice variables are not the type of care or living arrangement but hours of formal care (paid care) and informal care (care provided by the child).

Two of the papers in this literature assume that a single household utility function is appropriate in the context of elderly parents and their adult children. Corresponding to each possible living arrangement in Hoerger, Picone, and Sloan (1996) is a family utility function and budget constraint. In Kotlikoff and Morris (1990), the parent and child solve separate maximization problems if they live separately but maximize a weighted average of their individual utility functions subject to their pooled budget constraint if they live together. In this latter case, the weights are determined by a bargaining process. The remaining models in this literature (Pezzin and Schone 1997, 1999; Sloan, Picone, and Hoerger, 1997; Hiedemann and Stern, 1999; Engers and Stern 2001) are game-theoretic and thus involve separate utility functions for each family member.

The provision of care by adult children may be determined simultaneously with their labor force behavior. Accordingly, Ettner (1996) and Pezzin and Schone (1997, 1999) model labor force participation of adult children

jointly with care and/or living arrangements. Similarly, inter- or intragenerational transfers may be made as part of a family's long-term care decision. This possibility may be captured by assuming that the family pools its income (e.g., Hoerger, Picone and Sloan, 1996) or by explicitly modeling side payments among family members. Pezzin and Schone (1999) model intergenerational cash transfers jointly with caregiving, intergenerational household formation, and labor force behavior. In one of the models in Engers and Stern (2001), family members choose the long-term care alternative that maximizes their joint payoff and make any necessary side payments among themselves.

In all of these models, elderly parents and their adult children jointly select living and/or caregiving arrangements. Most of these models are game-theoretic and thus accommodate the possibility that elderly parents and their adult children have different preferences. However, with the exception of Hiedemann and Stern (1999), Engers and Stern (2001), *and Neuharth and Stern (2001),* the game-theoretic models in this literature are based on the assumption that only one adult child participates in the decision-making process. This assumption considerably simplifies modeling and estimation but obscures the dynamics within the younger generation. In practice, more than one adult child in a family may participate in the family's long-term care decision, and adult siblings may disagree regarding the best source of care for an elderly parent. The potential disagreement among adult siblings and between adult children and elderly parents motivates the development of a game-theoretic framework where the players include the parent and all of her children. The potential disutility of certain outcomes (e.g., providing care, institutionalizing the parent) may generate strategic interaction among adult siblings. For example, a child may prefer to offer care for a parent in the absence of a similar offer from a sibling but may prefer not to offer care in the presence of a sibling's offer. The possibility of such strategic play suggests that a non-cooperative model may be appropriate.

The econometric models in the long-term care literature are as varied as the theoretical models. Most papers present results based on nonstructural models (Boersch-Supan, Kotlikoff, and Morris, 1988; Wolf and Soldo, 1988; Kotlikoff and Morris, 1990; Lee, Dwyer, and Coward, 1990; Cutler and Sheiner, 1993; Ettner 1996; Hoerger, Picone, and Sloan, 1996; Boaz and Hun 1997; Diwan 1997; Norgard 1997; Sloan, Picone, and Hoerger, 1997; White-Means 1997; Couch, Daly, and Wolf 1999), but several recent papers present results based on structural models (Kotlikoff and Morris, 1990; Pezzin and Schone 1997, 1999; Hiedemann and Stern, 1999; Engers and Stern, 2001; *Neuharth and Stern, 2001*).

Table 1
Joint Distribution of Caregiving
Proportions of Families Employing Various
Caregiving Networks in 1984

# Kids	# Obs	No Care	1 Caregiver	Multiple Caregivers
2	775	0.6697	0.2877	0.0425
3	504	0.6190	0.2837	0.0972
4	276	0.5435	0.2971	0.1595
5	175	0.5200	0.3143	0.1657
6	100	0.5300	0.3400	0.1300
7	50	0.4400	0.3200	0.2400
8	35	0.4571	0.3429	0.2000

Source: Neuharth and Stern (2001)

The existing literature generally focuses on the role of a single child in each family as the primary caregiver and ignores the possibility of other children serving as sources of assistance (Frankfather, Smith, and Caro, 1981; Johnson and Catalano, 1981; Cantor, 1983; Johnson, 1983; Stoller and Earl, 1983; Horowitz, 1985; Barber, 1989; Kotlikoff and Morris 1990; Miller and Montgomery, 1990; Pezzin and Schone 1997, 1999; Stern 1994, 1995, 1996; Hiedemann and Stern, 1999; Engers and Stern 2001). However, data from the 1984 National Long-term Care Survey indicate that siblings often share long-term care responsibilities, especially in large families. As indicated in Table 1, almost 10% of families with three children and 24% of families with seven children contain multiple

caregivers. Even if each family uses a single caregiver, one cannot ignore the other children in the family. Children attempt to influence both the amount and the method of caregiving provided by their siblings. Not only are there possibilities for intersibling conflict arising as a result of parental long-term care provision,but a large majority of distant children report emotional support received from siblings regarding the situation of their disabled parent (Schoonover, Brody, Hoffman, and Kleban, 1988).

4 Preliminary Studies

Over the last few years, Stern has been using econometric methods to measure the effects of various parent and child characteristics on a family's choice of primary caregiver. Using the National Long-Term Care Survey (NLTCS), Stern put together a panel data set (two years) with information on the parent, each child, and caregiving arrangements. While the NLTCS has some problems, it was the best data set available when he started this research program. One of the goals of this new work is to construct better data. As discussed in the data section, the AHEAD data offers better measures of income and more information about childrens' economic choices.

In the first few studies, Stern (1994, 1995, 1996) uses instrumental variables methods to measure the effects of family characteristics on families' long-term care decisions controlling for the potential endogeneity of certain characteristics. In other words, he uses methods that account for the unclear causal relationship between certain characteristics and families' long-term care decisions. For example, children who live close to their parents are more likely to provide care than those who live far away. This correlation may occur because distance from the parent reduces one's ability to provide care. But it may occur because caregiving causes one to move closer to the parent (or have the parent move closer to the caregiver). A simple correlation between distance and caregiving propensity would not be sufficient to disentangle the direction of causation. The same point applies to the work status of children.

Stern's (1996) results suggest a hierarchy of decisions in the family. First, family members decide where to live. These decisions probably are made long before the parent needs any care. Then, once the parent needs care, the family decides who will be the primary caregiver (treating distances between family members as essentially fixed). Finally, conditional on caregiving arrangements, each child decides whether to adjust her work status.

Hiedemann and Stern (1999) and Engers and Stern (2001) develop game-theoretic models of how families make decisions and then estimate the parameters of these models using the NLTCS data. Both papers find that the effects of explanatory variables are somewhat robust to how the family decision making process is modeled. Moreover, the results are qualitatively similar to Stern's earlier papers. While Engers and Stern (2001) and Hiedemann and Stern (1999) contribute to our understanding of family long-term care decisions, these papers have several weaknesses. The results suggest that Medicaid financing rules have small effects on behavior. But these results are inconclusive because the measures of financing rules are imprecise. In this work, income and prices are not included because the NLTCS provides poor measures of income and information about variation in relevant local prices was difficult to collect. Also, these models neglect the possibility of shared caregiving.

More recent work improves on these deficiencies. Neuharth and Stern (2001) allow for sharing of caregiving responsibilities across many family members. They find that sharing is important even though the most common caregiving arrangements involve either no care by children or care by just one child. This proposal builds upon the results in Neuharth and Stern (2001). Our present work contributes to the long-term care literature by developing and estimating a model that accommodates shared caregiving in terms of time and financial transfers and by developing better measures of Medicaid eligibility and financing. Thus, our model is richer than previous models, and our results will have more policy relevance.

In our most recent work, described in detail below, we allow for each family member to make decisions about informal care,financial contributions toward formal care, leisure, market work, and consumption. Family members take into account alternative opportunities, the effect of their decisions on the parents' health, and the burden they will incur if offering informal care. The results suggest that burden is the most important factor in determining what type of care is provided.

5 Research Design

5.1 Roadmap

In order to aid the presentation, we first present a baseline theoretical model. The baseline model is a one period model without nursing home care as an option. We have already succeeded in estimating a restricted version of this model, and we report some results from this procedure. Then we discuss how to adjust the model to allow for nursing home care and for multiple periods. For each adjustment, we discuss the necessary changes to the model, new issues it allows us to address, and new problems to be solved.

5.2 Baseline Theoretical Model

Our goal is to model a multigenerational family with varying preferences making decisions about donating time and money to help members of the older generation. Consider a family[1] with M adult children and one or two elderly parents. The family contains between $M+1$ and $2(M+1)$ adults depending on the marital status of the parent and each child. We assume that married couples act as a single player; therefore there are $M+1$ players indexed by $i = 0, 1, 2, .., M$. When indexing married spouses, we use m and f for male and female parent and c and s for child and spouse. Each player makes decisions about consumption X_i, contributions to paid help for the parent *(measured in units of time)* H_i, leisure L_{ik}, time spent caring for each parent t_{imk} and t_{ifk} where $k = m, f$ for parents and $k = c, s$ for children and their spouses. *The children also determine their market work time, but the parents no longer participate in the labor market.* For the parents, t_{0fm} is care provided by the husband for the wife, and t_{0mf} is the care provided by the wife for the husband. At least one of t_{0mf} and t_{0fm} is zero, and, if there is only one parent, both are zero. We abstract from many of the alternatives available to parents including informal care by someone other than a spouse, child, or spouse of a child and the wide diversity of formal alternatives available because they are not very common in the data and therefore not empirically usable. Also, we do not allow for institutional care *in the baseline model* because the first wave of our data set is limited to people in the community. *But we discuss in detail how to allow for institutional care in the subsequent discussion.* Market work time is zero for both parents. For the children and their spouses, market work time is $1 - L_{ik} - \sum_{j=m}^{f} t_{ijk}$.

The health quality of each parent, Q_m and Q_f, is determined by a health production function,

$$\begin{aligned} Q_m &= \alpha_{0mf}\left(t_{0mf} + \gamma t_{0mf}^2\right) + \sum_{i=1}^{M}\sum_{k=c}^{s}\alpha_{imk}\left(t_{imk} + \gamma t_{imk}^2\right) + \mu\sum_{i=0}^{M} H_i + Z_m \qquad (1) \\ Q_f &= \alpha_{0fm}\left(t_{0fm} + \gamma t_{0fm}^2\right) + \sum_{i=1}^{M}\sum_{k=c}^{s}\alpha_{ifk}\left(t_{ifk} + \gamma t_{ifk}^2\right) + \mu\sum_{i=0}^{M} H_i + Z_f \end{aligned}$$

where Z_j is a linear combination of parent j characteristics. The parameters α_{ijk}, γ, and μ measure the *effects of care provide by family members (informal care) and paid care (formal care)* on health quality. *The α_{ijk} coefficients may depend on observed parent and child characteristics.*

The parents' utility function is

$$U_{0i} = \beta_0 + \beta_{10}\sum_{j=m}^{f}\ln Q_j + \beta_{20}\varepsilon_{x0}\ln X_0 + \sum_{k=m}^{f}\beta_{30k}\varepsilon_{L0k}\ln L_{0k} + \sum_{\substack{j,k=m \\ j\neq k}}^{f}\left(\beta_{40jk+}\varepsilon_{t0jk}\right)t_{0jk} + \varepsilon_{u0i} \qquad (2)$$

for $i = m, f$. Similarly, child i's utility function is

$$U_i = \beta_0 + \beta_{1i}\sum_{j=m}^{f}\ln Q_j + \beta_{2i}\varepsilon_{xi}\ln X_i + \sum_{k=c}^{s}\beta_{3ik}\varepsilon_{Lik}\ln L_{ik} + \sum_{k=c}^{s}\sum_{j=m}^{f}\left(\beta_{4ijk} + \varepsilon_{tijk}\right)t_{ijk} + \varepsilon_{ui}. \qquad (3)$$

[1] For now, we supress a family index n that will appear in the Estimation Section *and a time period τ index that will appear in the additions to the model.*

The coefficients β_{1i}, β_{2i}, β_{3ik}, and β_{4ijk} for $i = 0, 1, 2, .., M$ *may depend on observed child and parent characteristics*, and the errors ε_{xi}, ε_{Lik}, and ε_{tijk} are functions of unobserved child *and parent* characteristics. *Each family member's utility depends positively on the parents' health as well as the family member's consumption and leisure. Thus,* $\beta_{1i} \geq 0$, $\beta_{2i} \geq 0$, $\beta_{3ik} \geq 0$, $\varepsilon_{xi} \geq 0$, and $\varepsilon_{Lik} \geq 0$ for $i = 0, 1, 2, .., M$. Each player maximizes U_i over its choices subject to budget and time constraints taking as given the decisions of the other family members. *Children and their spouses face budget constraints of the form:*

$$\max\left[Y_i^*, Y_i^{**}\right] \geq p_{Xi}X_i + qH_i \tag{4}$$

where p_{Xi} is the price of the consumption good, q is the price of a unit of paid care assistance purchased in the parents' state of residence,

$$Y_i^* = \sum_{k=c}^{s} w_{ik}\left(1 - L_{ik} - \sum_{j=m,f} t_{ijk}\right) \tag{5}$$

is labor income,

$$Y_i^{**} = Y_i + sY_i^* \tag{6}$$

is income net of a hypothetical negative income tax ($0 < s < 1$), w_{ik} is the market wage, and Y_i is outside income including government welfare payments. The time constraint is implied by the definition of market work time. We use the structure in equations (4), (5), and (6) because there are some children with $Y_i^* = 0$. Our utility function in equation (3) implies that *consumption is always positive*, so we need to force children's income to be positive. We use the negative income structure implied by equation (6) as a crude approximation of reality. We estimate Y_i and s using Current Population Survey (CPS) data and allow it to vary across states.

For the parent, the budget constraint is

$$Y_0 \geq p_{X0}X_0 + qH_0 \tag{7}$$

if she is not eligible for Medicaid reimbursement of home health care expenses. If she is eligible, the budget constraint is

$$\Psi - \max\left(qH_0 - q\overline{H}, 0\right) \geq p_{X0}X_0$$

where Ψ is the income limit and $q\overline{H}$ is the maximum reimbursable amount for home health care expenses. Eligibility requirements and maximum reimbursable amounts are discussed below. The *parents'* time constraints are

$$1 \geq L_{0k} + t_{0jk}, \quad j, k = m, f; \quad j \neq k$$

where L_{0k} is the leisure time of parent k. *This implies that* $t_{0jk} = 1 - L_{0k}$ *for* $j, k = m, f$ *and* $j \neq k$. The standard nonnegativity constraints also apply: $t_{ijk} \geq 0$ and $L_{0k} \geq 0$ for $k = m, f$, and $L_{ik} \geq 0$, $H_i \geq 0$, and $X_i \geq 0$ for $k = c, s$ and $i = 1, 2, .., M$.

For each child, we can solve for X_i using equation (4) to get

$$X_i = \frac{\max\left[Y_i^*, Y_i^{**}\right] - qH_i}{p_{Xi}}. \tag{8}$$

For the parent, using equation (7), we get

$$X_0 = \frac{Y_0 - qH_0}{p_{X0}}.$$

The model accommodates the possibility that family members do not contribute financial resources or time for caregiving. Thus, for each child, the set of first order conditions (FOCs) for H_i is

$$\frac{\partial U_i}{\partial H_i} \leq 0, \quad H_i \geq 0, \quad \frac{\partial U_i}{\partial H_i} H_i = 0.$$

If *the child provides no financial assistance* ($\frac{\partial U_i}{\partial H_i} < 0$*), then the FOC is*

$$\varepsilon_{xi} \geq \frac{\beta_{1i} \mu p_{Xi} X_i \overline{Q}}{\beta_{2i} q} \tag{9}$$

where $\overline{Q} = \sum_{j=m,f} \frac{\delta_j}{Q_j}$, and $\delta_j = 1$ iff parent j is alive and zero otherwise. If *the child does provide financial assistance* ($H_i > 0$*), then the FOC is*

$$\varepsilon_{xi} = \frac{\beta_{1i} \mu p_{Xi} X_i \overline{Q}}{\beta_{2i} q}. \tag{10}$$

The FOCs for t_{ijk} depend on H_i. If $H_i > 0$, then the FOCs for t_{ijk} can be written as

$$\varepsilon_{tijk} = \beta_{1i} \left[\frac{\mu s_i^* w_{ik} \overline{Q}}{q} - \frac{\alpha_{ijk}}{Q_j} (1 + 2\gamma t_{ijk}) \right] - \beta_{4ijk} \tag{11}$$

where $s_i^* = 1$ if $Y_i^* > Y_i^{**}$ and $s_i^* = s$ if $Y_i^* = Y_i^{**}$ if $t_{ijk} > 0$, and as $\varepsilon_{tijk} \leq \beta_{1i} \left[\frac{\mu s_i^* w_{ik} \overline{Q}}{q} - \frac{\alpha_{ijk}}{Q_j} \right] - \beta_{4ijk}$ if $t_{ijk} = 0$. If $H_i = 0$, then the FOCs for t_i can be written as $\varepsilon_{tijk} = \frac{\beta_{2i} \varepsilon_{xi} s_i^* w_{ik}}{p_{Xi} X_i} - \frac{\beta_{1i}}{Q_j} \alpha_{ijk} (1 + 2\gamma t_{ijk}) - \beta_{4ijk}$ if $t_{ijk} > 0$, and as

$$\varepsilon_{tij} \leq \frac{\beta_{2i} \varepsilon_{xi} s_i^* w_{ik}}{p_{Xi} X_i} - \frac{\beta_{1i}}{Q_j} \alpha_{ijk} - \beta_{4ijk} \tag{12}$$

if $t_{ijk} = 0$.

The FOCs for L_{ik} also depend on H_i. If $H_i > 0$, then the FOCs for L_{ik} can be written as

$$\varepsilon_{Lik} = \frac{\beta_{1i} s_i^* w_{ik} L_{ik} \mu \overline{Q}}{\beta_{3ik} q}. \tag{13}$$

Note that, given the specification of the utility function in equation (3), $L_{ik} > 0$. If $H_i = 0$, then the FOCs for L_{ik} can be written as

$$\varepsilon_{Lik} = \frac{\beta_{2i} \varepsilon_{xi} s_i^* w_{ik} L_{ik}}{\beta_{3ik} p_{Xi} X_i}. \tag{14}$$

For interior solutions, we can summarize the FOCs as equations (10), (11), and (13), and, for the general case, they are all of the equations between equation (9) and (14).

For the parent, the FOC for H_0 is the same as for H_i: $\varepsilon_{x0} \geq \frac{\beta_{10} \mu p_{X0} X_0 \overline{Q}}{\beta_{20} q}$ if $H_0 = 0$, and as $\varepsilon_{x0} = \frac{\beta_{10} \mu p_{X0} X_0 \overline{Q}}{\beta_{20} q}$ if $H_0 > 0$. The FOC for t_{0jk}, for $j \neq k$, can be written as $\varepsilon_{t0jk} \leq -\frac{\beta_{10}}{Q_j} \alpha_{0jk} - \beta_{40jk}$ if $t_{0jk} = 0$, and as $\varepsilon_{t0jk} = -\frac{\beta_{10}}{Q_j} \alpha_{0jk} (1 + 2\gamma t_{0jk}) - \beta_{40jk}$ if $t_{0jk} > 0$. Note that ε_{L0k} is an unnecessary error (in the sense that there is enough random variation to explain any observed event).

Our model allows us to specify and estimate how policy and environmental changes affect behavior through budget constraint effects, through health effects, and through consumption and leisure effects. It is, by far, the most comprehensive and ambitious structural model of family decision making to date.

5.3 Estimation Strategy

5.3.1 Empirical Specification

In order to complete the specification of the model, we need to define how some "parameters" vary across individuals within a family and the joint density of the errors. First, assume that α_{ijk} in equation (1) is a function of parent and child characteristics,

$$\alpha_{ijk} = \begin{cases} \exp\left\{W_j^p \delta_\alpha^{pc} + W_k^p \delta_\alpha^{ph}\right\} & \text{if } i = 0 \\ \exp\left\{W_j^p \delta_\alpha^{pc} + W_{ik}^c \delta_\alpha^c\right\} & \text{if } i > 0 \end{cases} \tag{15}$$

where W_j^p is a vector of parent-j characteristics and W_{ik}^c is a vector of child characteristics for child i ($k = c$) and child spouse characteristics ($k = s$). Next, assume that μ and Z_j in equation (1) are functions of parent characteristics,

$$\mu = \exp\left\{\sum_{j=m,f} W_j^p \delta_\mu^p\right\}, \tag{16}$$

$$Z_j = \exp\left\{W_j^p \delta_z^p\right\}. \tag{17}$$

Next, assume that β_{li} for $l = 1, 2$ and β_{lik} for $l = 3, 4$ in equations (2) and (3) are functions of characteristics of i and ik respectively,

$$\begin{aligned} \beta_{li} &= \begin{cases} \exp\left\{\sum_{k=m,f} W_k^p \delta_{\beta l}^p\right\} & \text{if } i = 0 \quad \text{and } l \leq 2 \\ \exp\left\{\sum_{k=c,s} W_{ik}^c \delta_{\beta l}^c\right\} & \text{if } i > 0 \quad \text{and } l \leq 2 \end{cases} \\ \beta_{3ik} &= \begin{cases} 0 & \text{if } i = 0 \\ \exp\left\{W_{ik}^c \delta_{\beta 3}^c\right\} & \text{if } i > 0 \end{cases} \\ \beta_{4ijk} &= \begin{cases} W_{jk}^p \delta_{\beta 4}^{pp} + W_k^p \delta_{\beta 4}^p & \text{if } i = 0 \\ W_{ijk}^{pc} \delta_{\beta 4}^{pc} + W_{ik}^c \delta_{\beta 4}^c & \text{if } i > 0 \end{cases}. \end{aligned} \tag{18}$$

Note that:

a) β_{30k} appears in no first order conditions because parents' leisure time is determined jointly with their caregiving time. Thus, we set $\beta_{30k} = 0$ with no loss in generality.

b) Increasing the coefficients on the constant term in all β terms has no effect on first order conditions. Thus, we set the coefficients on constant terms equal to 0 for β_{2ik}.

For the joint density of errors, we assume

$$\begin{aligned} \varepsilon_{Xi} &= \exp\left\{\eta_{Xi}\right\}, \qquad \eta_{Xi} \sim iidN\left(0, \sigma_{\eta X}^2\right), \\ \varepsilon_{Lik} &= \exp\left\{\eta_{Lik}\right\}, \\ \begin{pmatrix} \eta_{Lic} \\ \eta_{Lis} \end{pmatrix} &\sim iidN\left(0, \sigma_{\eta L}^2 \begin{pmatrix} 1 & \rho_L \\ \rho_L & 1 \end{pmatrix}\right), \\ \begin{pmatrix} \varepsilon_{tijc} \\ \varepsilon_{tijs} \end{pmatrix} &\sim iidN\left(0, \sigma_{\eta t}^2 \begin{pmatrix} 1 & \rho_t \\ \rho_t & 1 \end{pmatrix}\right), \\ \varepsilon_{t0jk} &\sim iidN\left(0, \sigma_{\eta t}^2\right) \text{ for } j \neq k = m, f, \qquad \varepsilon_{ui} \sim iidN\left(0, \sigma_u^2\right). \end{aligned} \tag{19}$$

5.3.2 The Construction of Child Caring Time

A key issue in estimation is how to interpret the information about child caring time t_{ijk}. In the data, there are two relevant questions:

1) How many days per week does the helper provide help?; and

2) How many hours per day does the helper provide help on days when she helps?

While the responses to the second question provide a continuous measure of hours per day, responses to the first question are categorical: a) every day, b) several times a week, c) once per week, d) less than once per week, and e) never. We can use the answers to these two questions to construct a "pseudo" continuous variable: $t_{ijk} = 7\pi_{ijk}/168$ if she helps every day; $3.5\pi_{ijk}/168$ if she helps several times a week; $\pi_{ijk}/168$ if she helps once per week; $0.5\pi_{ijk}/168$ if she helps less than once per week; and 0 if she never helps (where π_{ijk} is the answer to the second question).

5.3.3 The Likelihood Function

The set of parameters to estimate is

$$\theta = \left(\delta_{\alpha}^{pc}, \delta_{\alpha}^{ph}, \delta_{\alpha}^{c}, \delta_{\mu}^{p}, \delta_{z}^{p}, \delta_{\beta}^{p}, \delta_{\beta}^{c}, \delta_{\beta}^{pc}, \delta_{\beta}^{pp}, \gamma, \sigma_{\eta X}^2, \sigma_{\eta L}^2, \sigma_{\eta t}^2, \sigma_{u}^2, \rho_{\eta}, \rho_{t}\right),$$

and the set of data for observation $n = 1, 2, .., N$ is

$$\left\{[t_{imk}, t_{ifk},\ L_{ik}, w_{ik}, W_i^c, W_i^{pc}, \delta_{ik}]_{k=c}^{s}, \widetilde{H_i}, Y_i, p_{Xi}\right\}_{i=1}^{M_n}$$

and $\left\{t_{0mf}, t_{0fm}, \widetilde{H_0}, \overline{H}, u_0, Y_0, p_{X0}, q, W_m^p, W_f^p, W_{mf}^p, \delta_f, \delta_m\right\}$. The variable t_{ijk} is time spent caring for parent j by family member ik. The variable $\widetilde{H_i} = 1$ iff player i paid for care, i.e., $\widetilde{H_i} = 1\left(H_i > 0\right)$. The variable $\overline{H}$ is the total amount of paid care, i.e., $\overline{H} = \sum_{i=0}^{M} H_i$. The variable $L_{ik} = 1 - \sum_{j=m,f} t_{ijk} - PT_{ik}\frac{20}{168} - FT_{ik}\frac{40}{168}$ is leisure for family member ik where $PT_{ik} = 1$ iff child i (or child i's spouse) works part-time and $FT_{ik} = 1$ iff child i (or child i's spouse) works full-time. The variable w_{ik} is child i's (or child i's spouse) weekly wage. We estimate w_{ik} as a function of the observed characteristics of the child (or spouse) using a different data set. The variable Y_i is a measure of nonlabor income for player i. For the parent, Y_0 is observed. It is assumed that $Y_i = 0$ for $i > 0$. The variable p_{Xi} is the local price level for player i, and q is the price of care in the parents' state. The variable u_0 is the answer to the question about whether the parent considers herself happy and is treated as a discrete measure of U_0. W_{ik}^c are exogenous characteristics for child i (or spouse), W_m^p and W_f^p are exogenous parent characteristics, and W_{ijk}^{pc} and W_{mf}^p are interactions between child and parent characteristics and between father and mother characteristics, respectively. The variable $\delta_{ik} = 1$ iff child ik is alive, and $\delta_j = 1$ iff parent j is alive. Define

$$\zeta_i = \log\left(\frac{\beta_{1i}\mu p_{Xi} X_i \overline{Q}}{\beta_{2i} q}\right). \tag{20}$$

Also, define

$$t_{ij} = \begin{cases} t_{ijk} & \text{if } \delta_{ik} = 1,\ \delta_{il} = 0 \text{ for } l = c, s,\ l \neq k \\ (t_{ijc}, t_{ijs})' & \text{if } \delta_{ic} = \delta_{is} = 1 \end{cases},$$

$$L_i = \begin{cases} L_{ik} & \text{if } \delta_{ik} = 1,\ \delta_{il} = 0 \text{ for } l = c, s,\ l \neq k \\ (L_{ic}, L_{is})' & \text{if } \delta_{ic} = \delta_{is} = 1 \end{cases}$$

for $i > 0$.

The structure of the likelihood contribution for family n, $\pounds_n$, varies with characteristics of the family's choices. Below, we consider two possible cases:

Case 1: $H_0 = 0$:

$$
\begin{aligned}
\pounds_n \;=\; & \left\{ \Pr\left[\widetilde{H}_0 = 0\right] \Pr\left[u_0 \mid \widetilde{H}_0, t_0\right] \prod_{\substack{j=m \\ k\neq j}}^{f} \Pr\left[t_{0jk}\right]^{\delta_k \delta_j} \right\} \bullet \\
& \prod_{i>0:\widetilde{H}_i=0} \left\{ \int_{\eta_{Xi}\geq\zeta_i} \prod_{j=m}^{f} \Pr\left[t_{ij} \mid \widetilde{H}_i = 0, \varepsilon_{Xi}\right]^{\delta_j} \bullet \right. \\
& \left. \Pr\left[L_i \mid \widetilde{H}_i = 0, \varepsilon_{Xi}\right] \frac{1}{\sigma_{\eta X}^2} \phi\left[\frac{\eta_{Xi}}{\sigma_{\eta X}}\right] d\eta_{Xi} \right\} \bullet \\
& \prod_{i:\widetilde{H}_i=1} \prod_{j=m}^{f} \left\{ \Pr\left[t_{ij} \mid \widetilde{H}_i = 1\right]^{\delta_j} \Pr\left[L_i \mid \widetilde{H}_i = 1\right] \right\} \bullet \\
& \iiint\limits_{\substack{\eta_{Xi}\leq\zeta_i \\ i:\widetilde{H}_i=1}} 1\left(\sum_{i:\widetilde{H}_i=1} H_i\left(\eta_{Xi}\right) = \overline{H} \right) \left(\prod_{i:\widetilde{H}_i=1} \frac{1}{\sigma_{\eta X}^2} \phi\left[\frac{\eta_{Xi}}{\sigma_{\eta X}}\right] d\eta_{Xi} \right)
\end{aligned}
\tag{21}
$$

where

$$
H_i\left(\eta_{Xi}\right) = \frac{Y_i + w_i\left(1 - L_i - \sum_{j=m,f} t_{ij}\right) - \frac{\beta_{2i} q}{\beta_{1i}\mu_{\overline{Q}}} \exp\left\{\eta_{Xi}\right\}}{q} \tag{22}
$$

is derived from equations (8) and (10), and *the other terms are derived directly from the first order conditions written as conditions on the errors. The details are provided in Byrne, Goeree, Hiedemann, and Stern (2001) (included in the appendix).* Case 2 ($H_0 > 0$) has a similar but slightly different form. Some of the terms in the likelihood equations need to be simulated. We have developed efficient and accurate methods to perform these simulations. They are all generalizations of the GHK algorithm (Hajivassiliou 1990; Geweke 1991; Keane 1994).

5.4 Data

5.4.1 Data Description

This project uses the *first three* waves of the Asset and Health Dynamics Among the Oldest Old (AHEAD) data set. AHEAD is a nationally representative longitudinal data set designed to facilitate study of Americans *aged 70* or older. Response rates are over 80%. Blacks, Hispanics, and Florida residents are oversampled. *The 1993 wave of AHEAD includes only noninstitutionalized individuals.* The emphasis on the joint dynamics of health, family characteristics, income, and wealth makes it a particularly rich source of information on family decisions associated with the care of elderly relatives. AHEAD offers three main advantages over the widely used National Long-Term Care Survey (NLTCS). In addition to more recent data, AHEAD provides a better measure of income and more information about childrens' economic decisions than the NLTCS. Since Medicaid eligibility depends upon income, we can use the AHEAD data but not the NLTCS data to examine the effects of Medicaid eligibility and financing on a family's long-term care decisions.

So far, we have used 3,583 households out of 6,047 in the first wave of AHEAD data. Households were included in the first wave only if they were residing in the community. As shown in Table 2, we excluded households for a variety of reasons. In most cases (1,116), records were missing data on the respondent's children. The existence of missing variables is likely to be correlated with a lack of connection between parents and children and the mental status of the parent; this is the case in the NLTCS as documented in Stern (1995). Such correlation could lead to selection bias. However, all empirical analysis using large secondary data sources suffer from the same problem,

and AHEAD and NLTCS are the best data sources available. Thus, there is no alternative but to recognize the problem and interpret results with the problem in mind. Households with more than 5 children (625), working respondents (270), and those where each respondent provided care for the other (25) were dropped to reduce the complexity of the model. Only the black and white non-Hispanic groups remained large enough for our analysis.

Table 2 Dropped Household Observations	
Total Housholds	6047
> Five Children	625
Missing Child Variable	1008
Missing Parent Variable	108
Working Respondent	270
Respondents Helping Each Other	25
Small Minority Groups	350
Coding Errors	78
Used Households	3583

Table 3 Inclusion Report on Respondents			
	Female	Male	Total
Black	356	138	494
White	2,748	1,551	4,299
Total	3,104	1,689	4,793

As seen in Table 3, our sample consists of blacks and whites. The total number of Hispanic and other minority households *not previously deleted (350) was not large enough* to include in the project. Other minority groups are not identified by the AHEAD survey. There is nothing we can do to increase the number of other minority respondents because the AHEAD data set is a public sample that we do not control.

Households included in AHEAD contain at least one respondent 70 years old or older. Many households also include spouses, some of whom are less than 70 years old. Spouses of respondents are also respondents. *As a consequence of the exclusion of nursing home residents from the 1993 wave and the inclusion of spouses regardless of age, the characteristics of our sample deviate from that of a representative person, 70 years old or older.* The characteristics of the respondents in our sample are shown in Table 4. On average, the male respondents (35% of the sample) are 77.1 years old with 11.5 years of education and 2.1 living children. Seventy-five percent are married, and 92% are white. (See Table 3 for more information on minority group inclusion.) On average, the female respondents are 77.0 years old with 11.4 years of education and 2.0 living children. Forty-one percent are married, and 89% are white.

Table 4 Selected Characteristics of Respondents		
Characteristic	Male	Female
Age	77.06	76.98
Education	11.50	11.42
Black	0.08	0.11
Living Children	2.06	2.01
Married	0.75	0.41
Number of ADLs	0.51	0.69
At Least 1 ADL	0.19	0.24
Number of IADLs	0.36	0.34

Table 5 Characteristics of Respondents' Children	
Characteristic	Mean
Age	47.65
Male	0.49
Education	13.98
Married	0.70
Number of Children	1.98
Imputed Weekly Wage	437

Nineteen percent of men and 24% of women reported difficulty with an activity of daily living (ADL). The most common difficulty was walking across a room, reported by 15% of male respondents and 18% of female respondents. All other problems with ADLs had prevalence rates of less than 10%. Twenty-two percent of men and 21% of women reported difficulty with an instrumental activity of daily living, most frequently difficulty with walking several blocks, pulling and lifting heavy objects, climbing stairs, or driving. Among the 4% of households reporting receipt of paid help in their home, the average payment was $132 per week. Nine percent of households reported receiving some care provide by their children with an average of 6.7 hours per week.

The average income of households in our sample is $445 per week. Most respondents are covered by Medicare, while few receive assistance from the Supplemental Security Income program and/or from Medicaid (about 5% and 8% respectively).

Table 5 contains information on the children of the respondents. Forty-nine percent of the children are male, and 70% are married. The average child is 47.7 years old with 14 years of education and 2 children. To model the decision-making process of the adult children of the elderly individuals, we need information on the market wages of the children, which is not part of the AHEAD survey. We impute wages using the CPS by regressing log-wages on demographic characteristics of the children available in AHEAD. *The average imputed wage is $437 per week.* We also construct a measure of the leisure time consumed by the children and the respondents by treating time not spent working or helping the parents as leisure. The characteristics of the respondents and their children listed in Tables 4 and 5 will enable us to address the first research question.

Table 6
Description of Variables

Variable	Description	Computational Definition	Notes
L	Leisure time	Residual of time spent working and caring for parent	
p_X	Price of consumption good	Gross state product deflator proxy	See table 7
q	Price of unit of home health care	Wages of home health aides proxy	See table 7
w	Market wage rate	Imputed from regressing log wages on demographics of children	See data description
Y^*	Labor income	Product of market wage and hours worked for child and child's spouse	
Y	Nonlabor income	Reported income from non-work sources including welfare payments	
$\overline{H}$	Total hours of paid care	Maximum reimbursable amount for health care expenses divided by price of home health care	See Tables 7 and 13
Ψ	Medicaid state income limit	State specific guidelines	See Tables 7 and 13

Finally, we construct a number of state-specific variables including a price level of the gross state product (BEA, 1999), the cost of home health care,[2] the average home health care state subsidy (HCFA, 1992), and variation in Medicaid eligibility rules for SSP, medically needy programs and home health care programs (see Table 9). All of these variables affect the budget constraints of the parents and their children in appropriate ways: the price level is used as a price of consumption, the cost of home health care is used as a measure of q in equations (4) and (7), and the average home health care state subsidy is added to the budget constraint of the parent if the parent is eligible for home health care and has formal care. We ignore eligibility rules associated with assets because the asset data in AHEAD is not good enough to determine eligibility and because a family need only spend down assets to meet the asset eligibility requirement.

In Table 6, we describe each of the variables used in this analysis, its description, and how it is computed using available data. Table 7 provides detail on how various price and wage indices are constructed.

[2]Since *we did not know that* it was possible to obtain wages of home health aids by state, we approximated the wage of home health care workers by using the first quintile of the wage distribution in each state from 1993 CPS data. This is available at http://www.epinet.org/datazone/dzlocal.html. I*n the proposed work, we intend to use the series available on average wages of home health care workers by state.*

Table 7 Description of State Specific Variables	
Variable of Interest	Source
Price of home health care	Census of Population 1990 (http://govinfo.kerr.orst.edu/earn-stateis.htm)
Quintile of wage distribution	CPS 1993
Price level	Bureau of Economic Analysis (www.bea.doc.gov/bea/regional/gsp/)
Medicaid Income Limits:	
SSI/SSP	Medicaid Source Book (CRS) Table III-10
Medically needy	Health Care Financing Administration Pub. 02178. Tables 2-5, 2-6
Institutionalized individuals	Medicaid Source Book (CRS) Table III-12

5.5 Estimation Results

We have estimated the model described above allowing covariates to affect α, β_4, and Z with results reported in Table 8. Parents care about their health in that it affects their utility ($\log \beta_1 = 0.382$). Care provided by a child becomes less productive as a parent ages, thus leading to less aid to the parent. Also, children receive more utility from helping a parent as the parent ages. These two effects are identified from one another because both effects influence the amount of time children spend caregiving, but only the α effect influences the parent's utility.

As the parent accumulates ADL problems, caregiving becomes less effective and more burdensome. While this makes sense theoretically, it has a troubling empirical implication that, as ADL problems accumulate, caregiving decreases. We have not yet determined why this happens in the data. Care provided by children is less effective for mothers than for fathers. However, children enjoy caring for mothers more than fathers. Black parents receive greater benefit from relative care. The parent's health declines with age and ADL problems and improves if married.

Care provided by the spouse becomes more effective as the spouse ages but less effective as the spouse accumulates ADL problems. The first result is counterintuitive. Care provided by children becomes less effective as the child ages, but older children receive more utility from caregiving.

Child gender results seem puzzling at first glance. The results suggest that sons ($0.204 - 0.192 = 0.012$) are slightly and statistically insignificantly more effective as caregivers than are daughters. However, sons ($0.412 - 0.743 = -0.331$) receive less utility caring for daughters but again by a statistically insignificant amount. Recall that, on average, sons earn more than daughters, and we control for differences in opportunity cost. Thus, the results suggest that gender differences in the provision of care for elderly parents may be attributed largely to variation in opportunity cost rather than variation in care effectiveness or preferences.

Sons and sons-in-law provide similar care ($0.162 - 0.192 = -0.03$), and daughters provide statistically insignificantly better care than do daughters-in-law (0.162). Surprisingly, sons-in-law receive more utility from providing care than do sons ($0.412 - 0.812 = -0.4$), and daughters-in-law receive more utility from providing care than do daughters (-0.812) but both effects are statistically insignificant.

Married children provide lower quality care and experience greater disutility providing care. The number of one's own children influences the burden associated with caregiving but does not have a significant effect on the quality of care provided by an adult child. These results suggest that caring for elderly parents is particularly burdensome for adult children with their own family responsibilities. The results reveal diminishing marginal productivity of time spent caring for elderly parents ($\gamma < 0$).

An informative way to analyze the results is to decompose, for example, gender effects into opportunity cost effects (wages), quality of care effects ($\partial\alpha/\partial Male$), burden effects ($\partial\beta_4/\partial Male$), and effects due to other child characteristics correlated with gender. Without a formal structural model, such a decomposition would not be possible. Table 9 shows the results of such an analysis. One can see from the last column (by comparing results for sons to results for daughters) that a significant amount of variation in $\log \Pr[t > 0]$ is due to variables other

than wage, α, and β_4. *Such variation makes it somewhat more difficult to interpret the results in the middle three columns.*

Table 8
Estimates with Covariation in $\log \alpha$ and β_4

Variable	Estimate	Variable	Estimate
Parent Characteristics on $\log \alpha$		Parent Characteristics on $\log Z$	
Constant	-5.755**	Constant	-3.708**
	(0.193)		(0.367)
Age/100	-0.786**	Age/100	-1.655**
	(0.010)		(0.165)
Educ	-0.016**	White	-0.159
	(0.002)		(0.140)
White	-0.275*	Married	0.853**
	(0.162)		(0.068)
# ADLs	-0.201**	# ADLs	-0.248**
	(0.028)		(0.028)
Female	-0.321**	Female	-0.333**
	(0.055)		(0.052)
Spouse Characteristics on $\log \alpha$		Parent $\log \beta_1$	0.382**
			(0.092)
Age/100	1.903**	Parent Characteristics on β_4	
	(0.021)		
# ADLs	-0.064**	Constant	-4.820**
	(0.033)		(0.574)
Child Characteristics on $\log \alpha$		Age/100	0.700
			(0.699)
Constant	0.197	White	0.225
	(0.228)		(0.275)
Age/100	-0.781**	# ADLs	-0.224**
	(0.015)		(0.096)
Male	0.204	Female	0.848**
	(0.149)		(0.149)
Biological	0.162	Child $\log \beta_1$	1.644**
	(0.121)		(0.071)
Biological*Male	-0.192	Child $\log \beta_3$	0.151*
	(0.168)		(0.088)
Educ	0.015*	Child Characteristics on β_4	
	(0.010)		
Married	0.099	Constant	-4.722**
	(0.132)		(0.858)
# Kids	0.020	Age/100	9.869**
	(0.018)		(1.293)
Oldest	-0.012	Male	-0.743
	(0.096)		(0.945)
$\log \mu$	-11.226**	Biological	-0.812
	(0.289)		(0.555)
		Biological*Male	0.412
			(0.956)

Table 8 (continued)
Estimates with Covariation in $\log \alpha$ and β_4

Variable	Estimate	Variable	Estimate
Educ	-0.172**	$\log \sigma_{\eta L}$	0.180**
	(0.045)		(0.009)
Married	-10.570**	$\log \sigma_{\eta t}$	0.778**
	(1.959)		(0.084)
# Kids	-0.250**	$\log \sigma_u$	11.556**
	(0.061)		(0.932)
Oldest	0.088	ρ_L	0.900
	(0.205)		
γ	-4.288**	ρ_t	0.900
	(0.305)		
$\log \beta_0$	11.744**		
	(0.817)		
$\log \sigma_{\eta X}$	-0.204**	Log Likl	-13310.3
	(0.055)		

Notes:
1) Numbers in parentheses are standard errors. Single starred items are significant at the 10% level, and double starred items are significant at the 5% level.
2) $\widehat{\rho}_L$ and $\widehat{\rho}_t$ are set equal to
$$\widehat{\rho}_k = 1.8 \frac{\exp\{\lambda_k\}}{1+\exp\{\lambda_k\}} - .9$$
for $k = L, t$ to insure nice properties of the model. Estimates without reported standard errors have standard errors that are trivial.

Table 10 helps by double differencing. Each element in Table 10 is the $\partial^2 \log \Pr[t > 0] \,/\, \partial \text{Effect} \partial \text{Gender}$*; it is the relevant difference in levels for sons and daughters for a particular effect minus the same difference for "No Effects." One can see quickly in Table 10 some strong patterns common across family size. Table 10 shows that, for unmarried children, the largest effect is the burden effect,*

$$\frac{\partial \log \Pr[t > 0]}{\partial \beta_4} \frac{\partial \beta_4}{\partial Male} \approx -1.$$

Sons feel significantly more burden caring for parents than do daughters ($\frac{\partial \beta_4}{\partial Male} = 0.412 - 0.713 = -0.331$*); as a result,* $\log \Pr[t > 0]$ *decreases by* 1 *on average for sons relative to daughters. The quality of care counterbalances the burden effect to some degree,*

$$\frac{\partial \log \Pr[t > 0]}{\partial \alpha} \frac{\partial \alpha}{\partial Male} \approx 0.19.$$

Finally, wage effects reduce $\log \Pr[t > 0]$ *for sons relative to daughters but are relatively small:*

$$\frac{\partial \log \Pr[t > 0]}{\partial w} \frac{\partial w}{\partial Male} \approx -0.08.$$

*This small reduction occurs even though the estimated effect of married on log wages in equation (**??**) is* $0.099 + 0.022 White$*. Second, for married children, the effects are much smaller, because each child is married to a spouse of the opposite gender.*

Table 9
Decomposition of Child Gender Effects on $\log \Pr[t > 0]$

	# Obs	All Effects	Just Wage Effect	Just Quality of Care Effect	Just Burden Effect	No Effects
One Child Families						
Daughters wo/ Spouse	165	-3.595	-3.595	-3.595	-3.595	-3.595
Sons wo/ Spouse	110	-4.690	-4.011	-3.744	-4.822	-3.931
Daughters w/ Spouse	238	-5.391	-5.438	-4.914	-5.660	-5.343
Sons w/ Spouse	238	-5.070	-5.117	-4.753	-5.191	-5.041
Two Children Families						
Daughters wo/ Spouse	361	-4.415	-4.415	-4.415	-4.415	-4.415
Sons wo/ Spouse	238	-5.380	-4.581	-4.313	-5.501	-4.497
Daughters w/ Spouse	675	-5.805	-5.839	-5.295	-6.081	-5.737
Sons w/ Spouse	732	-6.237	-6.263	-5.883	-6.367	-6.184
Three Children Families						
Daughters wo/ Spouse	282	-4.796	-4.796	-4.796	-4.796	-4.796
Sons wo/ Spouse	226	-5.441	-4.640	-4.373	-5.570	-4.559
Daughters w/ Spouse	631	-6.072	-6.095	-5.547	-6.345	-5.990
Sons w/ Spouse	686	-6.526	-6.549	-6.163	-6.648	-6.464
Four Children Families						
Daughters wo/ Spouse	205	-5.373	-5.373	-5.373	-5.373	-5.373
Sons wo/ Spouse	210	-5.976	-5.069	-4.796	-6.093	-4.985
Daughters w/ Spouse	457	-6.128	-6.158	-5.605	-6.414	-6.059
Sons w/ Spouse	432	-6.803	-6.821	-6.414	-6.916	-6.721
Five Children Families						
Daughters wo/ Spouse	99	-5.456	-5.456	-5.456	-5.456	-5.456
Sons wo/ Spouse	93	-5.677	-4.841	-4.567	-5.811	-4.760
Daughters w/ Spouse	247	-6.208	-6.238	-5.682	-6.515	-6.148
Sons w/ Spouse	261	-6.852	-6.869	-6.446	-6.946	-6.752

Notes:
1) Each element in the table is the
$$\log \Pr[t > 0 \mid Male, Effect] - \log \Pr[t > 0 \mid Female, Effect].$$
2) The elements corresponding to single children use the log Pr[that child provides care], and the elements corresponding to married children use the log Pr[that child or spouse of that child provide care].

We also performed a similar exercise for race. On average, whites provide less care than blacks. Part of that is due to an opportunity cost, but a larger part is due to a quality of care difference. The burden effect points in the other direction but is dominated by the other two effects.

Table 10
Decomposition of Child Gender Effects on $\frac{\partial^2 \log \Pr[t>0]}{\partial \text{Effect} \partial \text{Gender}}$

	All Effects	Just Wage Effect	Just Quality of Care Effect	Just Burden Effect
Children without Spouses				
One Child Families	-0.759	-0.080	0.187	-0.891
Two Chilren Families	-0.883	-0.084	0.184	-1.004
Three Children Families	-0.882	-0.081	0.186	-1.011
Four Children Families	-0.991	-0.084	0.189	-1.108
Five Children Families	-0.917	-0.081	0.193	-1.051
Children with Spouses				
One Child Families	0.019	0.019	-0.141	0.167
Two Chilren Families	0.015	0.023	-0.141	0.161
Three Children Families	0.020	0.020	-0.142	0.171
Four Children Families	-0.013	-0.001	-0.147	0.160
Five Children Families	-0.040	-0.027	-0.160	0.173

Notes:
1) Each element in the table is the
$\log \Pr[t > 0 \mid Male, Effect] - \log \Pr[t > 0 \mid Female, Effect]$
$- \log \Pr[t > 0 \mid Male, No\ Effects] -$
$\log \Pr[t > 0 \mid Female, No\ Effects]$.
2) The elements corresponding to single children use the $\log \Pr$[that child provides care], and the elements corresponding to married children use the $\log \Pr$[that child or spouse of that child provide care].

5.6 Medicaid Financing Rules

Medicaid is a joint federal/state, means-tested entitlement program that finances medical assistance to persons with low income. Federal contributions to each state vary according to a matching rule that depends upon which medical services are financed by the state. Medicaid is estimated to have served 31.4 million persons in FY 1992 at a combined cost of $118.8 billion, about 15% of total national health spending (Congressional Research Service, 1993, p. 1).

Eligibility for Medicaid is linked to actual or potential receipt of cash assistance under the Supplemental Security Income (SSI) program or the former Aid to Families with Dependent Children (AFDC) program. *In designing their Medicaid programs, states must adhere to federal guidelines. Even so, variation among state programs is considerable. States participating in the Medicaid program have great flexibility in determining eligible groups, services covered, and reimbursement rates for services. Eligibility in each state depends upon the state's policies with regard to three main groups: "categorically" needy individuals, medically needy individuals, and individuals residing in medical care institutions or needing home and community-based care.*

Elderly persons become "categorically" eligible for SSI payments by passing two tests. They must have countable income (income less $20), as well as countable resources, below standards set by federal law. For 1993, the SSI income limit was $434 per month for individuals and $652 per month for couples. Countable resources generally refer to liquid assets such as money in bank accounts, stocks and bonds, mutual fund investments, and certificates of deposit. In 1993, the SSI resource limits were $2000 for individuals and $3000 for couples. Applied to state Medicaid programs, the categorical requirement is more complicated. States may apply different standards to

determine Medicaid eligibility.

First, states have the option of supplementing the federal benefit income standard with state supplemental payments (SSP) that are made solely with state funds, resulting in income limits above the federal maximum. Many states provide these additional cash assistance payments because they feel the SSI benefit standard to be insufficient to cover a person's living expenses (Congressional Research Service, 1993, p. 201). In 1991, the SSI benefit for a single individual represented 74% of the federal poverty level (83% for a couple). When states providing Medicaid coverage supplement federal payments, the combined federal SSI and state SSP benefit becomes the effective income eligibility standard.

In addition, states may use more restrictive eligibility standards for Medicaid than those for SSI if they were using those standards prior to the implementation of SSI. States that have chosen to apply more restrictive standards are known as "Section 209(b)" states. In 1993, there were 12 states classified as 209(b) states. These states may use more restrictive income and resource limits or differing methodologies for determining income and resources. States using more restrictive income standards must allow applicants to "spend down" their income as described below.

Medicaid also allows states to cover individuals who are not poor by the relevant income standard but who need assistance with medical expenses. Medically needy individuals have incomes too high to qualify for Medicaid but have incurred significant medical expenses such that their income has been depleted to levels that make them eligible. Although this program is optional, 37 states had a medically needy program in 1993 (House Ways and Means Committee, 1993, p. 1637). Individuals living in states with a medically needy program may deduct medical expenses before applying the income test.

To qualify for medically needy coverage, individuals first deplete their resources to the state's resource eligibility standard and then continue to incur medical expenses until their income meets the level required by the state. In 1993, the resource standard for most states was the same as SSI's: $2000 for individuals and $3000 for couples. For example, a person could not have more than $2000 in a bank account to qualify for medically needy coverage. Income standards for medically needy coverage, however, were often different from the limits specified by SSI in 1993. In most instances they were lower than the SSI/SSP income limit. This is because states must use a single eligibility standard for all medically needy applicants which include families and children as well as the elderly. Federal law stipulates that the medically needy income standard be no more than one-third higher than the AFDC payment. Consequently, the medically needy standard is often lower than the SSI/SSP benefit standard for the elderly, especially for couples.

Medicaid funds a broad range of long-term care services for the elderly including: nursing facility services, home health care, personal care, and home and community-based care services. States are permitted by federal law to establish a special income standard for persons who are residents of nursing facilities or other institutions. The special income limit may not exceed 300% of the maximum SSI benefit. In states without a medically needy program, this "300% rule" is an alternative way of providing coverage to individuals with incomes above the state's limit. Unlike the medically needy, however, individuals with incomes above the 300% limit cannot spend down to Medicaid eligibility, even if their income is insufficient to cover the costs of their care. Under the Section 1915c waiver program, states have the option of covering persons needing home and community-based care services if these persons would otherwise require institutional care covered by Medicaid. In order to implement the program, often referred to as the home and community-based care waiver program, states are required to get HCFA approval. States must assure HCFA that, on average, the cost of providing services with the waiver will not exceed the cost without the waiver. Using these waivers, states can cover a wide range of nonmedical long-term care services including personal care services, rehabilitation, and adult day care. States can limit the services provided with respect to number, type, and location of people served, as well as the volume of services provided.

States use waiver programs to provide services to a diverse long-term care population, including the elderly. Typically states use assessments of ADLs and IADLs to determine whether an individual's functional impairments would require nursing home placement if home and community-based care services were not available. As of December 1991, 40 states had waiver programs serving aged/disabled persons. *Under waiver programs, states may use any or all of the major paths to eligibility that have been discussed.*

Spending for 1915c waiver services has grown dramatically since the enactment of the law in 1981. Federal

and state spending has increased from $3.8 million in FY 1982 to $1.7 billion in FY 1991 (Congressional Research Service, 1993, p. 400). Equivalently, about 13% of Medicaid long-term care spending was for home and community based care in 1991. Programs serving the aged/disabled accounted for 31% of the total waiver spending, while the aged/disabled represented 73% of all persons served in that year.

States also may provide home and community based care to elderly persons under a new, optional Medicaid benefit called home and community-based care for functionally disabled elderly persons (the "frail elderly"). Established by OBRA 90, this new benefit allows states to cover a variety of home and community based services without going through the process of applying for a 1915c waiver. However, under this benefit, federal matching payments are capped. As of July 1992, only two states, Texas and Rhode Island, had made use of the new option, so we will not consider the no-waiver option in the following analysis.

5.7 Policy Questions

Given parameter estimates, our methods and results will allow us to address the following questions:

a) How do characteristics of family members affect decisions about long-term care such as time spent caring for the parent and financial transfers to the parent? We can address this question by simulating the variation in average behavior of families as we vary their characteristics.

b) What secular changes in family structure explain secular changes in long-term care? More specifically, to what extent have decreasing fertility rates, decreasing marriage rates, increasing divorce rates, and increasing geographic distance among family members influenced the trend away from care provided by family members in favor of increased independence, institutional care, and home health care? We can address this question by simulating the variation in average behavior of families as we vary their structure in a process similar to Hiedemann and Stern (1999).

c) How do government funding rules associated with home health care and nursing home care such as Medicaid funding and tax credits affect family decisions and social efficiency? We can address this question by simulating changes in behavior through changes in the family's budget constraints as we change government funding rules. We can measure the social efficiency of various government rules by observing their effects on behavior and the incidence of the changes. *In particular, in the attached paper, we consider in-kind subsidies for formal care, subsidies for informal care, price subsidies for formal care, lump sum subsidies to older people, changing SSI limits, and providing in-kind subsidies for formal care as a function of ADL problems.*

d) How do families share the incidence of costs associated with caring for elderly parents? We can address this question by simulating variation in cost and observing how the cost variation is shared by parents and children.

With respect to each question above, we can simulate the effects of the proposed policy by simulating the errors from the theoretical model and then computing the derivative of choice variables (such as informal care levels) and outcomes (such as well being and utility) conditional on the errors. We have discovered that somewhat sophisticated simulation methods are necessary because most observations are at corner solutions with respect to informal care or financial contributions. Standard simulation methods would waste too much effort in regions of the support of the error where families are at corners. The enclosed paper, entitled "Simulation of Policy Effects when Corner Solutions are Prevalent," provides details. The basic idea is to divide up the support of each error into a part where the family is at a corner and a part where it is not and then to importance sample (Stern 1997) in such a way to ensure that errors from both parts are included.

Currently, we cannot address any questions associated with the use of nursing homes because the first wave of our data has no institutionalized individuals. However, we have started working with a preliminary version of Wave II with nursing home data and plan to use it when its final form becomes available.

5.8 Using Waves II and III

5.8.1 Modeling Issues

There are a number of modeling issues we need to address with the second wave. These are listed below, and potential resolutions are suggested:

1) We need to model nursing homes as a potentially attractive choice. We plan to do this by allowing nursing home use to affect the health production function in equation (1) *and the utility function in equations (2) and (3). In particular, we can adjust equation (1) to*

$$Q_j = \alpha^{\iota}_{0jj'}\left(t_{0jj'} + \gamma t^2_{0jj'}\right) + \sum_{i=1}^{M}\sum_{k=c}^{s}\alpha^{\iota}_{ijk}\left(t_{ijk} + \gamma t^2_{ijk}\right) + \mu^{\iota}\sum_{i=0}^{M} H_i + b^{\iota}_0 Z_j \tag{23}$$

for $j = m, f$, $j' = f$ *if* $j = m$ *and* $j' = m$ *if* $j = f$, *and* $\iota = 1$ *for community and* $\iota = 2$ *for nursing home.*[3] *The specification in equation (23) allows the marginal value of informal care and of formal care to depend upon whether the parent is in the community or a nursing home (because* α^{ι} *and* μ^{ι} *are allowed to vary with* ι*), and it allows the effect of baseline health* Z_j *to interact with community or nursing home.*[4] *In the interest of parsimony, we could consider restricting* $\alpha^2_{ijk} = b_1\alpha^1_{ijk}$ *and* $\mu^2 = b_1\mu^1$. *Next, we can adjust the utility function in equation (2) to*

$$U_{0i} = \beta^{\iota}_0 + \beta^{\iota}_{10}\sum_{j=m}^{f}\ln Q_j + \beta^{\iota}_{20}\varepsilon_{x0}\ln X_0 + \sum_{k=m}^{f}\beta_{30k}\varepsilon_{L0k}\ln L_{0k} + \sum_{\substack{j,k=m\\ j\neq k}}^{f}\left(\beta^{\iota}_{40jk+}\varepsilon_{t0jk}\right)t_{0jk} + \varepsilon^{\iota}_{u0i} \tag{24}$$

and make a similar adjustment for equation (3). This specification allows the utility each family member gets from Q_j *and* t *to depend upon whether the parent is in the community or a nursing home. For the parent,* β^2_{20} *is not identified because we do not observe consumption in the nursing home. So we can set* $\beta^2_{20} = 0$ *without loss of generality (its effect is captured in* β^2_0*. Stern (1994, 1995, 1996), Hiedemann and Stern (1999), and Engers and Stern (2001) used similar mechanisms. To implement the changes implied by equations (23) and (24), we need only allow some of the coefficients in equations (15), (16), and (18) to vary with* ι.

We can allow the terms that vary with ι *to depend upon average state characteristics of nursing homes. In particular, we propose to use daily direct care staff hours per nursing home resident and average ADL problems per resident as measures of average quality of nursing home care. The second variable is a control for severity of need. These variables are available from the American Health Care Association at http://www.ahca.org.*

Once we use a model like this, we need to respecify how decisions are made and how equilibrium occurs. We consider three possibilities:

1. *Each child and the spouse make decisions for each possible value of* ι*, and then the parent chooses whether to live in the community or a nursing home conditional on the children's and spouse's behavior. This is the most straightforward possibility. However, it still requires simulating what each family member would have done had the parent chosen the other alternative. This significantly complicates the first order conditions in equations (9) through (14). But some monotonicity results with respect to choices will help. We have already written a program to simulate equilibrium and can easily make it much more efficient. Engers and Stern (2001) provide some detail how to solve such equilibrium problems efficiently using derivative based optimization algorithms.*

2. *The family maximizes the sum of utilities across family members in deciding (jointly) whether the parent should live in the community or a nursing home. The binding problem with this approach is that it requires adding unobserved and nonlinear sidepayment rules to implement. We propose to work out in more detail the implications of such an assumption but expect not to be able to implement it.*

3. *The children (and possibly the spouse) make credible threats to influence the decision of the parent. Such a threat would be of the form, "I refuse to help you if you stay in the community." Issues associated with such threats are that a) we must determine what constitutes a credible threat; b) there are probably multiple equilibria issues; and c) it is much harder to evaluate the likelihood function. We propose to work out in more detail the implications of such an assumption but expect not to be able to implement it.*

[3] *When a parent is in a nursing home,* H *represents extra formal care paid for by the family.*
[4] *Without loss of generality, we can set* $b^1_0 = 1$.

2) We need to model the dynamic nature of long-term care decisions to the extent that they can be identified by *three* waves of the AHEAD data. Stern (1994, 1995, 1996), Hiedemann and Stern (1999), and Engers and Stern (2001) essentially avoided dynamic issues by modeling only the transition from the parent living independently in 1982 to the long-term care arrangement in 1984. *Here we propose a series of dynamic models:*

1. *The simplest model allows for person-specific effects in equations (23) and adjusted (2), and (3). In particular, we can allow each of the errors in equations (2) and (3) to have a person specific component, constant across time and allow for a person specific unobserved component of Z in equation (23). Such a specification allows for decisions within a family across time to be correlated. Neuharth and Stern (2001) find that allowing for such effects is empirically important. It is straightforward to implement such an assumption econometrically. It involves writing the likelihood function conditional on the person specific effects and then using simulation to integrate over the joint density of the effects. This specification really ignores dynamic issues, but it probably captures the most important serial correlation in decision-making in the data. See Neuharth and Stern (2001).*

2. *Probably, the most important true dynamic effect is caregiver burnout. We can allow for caregiver burnout by modelling* β_4 in equations (*2*) and (*3*) (adusted to allow for nursing homes) as

$$\beta^{\iota}_{4ijk\tau+1} = \beta^{\iota}_{4ijk\tau} + \beta^{\iota}_{5} 1\left(t_{ijk\tau} > \varsigma\right)$$

   where τ is a time index and ς is an estimable burnout threshhold. This specification allows the burden one experiences by providing informal care to increase (or potentially decrease) as one provides more care. There appears to be an identification issue associated with β^{ι}_{5} and the standard deviation of the ε_t person specific effect. This is the standard state dependence/unobserved heterogeneity identification problem described in Heckman (1981). However, the two are separately identified by the pattern of transitions in informal care observed in the data. In particular, unobserved heterogeneity implies certain symmetries in transitions that would not be implied by state dependence. Also, state dependence implies that future (and past) person specific explanatory characteristics should affect today's decisions while unobserved heterogeneity does not. We can estimate the model restricting all state dependence terms to zero and then perform a Lagrange Multiplier test for state dependence.

3. *There are a number of papers following the lead of Bernheim, Schleifer, and Summers (1985) that suggest that children provide informal care for parents as a way to compete for the inheritance of their parents, and parents encourage the competition. Neuharth and Stern (2001) provide evidence that such an effect is not empirically important. However, it is still worthwhile and straightforward to test the bequest competition argument. In the context of this work, we can test the bequest competition hypothesis using Lagrange multiplier test statistics. In particular, we can test the null hypotheses that informal caregiving decisions are independent of the assets of the parents and that informal caregiving decision residuals are independent of the number of siblings. If the bequest competition hypothesis is true, then we should reject both null hypotheses and find that children of parents with more assets provide more informal care and children in larger families provide more care than predicted by the model. The beauty of the Lagrange multiplier test statistic is that it requires only estimating the model under the null hypothesis and then evaluating the derivative of the log likelihood function with respect to the interaction being tested.*

4. *Other relevant dynamics here are associated with wages of the children, the health of the parent, and migration of family members. The data provide very little information about the dynamics associated with any of these dynamics. For example, while there is information about how the parent's health is changing over time, there is not enough information to identify whether those changes are due to informal care decisions of children or whether children make informal care decisions anticipating future changes in the parent's health. So it seems very unlikely that we can provide any convincing evidence relevant to these issues.*

5.8.2 Data Issues

The second *and third waves* of AHEAD data are available for public use. Both waves contains information on the same health, family, wealth, and income characteristics of the respondents as in Wave I and will allow us to model transitions in these variables. *The second wave of data collection ended in May 1996, with a retention rate (from the 1993 survey) of over 85%. There were a total of 7,027 persons that gave an interview for 1995 AHEAD, with 5,222 unique households in which at least one respondent gave an interview. In 1,805 of these households, two respondents gave interviews.* Some effort will be required to ensure that the survey questions are consistent over time and to handle attrition from the sample in a sensible way. *An example of the changing data structure is the way that informal care questions are asked. Given the limited data available in the first wave, we will have to condition the likelihood function on the conditions necessary for informal care to be observed in the first wave when it is observed. This requires a small adjustment in the likelihood function. In particular, the respondent is asked about getting help from children only if she reports having an ADL or IADL problem and needing help most of the time. In the subsequent waves, there is still a problem though slightly different. In particular, in the first wave, for each ADL problem, the respondent is asked who helps the most. The respondent also is asked who the two people are who help the most with IADL problems collectively. In subsequent waves, the respondent is asked about help for all ADL problems collectively. The respondent is asked who the six people are who help the most with IADL problems. Also, in subsequent waves, the respondent is asked about help even if the respondent needs only a little help. Thus, the selection problem is mitigated but not eliminated in subsequent waves. It is probably reasonable to think that almost all of the respondents receiving help from children have an ADL or IADL, implying very little bias at least for the second and third wave. For the 1993 wave, there is no better alternative. We are more worried that the AHEAD data set will exhibit many of the time inconsistency problems that we observed in the National Long-Term Care Survey. These are discussed in detail in Stern (1994). However, we expect smaller problems and have experience dealing with any problems that occur. Another issue is that rehabilitative nursing home stays (paid for by Medicare or private insurance) are very different than permanent nursing home stays (usually paid for by Medicaid or personal savings). Unfortunately, the second and third waves do not provide enough information to distinguish between the two. So we can not distinguish between different types of nursing home stays. Medicaid is the largest source of public financing for nursing home care, accounting for over 51% of the financing in 1993 . Although Medicare does not cover LTC, it accounted for approximately 9% of national nursing home expenditures while 33% was self-financed in 1993. The remaining expenditures were financed through other sources, such as private health insurance or other private or public means (see Snider 1995).* We have spent significant time working with and understanding the preliminary release of Wave II, so we are aware of many of the problems and confident that we will be able to achieve our goals.

5.9 Timeline

Item	Timeframe	Primary Responsibility
1) Finish paper using just Wave I	11/01-12/01	SS
2) Prepare Waves II and III data	4/02-8/02	MG, DB
3) Collect Medicaid eligibility information and other state data for Waves II and III	4/02-8/02	MG
4) Work out theoretical issues	4/02-6/02	SS, BH
5) Construct likelihood function	6/02-10/02	SS, BH
6) Write FORTRAN code	10/02-1/03	SS
7) Estimate model	2/03-8/03	SS, DB
8) Test model	9/03-11/03	SS
9) Perform policy simulations	11/03-2/04	SS, BH, MG
10) Finish writing paper	2/04-5/04	SS, BH

6 Human Subjects

This research will involve the analysis of existing, publicly available data. The method of collection is interview by phone or in person. Characteristics of the sample are reported in Tables 2 through 5.

Most of the data for this project are public use data. However, we have access to a file that identifies the state of residence of each respondent. *Consequently, we follow the guidelines of ISR (the suppliers of the data) and take unusual precautions to protect its confidentiality. This is somewhat different than what we did with our earlier analysis because the machine we were using then is now obsolete. The CD-ROMs containing the original copy of the restricted data will be stored in a safe deposit box at a local bank, separate from all documentation. Only Steven Stern has access to the safe deposit box. The restricted data files will be accessed exclusively on two PCs located in Stern's office at the University of Virginia and Byrne's office (location to be determined). Prior to accessing the restricted data, all external network connections will be turned off by manually unplugging the connection from the back of the PC. The office door will be closed and locked while restricted data is being accessed and when unoccupied. Posted signs will indicate the presence of a restricted use data area and the associated penalties for unauthorized access. Creation of subsets and analyses will be performed only on the PC described above. Software to be utilized includes FORTRAN programs written by Stern and Byrne. Users will not be using hard copy printouts containing the restricted data. All subsets will be deleted from the PC immediately after use and prior to reconnecting network connections.* We keep the data in a PGP encrypted form when not in use. We do not use paper printouts containing the restricted data. When the data are displayed on the workstation monitor (which occurs infrequently), it is positioned so as to prevent unauthorized viewing. The office of the primary researchers are locked when unoccupied. The restricted data reside in a directory that is excluded from filesystem backups. We treat all data derived from restricted data in the same manner as the original restricted data. We understand that the data derived from restricted data includes, but is not limited to: a) subsets of cases or variables from the original restricted data; b) numerical or other transformations of one or more variables from the original restricted data, including sums, means, logarithms, or products of formulas; c) variables linked to another dataset using variables from an HRS restricted dataset as linkage variables. We do not link the HRS restricted dataset to any other dataset. We understand that the following apply: a) no HRS restricted dataset may be linked to any other HRS restricted dataset without the explicit written permission of HRS; b) no dataset including geography at a level of detail finer than Census Division (including the HRS Wave I Interview Dataset) may be linked to any of the following:

1. HRS Wave I Social Security Covered Earnings Data
2. HRS Wave I RSDI Benefits Data
3. HRS Wave I SSI Benefits Data
4. HRS Wave I SSA Summary Earnings and Benefits Data

ISR has *not* yet approved this project and the data protection plan. *But, it approved our earlier plan, and this is more restrictive since it involves no ethernet of LAN connections. Thus, it is very likely ISR will approve it, implying that it believes* that the benefits of the research are worth the risks to respondents, given the protection plan.

We address the six points detailed in the Human Subjects section of the NIH application instructions as follows:

1. This research will involve the analysis of existing data. Consequently human subjects will not be directly involved in the work. The data were collected through an oral interview process. The characteristics of the subject population are described in Tables 3, 3a, 4, and 5. This research will not involve fetuses, pregnant women, children, prisoners, or others likely to be vulnerable. The *second and third waves* of the data do include residents of nursing homes.

2. The data used in the study were obtained through an oral interview process for research use by the public. The data is specifically gathered for research. Confidential data is specifically limited to research use and then only under very tight security measures described in the grant proposal.

3. The recruitment of subjects and consent procedures followed when collecting the data were designed and

implemented by ISR. We are not involved in this process. Nevertheless, we have *had* IRB approval to use the data *in the past*.

4. There are minimal risks to the confidentiality of the respondents in that we have access to a file that identifies the state of residence of each respondent but no other personal identifiers.

5. We follow the extensive security measures to minimize risk to respondent confidentiality as described in the Human Subjects section of the main body of the proposal.

6. We believe the benefits of research in this area to public policy analysis are substantial and worth the risk to the respondents, given the extensive protection plan.

7 Gender, Minority and Children Subjects

We will include women and members of minority groups in the research to the greatest extent possible. Unfortunately, as detailed in Table 3a, we are not able to identify members of the American Indian / Alaskan Native or Asian / Pacific Islander groups. In addition, the representation of the Hispanic group in the data is too small to permit estimation of the effects of interest to our study. While we recognize that cultural differences across minority groups and subpopulations may affect decisions about care for elderly parents, we cannot further address these differences.

There are no publicly available data sets with better representation of minority groups that contain the information we need on income and health variables. Because we are analyzing existing data, we are not able to conduct outreach programs to recruit members of the under-represented minority groups.

Table 3a
Gender and Minority Inclusion

	Female	Male	Unknown	Total
American Indian or Alaskan Native	†	†	†	†
Asian or Pacific Islander	†	†	†	†
Black, not of Hispanic Origin	356	138	0	494
Hispanic	123	85	0	208
White, not of Hispanic Origin	2,746	1,551	0	4,299
Other or Unknown	42	28	0	70
Total	3,269	1,802	0	5,071

† Respondents of this group are not separately identified in the data.

7.1 Participation of Children

Children under the age of 21 are not directly included in this study simply because the elderly parents are too old to have children in this age group. However, the effect children under the age of 21 is included through the grandchildren of the elderly under study. The effect of these grandchildren on caregiving behavior is included by controlling for the presence of children in the household when estimating the behavioral parameters of the adult children of the elderly parents. Because we do not know the age of these grandchildren, we cannot identify which are under 21. Information was not gathered directly from any children under 21 for the data set we use.

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