Human Capital and Economic Opportunity:
A Global Working Group

Working Paper Series

Working Paper No. 2012-019

Dynamic Modelling of Long-Term Care Decisions

Michelle Sovinsky
Steven Stern

September, 2012

Human Capital and Economic Opportunity Working Group
Economic Research Center
University of Chicago
1126 E. 59th Street
Chicago IL 60637
humcap@uchicago.edu

Dynamic Modelling of Long-Term Care Decisions

Michelle Sovinsky
University of Zurich and CEPR

Steven Stern
University of Virginia

June 15, 2012

Abstract

This paper describes and analyzes research on the dynamics of long-term care and suggests directions for the literature to make progress. We discuss sources and causes of dynamics including inertia/state dependence (confounded by unobserved heterogeneity); match-specific effects; and costs of changing caregivers. We comment on causes of dynamics including learning/human capital accumulation; burnout; and game-playing. We suggest how to deal with endogenous geography; dynamics in discrete and continuous choices; and equilibrium issues (multiple equilibria, dynamic equilibria). Next, we evaluate the advantages of different potential data sources (NLTCS, PSID, AHEAD/HRS, SHARE, ELSA) and identify first order data problems including noisy measures of wealth and family structure. We suggest some methods to handle econometric problems such as endogeneity (work, geography) and measurement error. Finally, we discuss potential policy implications of dynamics including the effect of dynamics on parameter estimates and direct policy implications of inertia (implications for family welfare, parent welfare, child welfare, and cost of government programs).

1 Introduction

There has been a long, multidisciplinary, and robust literature on how families make decisions about caring for older parents. Most of the literature has ignored dynamics associated with the decision-making process. However, it is clear that dynamics plays an important role in the process. For example, learning about how to provide care effectively, burnout, asset decumulation, and other issues cause dynamic effects that can have significant impacts on the decision-making process.

In this paper, we discuss the relatively small literature on the dynamics of long-term care and suggest directions for the literature to make progress. We discuss sources and causes of dynamics including inertia/state dependence (confounded by unobserved heterogeneity); match-specific effects; and costs of changing caregivers. We comment on causes of dynamics including learning/human capital accumulation; burnout; and game-playing. We also comment on relevant econometric issues including the potential for endogenous geography; dynamics in discrete and continuous choices; and equilibrium issues (multiple equilibria, dynamic equilibria). We evaluate the advantages of different potential data sources (NLTCS, PSID, AHEAD/HRS, SHARE, ELSA) and identify first order data problems including noisy measures of wealth and family structure. We suggest some methods to handle econometric problems such as endogeneity (work, geography) and measurement error. Finally, we discuss potential policy implications of dynamics including the effect of dynamics on parameter estimates and direct policy implications of inertia (implications for family welfare, parent welfare, child welfare, and cost of government programs).

2 Empirical Issues

A variety of data sources are available that contain information that is useful to study the dynamics of long-term care of elderly people. We focus on five data sets that are used in the literature. These are the Study of Assets and Health Dynamics Among the Oldest Old (AHEAD)/Health and Retirement Survey (HRS), The Survey of Health, Ageing, and Retirement in Europe (SHARE), The English Longitudinal Study of Ageing (ELSA), the Panel Study of Income Dynamics (PSID), and the National Long Term Care Survey (NLTCS). Table 1 provides a summary.

Survey	Countries Included	Survey Years	Sample Size	Age of Respondent	Further Information
AHEAD/HRS	United States	1993, 1995, 1998, then every 2 years	8,222	70+ and spouses	hrsonline.isr.umich.edu/
SHARE	20 European Countries	2004, 2006, 2009, 2011	55,000	50+	share-project.org.
ELSA	England	every 2 years starting in 2002	13,500	50+	natcen.ac.uk/elsa/
PSID	United States	Annually from 1968 to 1997, then every 2 years	18,000	18+	psidonline.isr.umich.edu
NLTCS	United States	1982, 1984, 1989, 1994, 1999, and 2004	20,000	65+	nltcs.aas.duke.edu/

Table 1: Overview of Common Data Sources

All five surveys are longitudinal and contain information on respondents for at least six waves. AHEAD/HRS, SHARE, and ELSA were specifically developed with the intent to be comparable to each other, while each covers different world geographic regions. Each of the five surveys contain information on household member demographics such as sex, age, marital status, and number of children. Information regarding health status varies across the surveys but includes self-reported general health as well as difficulties with activities of daily living (ADLs) and instrumental activities of daily living (IADLs).

Especially relevant is the current living and financial situation of the elderly respondent. Typical information acquired includes specifics about the respondent's current housing situation, housing-related expenses, ownership of durable goods, and expenditure on food. Financial information such as working status and pension receipts is included in many surveys.

Assets are potentially important characteristics that influence an elderly individual's caregiving needs and opportunities in that the ability to purchase care may reduce an individual's dependence on relatives and it may affect one's eligibility for Medicaid funding for nursing home care. There are many well-known issues associated with obtaining accurate wealth and assets information. For example, there is a high incidence of missing data either because individuals are unwilling to provide the information or unable to determine the value. This makes wealth imputation difficult. The PSID survey developed a method, called unfolding brackets, to deal with this issue (Juster et. al., 2006). This involves a series of questions in which the respondent is asked to categorize their assets into ranges, where the ranges get progressively smaller. All of the data sets surveyed here include questions about wealth, income, and assets that use unfolding brackets.

Unfortunately, several issues remain with the asset data reported in AHEAD. One issue concerns large, spurious changes in assets within families across time due to changes in the survey structure (for details, see Hurd, Juster, and Smith, 2003 and Juster et al., 2007). The large variation in asset changes is particularly problematic for dynamic studies where transitions are important.[1] Another issue is that, among wealthier individuals, 1993 assets are understated by a factor of two, and income and asset reports in the second wave are inconsistent with the 1993 wave. This was not resolved in subsequent waves where mean assets double between the second and third waves. Another issue concerns underreporting: financial measures, particularly those related to equity in a second home, are under-reported (Hurd, Juster, and Smith, 2003; Juster et al., 2007) as are income measures (Hurd, Juster, and Smith, 2003).

Each survey also contains information on the family structure and social support of the elderly. Typical items include number of siblings of the respondent and the respondent's circumstances in childhood. Some also survey the children of respondents (AHEAD/HRS, SHARE, NLTCS) as well as caregivers of the respondents (AHEAD/HRS, NLTCS Caregivers Survey). However, the level of detail provided about children and caregivers varies across the data sets. We now discuss each dataset in more detail.

2.1 The Study of Assets and Health Dynamics Among the Oldest Old

AHEAD was first administered in 1993 to a nationally representative sample of around 6000 Americans age 70 and older. Spouses of respondents are also respondents even if they would not otherwise qualify on the basis of their own age, thus increasing the sample size for the initial wave to 8222 respondents. The first wave interviewed only individuals who were living in the community. These respondents were re-interviewed in 1995, 1998, and every two years thereafter. Subsequent waves retain all living respondents; thus later waves include nursing home residents. In 1998, the AHEAD survey was merged with the (closely related) Health and Retirement Survey (HRS).[2]

The survey focuses on the joint dynamics of health and demographic characteristics. The survey contains detailed information on characteristics that influence an elderly individual's caregiving choices such as the financial help and time help provided by family members (most notably children). The presence of a spouse may reduce an elderly individual's need for assistance from adult children or from formal care providers, particularly if the spouse is relatively

[1] Hill (2006) also finds unusual variation in changes in assets in HRS.

[2] Skira (2012), for example, uses potential caregivers in HRS for a study of caregiver behavior.

young and healthy; thus, the survey includes detailed information on both the spouse, such as the spouse's age, and the spouse's activity limitations.

2.2 The Survey of Health, Ageing and Retirement

SHARE in Europe is a cross-national panel of more than 55000 individuals aged 50 or older that reside in one of 20 European countries. Eleven countries were involved in the 2004 baseline study, which included Denmark, Sweden, Austria, France, Germany, Switzerland, Belgium, the Netherlands, Spain, Italy, and Greece. The second wave (in 2006) included information from Israel, the Czech Republic, Poland, and Ireland. The survey's third wave, SHARE-LIFE, has collected detailed retrospective life-histories in fourteen countries in 2008-09. The survey contains a number of elements useful to study the dynamics of care including health related variables (e.g., self-reported health, health conditions and physical functioning, and use of health care facilities), biomarkers (e.g., grip strength and body-mass index) and psychological variables (e.g., psychological health, well-being, and life satisfaction). SHARE also collects information about economic variables (e.g., current work activity, job characteristics, sources and composition of current income, wealth and consumption, housing, and education). As with the AHEAD/HRS survey, SHARE collects information on provision of care and social support such as assistance within families, transfers of income and assets, and social networks.

2.3 The English Longitudinal Study of Ageing

ELSA is a panel survey in England that was started in 2002. It contains information on respondents aged 50 and over and their partners (regardless of age) who were living in the community at the survey start. As with AHEAD/HRS and SHARE, ELSA collects information on health, biometric measures, economic situation, and quality of life. As it was developed to be comparable to the previous two studies, it also contains extensive information on social support, caregiving arrangements, and housing as well as individual and household characteristics.

2.4 The Panel Study of Income Dynamics

The PSID began in 1968 with a nationally representative sample of over 18000 individuals living in 5000 families in the United States. Information on these individuals and their descendants has been collected continuously including data covering employment, income, wealth, expenditures, health, marriage, childbearing, child development, philanthropy, education, and numerous other topics. Unlike the previous datasets, only one person in the household is interviewed, although they are asked questions about their spouse if they are married, and about their parents' living arrangements including where the parent resided and for how long (in the Parental Supplement). Interviews were collected on an annual basis between 1968 and 1997 and then biennially thereafter. Survey content changes slightly across waves, but many content areas have been measured consistently since 1968. Unfortunately these data to do not contain extensive information on caregivers or children. But, given the length of the data, they provide a wealth of information about the dynamics of the elderly population.

2.5 The National Long Term Care Survey

The NLTCS is a longitudinal survey of Americans aged 65 and over. The survey began in 1982 and was designed to study changes in the health and functional status of respondents. The initial sample size was over 20000, and follow-up surveys were conducted in 1984, 1989, 1994, 1999, and 2004. It contains many components that are valuable for studying the elderly population including disability measures, medical conditions, education levels, and income. In addition, it contains information on caregivers (both paid and unpaid), family support, and institutionalization. As well as extensive financial information relating to insurance, medical providers, and Medicare and Medicaid. In four waves (1982, 1989, 1999, and 2004), ancillary surveys were conducted including a caregiver survey that contains data on informal caregivers themselves and a survey administered to survivors of sample persons who had died between 1982 and 1984 and again between 1994 and 1999. The long time periods between waves have advantages and disadvantages, but low usage of the data, at least in economics, suggest that the disadvantages dominate.

3 Literature on Dynamics of Long-Term Care

The literature on dynamics of long-term care models is relatively new. In this section, we describe and analyze six papers that have moved the frontier in this area. We describe each paper in and of itself, and, in the next section, we fit each of the papers into a more general approach to modelling the dynamics of long-term care and family decision-making.

Dostie and Léger (2005) (DL) is the first paper to address this question. It specifies a transition matrix for four states indexed by j (and k): living alone, cohabiting, living in a nursing home, and death. The hazard rate from state j to k is specified as[3]

$$\log h_{jk}\left(t_j\right) = x_t \beta_{jk} + \gamma_{jk} t_j + \lambda_{jk} u$$

where t_j is duration in state j, x_t is a vector of exogenous, possibly time-varying covariates, and u is a single-factor unobserved heterogeneity term whose effects can vary across transitions (Heckman and Walker 1990). The included variables in x_t are a limited set of demographic characteristics of the parent and some

[3] We adjust the notation in some papers to make it more compatible with the rest of this paper.

ADL and medical health variables; there are no child-specific variables and no environmental variables. The model is estimated using the PSID.

The estimation results show negative duration dependence with respect to time in spell and age for most transitions even in the presence of modelled unobserved heterogeneity. This paper provides valuable information about transitions in living arrangements, in particular, the importance of modeling duration dependence and allowing for unobserved heterogeneity. But it has nothing to say about care provision.

Hotz, McGarry, and Wiemers (2010) also use PSID data and focus more on transitions concerning coresidence of parents and children. The results imply that coresidence benefits children at least as often as it benefits parents. The direction of this effect explains the existence of coresiding children who report no care provided to parents (Hiedemann and Stern 1998; Engers and Stern 2002; Byrne et al. 2009).

Heitmuller and Michaud (2006) (HM) models work and caring behavior together. In some sense, one might think of this as a dynamic version of Ettner (1995). HM models hours worked as

$$h_{it}^* = x_{it}\beta_h + \phi_{hh}h_{it-1} + \sum_{k=1,2} \phi_{hd_k} d_{kit-1} + u_{it}^h, \tag{1}$$

where h_{it}^* is a latent measure of work for (potential) caregiver i at time t with

$$h_{it} = 1\left(h_{it}^* > 0\right),$$

x_{it} is a vector of exogenous covariates, d_{kit} is a dummy variable for care provision of type k, and u_{it}^h is an error. Care provision is modeled as $d_{kit} = 0, 1, 2$, denoting different intensities of care provision (increasing with d_{kit}). The equation determining the level of care to provide is

$$\begin{aligned} d_{jit}^* &= x_{it}\beta_{dj} + \phi_{d_j h}h_{it-1} + \sum_{k=1,2}\sum_{j=1,2} \phi_{d_j d_k} d_{kit-1} + u_{jit}^d, \quad j = 1, 2, \qquad (2) \\ d_{0it}^* &= 0; \\ d_{1it} &= 1\left(d_{1it}^* > 0\right) 1\left(d_{1it}^* > d_{2it}^*\right); d_{2it} = 1\left(d_{2it}^* > 0\right) 1\left(d_{2it}^* > d_{1it}^*\right). \end{aligned}$$

The error, $u_{it} = \left(u_{it}^h, u_{jit}^d\right)'$, is modelled as

$$\begin{aligned} u_{it} &= e_i + \varepsilon_{it}; \\ Ee_ie_i' &= \Omega_e; E\varepsilon_{it}\varepsilon_{it}' = \Omega_\varepsilon. \end{aligned}$$

The model is estimated using maximum simulated likelihood estimation on British data.

It should be noted that HM avoids multiple equilibrium problems by excluding d_{kit}, $k = 1, 2$, from equation (1) and h_{it} from equation (2) (Heckman 1978). However, it is likely that work hours and care provision should be determined contemporaneously. One can imagine that equations (1) and (2) are reduced form equations associated with first order conditions from a well-specified dynamic programming model. HM also make an adjustment for initial conditions issues. Some child characteristics affect decisions, but, because the focus is on a particular child, there is no potential for estimating substitution or complementarity effects across children from the same family which is an important issue in the static literature (e.g., Checkovich and Stern 2002).

The estimates in HM imply that the dynamic effects allowing employment to affect future caregiving are very small and statistically insignificant. Current coresidential caregiving has a negative effect on future employment opportunities of carers, but caregiving outside of the home has a statistically insignificant effect on future employment; HM argues that the estimates are consistent with Ettner (1995). HM finds that both state dependence and unobserved heterogeneity are important sources of persistence in observed choices.

Gardner and Gilleskie (2012) (GG) constructs a dynamic, discrete model in the pseudo-structural sense of papers such as Mroz (1999), Mroz and Savage (2006), or Yang, Gilleskie, and Norton (2009). Using multiple waves of AHEAD, it estimates a dynamic model with endogenous health transitions, health insurance receipt, long-term care arrangement, and wealth. An interesting issue it must tackle is how to use dynamic wealth data that is measured with large errors (see below). The paper finds many significant dynamic effects.

Skira (2012) (Sk) constructs and estimates a dynamic programming, discrete choice model of a child making decisions about caring for a parent and work (in some sense, a more structural version of HM). The model allows present caregiving to affect current and future labor force participation and wages. The model is estimated using a method of moments strategy on the HRS. This is the first and only dynamic structural model of caregiving. The estimates imply that dynamics are important in that present caregiving has large impacts on future labor market outcomes. The estimated model is used to analyze a series of relevant government policies including FMLA amendments and caregiving subsidies.

Hiedemann, Sovinsky, and Stern (2012) (HSS) is a series of pseudo-structural models somewhat similar to HM (without endogenous work). It includes models for the choice of primary caregiver; the independent choices of (potentially) multiple caregivers; and the independent continuous choices of how many hours of caregiving to provide. All models include state dependence and unobserved heterogeneity. Also, a methodology for dealing with initial conditions, which is somewhat specific to models of long-term care, is described and used. HSS is the only paper to include decisions of all family members in a dynamic setting and thus be able to say anything about family decision-making issues. HSS finds large state dependence effects even in the presence of included unobserved heterogeneity. However, it appears that the results confound unobserved heterogeneity with substitution/complementarity effects. The paper finishes with a thorough discussion of issues associated with using dirty wealth data, controlling for potential endogeneity of geographic location of family members (see below), and controlling for initial conditions problems.

4 Modelling Dynamic Effects for Long-Term Care

4.1 Basic Model

Following HSS, we model a latent variable y^*_{ijt} measuring some dimension of the care decision for family member j in family i at time t as

$$y^*_{ijt} = X_{it}\beta_j + Z_{ijt}\gamma + \alpha y_{ijt-1} + u_{ijt} \tag{3}$$

where

- X_{it} is a set of (possibly) time-varying parent characteristics including, for example, parent age, gender, health, ADLs and IADLs;
- Z_{ijt} is a set of (possibly) time-varying child characteristics including, for example, child age, gender, work status, and geographical distance from the parent (or characteristics of other alternatives such as local characteristics of the nursing home market and state Medicaid eligibility rules);
- y_{ijt-1} is the physical (observed) measure of the care decision from the period before, and
- u_{ijt} is an error capturing the effects of unobserved heterogeneity and other unobserved characteristics relevant to the decision-making process.

HSS present three models where y_{ijt} is an indicator for the primary caregiver, an indicator for each child providing any care, and a continuous measure of the amount of care provided. DL is less informative in that it does not distinguish among different child care providers, but it is more general in that it allows for a more flexible duration dependence.[4] HM has a similar structure for care provision but adds another similar equation for the work decision of the child. GG models health transitions, health insurance coverage, long-term care arrangement, and savings and gifting behavior with equations similar to equation (3) for each dependent variable.

4.2 Sources and Causes of Dynamics

An important potential sources of dynamics in these models is state dependence (DL, HM, GG, and HSS all allow for state dependence). State dependence is captured in equation (3) by the inclusion of y_{ijt-1} in the model. As is well known (Heckman 1986), it is easy to mistake unobserved heterogeneity for state dependence. Thus, it is important to allow for unobserved heterogeneity in the error in equation (3),

$$u_{ijt} = e_{ij} + \varepsilon_{ijt} \tag{4}$$

where e_{ij} is the unobserved heterogeneity and may, itself, decompose into a family-specific and child-specific effect. DL, HM, GG, and Sk all allow for

[4] The model in equation (3) assumes a Markov structure, while DL allow for duration dependence.

unobserved heterogeneity of a type similar to equation (4). HM uses a specification equivalent to equation (4). DL uses a one-factor model with different factor loadings (Heckman and Walker 1990). GG uses a simultaneous equations discrete factor structure (Mroz 1999) with 4 permanent mass points and 2 time-varying mass points. Sk uses a discrete factor structure (Heckman and Singer 1984) with 2 mass points, each point having 8 components). HSS experiments with different error structures across their three models. All models incorporate parent-specific effects and then they experiment with child-specific and parent/time-specific effects. All effects are modeled as normal random variables. It finds that the parent-specific effects are significant, and the other effects are not.

HM controls for the initial conditions problem following Heckman (1981) and Alessie, Hochguertel, and van Soest (2004), by approximating the relevant probability function for the first period outcomes flexibly, thus adding a number of parameters to the estimation procedure. Its estimates suggest that first period unobserved heterogeneity is uncorrelated with subsequent unobserved heterogeneity, which is not consistent with the model. Sk controls for the initial conditions problem, following Aguirregabiria and Mira (2010), by modelling the probabilities of the unobserved heterogeneity types as parametric functions of the initial state variables. It finds that first period state variables have important effects on unobserved heterogeneity type probabilities.

A second source of dynamics is the existence of match-specific effects. For example, Jovanovic (1979) and Berkovec and Stern (1991) model a match-specific component to the productivity of a worker at a particular firm. This causes dynamic effects because, once a worker and firm separate, there is no possibility of the two matching up together, and so the match-specific component is lost. In effect, a worker might choose to stay at a firm with a high match value even if there is a temporary small value of the flow. In terms of the model above, one might continue to provide care if e_{ij} is high even if $e_{ij} + \varepsilon_{ijt}$ is temporarily low caused by a small realization of ε_{ijt}. In a dynamic model of care provision, such a source of dynamics is unlikely to be important because, even if the parent changes from a child with a large match-specific component (e_{ij}) to one with a smaller match-specific component because of a short-term problem with the child with the large match-specific component, there is the option to return to that child later without losing the good match.[5] Thus DL, HM, GG, and HSS all decline to introduce this potential source of dynamics.

A likely cause of dynamic effects is a cost of changing states. For example, Berkovec and Stern (1991) include a job-starting cost and find it is, by far, the most important source of dynamic behavior in the model. Structural models of divorce (Van der Klaauw 1996; Brien, Lillard, and Stern 2006), career changes (Keane and Wolpin 1997), and empirical IO models of entry (Aguirregabiria and Mira, 2007) place a lot of emphasis on this source of dynamics. Care provision start costs could be quite large as they could involve significant changes in work arrangements or relocation decisions (Sk). Such costs would result in state

[5] An exception might be ending a relationship with a particular formal care provider.

dependence of the type modeled in equation (3).

Another potential cause of dynamics is human capital accumulation associated with providing care. It might be the case that, the longer one provides care, the better one becomes at providing care. This could occur either because one makes adjustments to make care provision easier or because one might learn "on the job" how to provide care better. Such human capital accumulation could result in either a reduction in the burden incurred by the child in association with providing care or in the quality of care provided by the child. One might interpret a positive estimate of α in equation (3) as evidence of the existence of such an effect.

Another potential cause of dynamics is "burnout" experienced by the care provider associated with longer time providing care. Seltzer and Li (2000) provide a survey of the psychological literature on burnout. It cites much longitudinal work documenting changes in the well-being of caregivers and the existence of burnout (e.g., Aneshensel et al. 1995; Goode et al. 1998; Li, Seltzer, and Greenberg 1999). Also it cites some work showing direct effects of the level of stress felt by caregivers on transition probabilities into other caregiving arrangements, in particular nursing homes (e.g., McFall and Miller 1992; Zarit and Whitlatch 1993; Montgomery and Kosloski 1994; Scott et al. 1997). In other work, for example, Roth et al. (2001), Gaugler et al. (2005a, 2005b), and Perren, Schmid, and Wettstein (2006) decompose changes in caregiver well-being into those caused by changes and severity in parent health and those caused by duration of caregiving. Most use a relatively short horizon. One might interpret a negative estimate of α in equation (3) as evidence of the existence of burnout. Alternatively, burnout might manifest itself as evidence of positive duration dependence in transitions out of caregiving. However, given the relatively short panels used to estimate burnout effects (McFall and Miller 1992; Zarit and Whitlatch 1993; Montgomery and Kosloski 1994; Scott et al. 1997; Roth et al. 2001; Gaugler et al. 2005a, 2005b; and Perren, Schmid, and Wettstein 2006), it is not clear one can distinguish empirically between a negative α and positive duration dependence when using data with waves at least one year apart.

HSS estimates positive values of α across three different models of caregiving. DL finds negative duration dependence with respect to time in spell and age for most transitions even with the inclusion of unobserved heterogeneity (which is similar to estimating a positive alpha). HM also finds the equivalent of positive values of α (larger for coresidential caregiving than for caregiving outside of the home) even with the inclusion of unobserved heterogeneity. It attributes this to transition costs associated with care provision. All three suggest that transition costs and human capital accumulation has a bigger effect than burnout. However, given the robust evidence for burnout in the psychology literature, it is worthwhile determining how to measure these effects separately and simultaneously.

One possible way to decompose the different sources of dynamics is to amend equation (3) to

$$y^*_{ijt} = X_{it}\beta_j + Z_{ijt}\gamma + \sum_{s=1}^{S} \alpha_s y_{ijt-s} + u_{ijt} \tag{5}$$

for some $S > 1$. Such a specification explicitly distinguishes between inertia ($\alpha_s > 0$) and duration dependence ($\Delta_s \alpha_s < 0$). However, for every increment of S, one loses a year of data (initial conditions), and almost all of the usable longitudinal data sets have relatively small time dimensions.[6] Also, one could interpret $\Delta_s \alpha_s > 0$ as human capital accumulation thus destroying the identification argument. Another possibility is to explicitly model well-being of the caregiver and use observed measures of caregiver well-being. One of the Z_{ijt} terms in equation (3) would be the observable, time-varying measure of caregiver well-being, and another equation would be added to model caregiver well-being as a function of, among other characteristics, care provision. This would be somewhat similar to HM except that the second process would be for caregiver well-being instead of the value of working. The advantage of this approach over the former approach (equation (5)) is the source of identification. In the former approach, identification comes solely through the pattern of duration dependence. This is problematic because the time dimension of the relevant longitudinal data sets is small and because attributing $\alpha_s > 0$ to inertia and $\Delta_s \alpha_s < 0$ duration dependence is somewhat subjective. In the latter approach, identification of the effect of caregiving duration on caregiver well-being comes from the empirical analog to $\partial w_{ijt}/\partial d_{ijt}$ where w_{ijt} is well-being of child j at time t and d_{ijt} is the duration of caregiving of j at t; and identification of the effect of well-being on transition probabilities is identified by the empirical analog of $\partial E y_{ijt}/\partial w_{ijt}$ or $\partial E y_{ijt}/\partial w_{ijt-1}$.

There are two other sources of dynamics worth mentioning. First, dynamics may occur through some other variable. For example, HM and Sk have dynamics in the labor force participation decision that cause dynamics for the caregiving decision. GG have dynamics of this type among all of their dependent variables as well. A model including asset spend-down would also have this type of dynamics. A dynamic generalization of Byrne et al. (2009) could also include such dynamics.

The other potential source is strategic game-playing behavior. For example, older children might move away from the parents preemptively to make it more difficult for younger children to avoid caring for the parent (Rainer and Siedler 2009; Johar and Maruyama 2012). Another possibility could involve children competing against each other to gain the favor of the parent (i.e., a dynamic version of Bernheim, Shleifer, and Summers 1985). Another could involve children trying to disguise their true preferences about caregiving from their siblings to affect their siblings' decision-making processes in the future (e.g., an empirical version of Hart and Tirole (1988) or a dynamic version of Lundberg

[6] The significant exception is the PSID (DL; Hotz, McGarry, and Wiemers 2010), but the PSID has very limited data on care provision.

and Pollak (1993) or Heidemann and Stern (1999)).[7]

4.3 Related Issues

4.3.1 Endogenous Geography

In almost all of the empirical literature on family long-term care decisions, geographic distance between the children and the parent is treated as exogenous. Stern (1995) uses lagged geographic distance as an instrument for current geographic distance to handle the endogeneity argument. Hiedemann, Sovinsky, and Stern (2012) explore the potential endogeneity of geography with mixed results. On the one hand, they find some location moves that seem to be motivated by the need of care provision by a parent. On the other hand, such moves occur so infrequently that it would be very difficult to estimate any parameters associated with location choice with any precision.

4.3.2 Dynamics in Discrete and Continuous Choices

In the static, empirical literature on long-term care, most of the focus has been on discrete decisions (e.g., Stern 1995; Hoerger, Picone, and Sloan (1996); Hiedemann and Stern 1999; Pezzin and Schone, 1999a; Engers and Stern 2002; Brown 2006; Stabile, Laporte, and Coyte 2006).[8] In the empirical dynamic literature, DL, HM, and Hotz, McGarry, and Wiemers (2010) consider only discrete choices and outcomes. GG allow for continuous measures of wealth, but their other dependent variables (health transitions, health insurance coverage, and long-term care arrangements) are discrete. Sk models care as a continuous variable but then discretizes it in the estimation methodology. Only HSS estimates a dynamic model with a continuous care variable.

One of the advantages of modeling care as a continuous choice is that it allows one to decompose transitions over time into changes in hours of care and identity of caregivers. For example, HSS amends equation (3) to[9]

$$y^*_{ijt} = X_{it}\beta_j + Z_{ijt}\gamma + \alpha_d y_{ijt-1} + \alpha_c y^*_{ijt-1} + u_{ijt}$$

and finds that both α_d and α_c are important. Also, modelling continuous choices allows one to estimate burden effects and quality effects as in Byrne et al. (2009). In a structural dynamic model, one usually discretizes continuous choice and state variables (e.g., Brien, Lillard, and Stern 2006), still frequently leading to large state spaces. A possible solution to this problem is to follow the empirical IO literature and set up the model so that solving for all optimal continuous choices involves a static problem conditional on discrete choices with dynamics (e.g., Aguirregabiria and Mira, 2007). In the context of long-term

[7] The fact that there is no empirical version of Hart and Tirole (1988) or dynamic version of Lundberg and Pollak (1993) or Heidemann and Stern (1999) suggests that such an approach may be too demanding theoretically and/or empirically.

[8] Exceptions include Sloan, Picone and Hoerger (1997), Pezzin and Schone (1999b), Checkovich and Stern (2002), Van Houtven and Norton (2004), and Byrne et al. (2009).

[9] We ignore some other terms irrelevant to the discussion.

care, one might think of each family member deciding whether to provide care as part of a dynamic problem and then how much care to provide conditional on those providing care as a static problem (see Pezzin, Pollak, and Schone (2007) and Rainer and Siedler (2009) for models with some similarities).

4.3.3 Models with Multiple Children

There are a number of interesting issues to be handled in models with multiple children. An empirical issue is determining whether care provided by different children in the same family are complements or substitutes. In static models, Checkovich and Stern (2002) finds that such care is substitutes, and Byrne et al. (2009) makes functional form assumptions about a care production function that requires such care to be substitutes. In a dynamic model, HSS finds that they are complements. The model structure in Checkovich and Stern (2002) is

$$\begin{aligned} y_{ij}^{*} &= X_i\beta_j + Z_{ij}\gamma + \delta\sum_{k\neq j} y_{ik} + u_{ij}, \\ y_{ij} &= \max\left[0, y_{ij}^{*}\right], \end{aligned}$$

and HSS has a dynamic version of the same thing. If care provision across children are substitutes, then $\delta < 0$ (the more care provided by other siblings, the less needed by each one), while, if they are compliments, then $\delta > 0$.[10] Checkovich and Stern (2002) estimates $\delta < 0$, and HSS estimates $\delta > 0$. It remains an issue for future work to resolve this anomaly.

A different issue is that, in models with multiple agents making discrete choices, there is a strong probability of multiple equilibria existing (Heckman 1978; Bresnahan and Reiss 1991). New methods have appeared in the empirical IO literature to handle such problems in static models (e.g., Tamer 2003). Fontaine, Gramain, and Wittwer (2009) apply the Tamer methodology to the family decision-making problem for long-term care for families with two children. However, there is no work in empirical IO or other fields generalizing for multiple equilibria in dynamic models. More generally, at least with respect to models of family decision-making about long-term care, there are no dynamic equilibrium models, and there are very few relevant to the economics of the family.[11].

5 Potential Policy Implications of Dynamics

In order to develop policies aimed at caring for elderly individuals, it is necessary to accurately predict their future care requirements. Therefore, it is crucial to understand the dynamic factors that affect the living arrangements of

[10] Note that a model like Bernheim, Schleifer, and Summers (1985) would have implications for δ having nothing to do with complementarity/ substitutability. If the reaction of other children to one who is providing a lot of care is to compete and offer more care, then $\delta > 0$; if instead, the other children give up, then $\delta < 0$.

[11] An exception is Mazzocco (2007).

the elderly. In this section, we focus on the importance of modelling and controlling for dynamics in care arrangements as they relate to i) duration dependence/inertia in care arrangements, ii) costs to caregivers and caregiver burnout, and iii) costs to government in providing care.

Even if one is not particularly interested in policy interventions focused on dynamic issues associated with caregiving, if the exclusion of dynamic effects causes significantly biased estimates of parameters of particular interest, then any policy analysis relying on consistent estimates of those parameters will be flawed. Berkovec and Stern (1991) make this point in the retirement literature.

5.1 Duration Dependence / Inertia in Care Arrangements

As many of the studies highlighted indicate, an important dynamic element in long-term care is persistence in care arrangements. This encompasses both the possibility that the choice of the current living arrangement as well as the time spent in a particular living arrangement impacts the chance of transitioning out of the arrangement and the possible destination. Care arrangements may exhibit persistence due to the family's preferences (or constraints) or as a result of inertia. For example, a family's aversion to nursing home care may lead to persistence in informal care arrangements. Duration dependence is likely to play a larger role if the costs of leaving a particular care arrangement change with the time spent in the particular care arrangement. For example, an elderly individual may become emotionally attached to a formal home health aide the longer she receives care from the aide.

Thus, care arrangements can be dependent on past arrangements, both for observed and unobserved reasons, as well as length in the arrangement. DL finds that duration dependence is an important predictor of care arrangement transitions. HSS finds that the effect of inertia in arrangements is strong and significant. These results suggest that the timing of long-term care policy is crucial and that different policies should be developed to reach those currently residing in the community from those residing in an institution.

5.2 Costs to Caregivers and Caregiver Burnout

Most informal care provided by family members is unpaid. However, it can still be costly due to opportunity costs in terms of foregone earnings, household production, and leisure. In addition, providing care to elderly sick parents may take a toll psychologically on the caregiver. As a result, caregivers may experience burnout, which could result in changes in care arrangements over time. For example, an elderly individual's care arrangements may evolve as her health deteriorates or her spouse dies. Furthermore, within the context of informal care, there may be transitions in the actual caregiver if adult children rotate the role of primary caregiver to share the burden.

Given that most disabled elderly people would prefer to receive care in the community, it is important to consider ways to compensate caregivers for their opportunity costs of time or provide them with relief as they experience burnout

(Sk). Thus, one way to reduce nursing home expenses may be to subsidize informal caregivers. This plays a larger and larger role as the number of disabled elderly people continues to grow resulting in a larger Medicaid burden for state budgets. However, controlling for dynamics may affect policy analysis significantly. For example, Pezzin, Kemper and Reschovsky (1996) perform a static analysis of the Channeling experiment and ignore dynamics (which is reasonable given the nature of the program). However, if human capital accumulation in caregiving skills is important, then the estimated Channeling effects would be larger than reported, while, if burnout is important, then it is probably less effective.

5.3 Costs to Government

Most long-term care arrangements are not covered by Medicare or private insurance. However, nursing homes cost $55000 per year on average (Kassner, 2004). Recent work suggests that elderly people are spending down their savings to qualify for Medicaid as they anticipate their need for institutional care. (Hoerger, Picone, and Sloan, 1996; Hubbard, Skinner, and Zeldes, 1995; Norton, 1995). This spending down of income is an inherently dynamic effect, and hence the appropriate policy prescription depends both savings and care arrangement decisions. For example, it is important to consider how Medicaid policies regarding eligibility and benefits affect savings patterns and whether these policies impact Medicaid take up (GG). Sk measures the effect of changes in FMLA rules on labor market participation for potential care providers which obviously also has implications for income tax revenues and government expenditures associated with reduces labor market participation (e.g. TANF, Social Security)

6 Conclusions

References

[1] Aguirregabiria, V. and P. Mira (2007). "Sequential Estimation of Dynamic Discrete Games." *Econometrica*, 75(1): 1-53.

[2] Aguirregabiria, V. and P. Mira (2010). "Dynamic Discrete Choice Structural Models: A Survey." *Journal of Econometrics*. 156: 38-67.

[3] Alessie, R., S. Hochguertel, and A. van Soest (2004). "Ownership of Stocks and Mutual Funds: A Panel Data Analysis." *Review of Economics and Statistics*. 86(3): 783–796.

[4] Aneshensel, C., L. Pearlin, J. Mullan, S. Zarit, and C. Whitlatch (1995). *Profiles in Caregiving: The Unexpected Career.* Academic Press, San Diego.

[5] Berkovec, James and Steven Stern (1991). "Job Exit Behavior of Older Men." *Econometrica*. 59(1): 189-210.

[6] Bernheim, Douglas, Andrei Shleifer, and Lawrence Summers (1985). "The Strategic Bequest Motive." *Journal of Political Economy*. 93: 1045-1076.

[7] Berry, Steven (1992). "Estimation of a Model of Entry in the Airline Industry." *Econometrica*. 60(4): 881-917.

[8] Bresnahan, Timothy and Peter Reiss (1991). "Entry and Competition in Concentrated Markets." *Journal of Political Economy*. 99(5): 977-1009.

[9] Brien, Michael, Lee Lillard, and Steven Stern (2006). "Cohabitation, Marriage, and Divorce in a Model of Match Quality." *International Economic Review*. 47(2): 451-494.

[10] Brown, Meta (2006). "Informal Care and the Division of End-of-Life Transfers." *Journal of Human Resources.* 41(1): 191-219.

[11] Byrne, David, Michelle Goeree, Bridget Hiedemann, and Steven Stern (2009). "Formal Home Health Care, Informal Care, and Family Decision-Making." *International Economic Review*. 50(4): 1205-1242.

[12] Checkovich, Tennille and Steven Stern (2002). "Shared Caregiving Responsibilities of Adult Siblings with Elderly Parents." *Journal of Human Resources.* 37(3): 441-478.

[13] Dostie, Benoit and Pierre Thomas Léger (2005). "The Living Arrangement Dynamics of Sick, Elderly Individuals." *Journal of Human Resources.* 40(4): 989-1014.

[14] Engers, Maxim and Steven Stern (2002). "Long-Term Care and Family Bargaining." *International Economic Review*. 43(1): 73-114.

[15] Ericson, Richard and Ariel Pakes (1995). "Markov-Perfect Industry Dynamics: A Framework for Empirical Work." *Review of Economic Studies.* 62(1): 53-82.

[16] Ettner, S. (1995). "The Impact of 'Parent Care' on Female Labor Supply Decisions." Demography. 32: 63-80.

[17] Fontaine, Romeo, Agnes Gramain, and Gerome Wittwer (2009). "Providing Care for an Elderly Parent: Interactions Among Siblings?" *Health Economics.* 8(9): 1011-1029.

[18] Gardner, Lara and Donna B. Gilleskie (2012). "The Effects of State Medicaid Policies on the Dynamic Savings Patterns and Medicaid Enrollment of the Elderly." *Journal of Human Resources*. forthcoming.

[19] Gaugler, J., R. Kane, R. Kane, T. Clay, and R. Newcomer (2005a). "The Effects of Duration of Caregiving on Institutionalization." *Gerontologist*. 45(1): 78-89.

[20] Gaugler, J., R. Kane, R. Kane,and R. Newcomer (2005b). “The Longitudinal Effects of Early Behavior Problems in the Dementia Caregiving Career.” *Psychology and Aging.* 20(1): 100-116.

[21] Goode, K., W. Haley, D. Roth, and G. Ford (1998). “Predicting Longitudinal Changes in Caregiver Physical and Mental Health: A Stress Process Model.” *Health Psychology.* 17: 190-198.

[22] Hart, Oliver and Jean Tirole (1988). “Contract Renegotiation and Coasian Dynamics.” *Review of Economic Studies.* 55: 509-540.

[23] Heckman, James (1978). “Dummy Endogenous Variables in a Simultaneous Equation System.” *Econometrica.* 46(4): 931-959.

[24] Heckman, James (1986). “Statistical Models for Discrete Panel Data.” *Structural Analysis of Discrete Data with Econometric Applications.* (eds.) Charles Manski and Daniel McFadden. Cambridge: MIT Press.

[25] Heckman, J. and B. Singer (1984), “A Method for Minimizing the Impact of Distributional Assumptions in Econometric Models for Duration Data,” Econometrica 52

[26] Heckman, James and James Walker (1990). "The Relationship Between Wages and Income and the Timing and Spacing of Births: Evidence from the Swedish Longitudinal Data." Econometrica. 58(6): 1411-1441.

[27] Hiedemann, Bridget, Michelle Sovinsky, and Steven Stern (2012). “Will You Still Want Me Tomorrow? The Dynamics of Families’ Long-Term Care Arrangements.” Unpublished manuscript.

[28] Heidemann, Bridget and Steven Stern (1999). “Strategic Play Among Family Members when Making Long-Term Care Decisions.” *Journal of Economic Behavior and Organization.* 40(1): 29-57.

[29] Heitmueller, Axel and Pierre-Carl Michaud (2006). “Informal Care and Employment in England: Evidence from the British Household Panel Survey.” Unpublished manuscript.

[30] Hoerger, Thomas, Gabriel Picone, and Frank Sloan (1996). “Public Subsidies, Private Provision of Care and Living Arrangements of the Elderly.” *Review of Economics and Statistics.* 78(3): 428-440.

[31] Hotz, V. Joseph, Kathleen McGarry, and Emily Wiemers (2010). “Living Arrangements of Mothers and Their Adult Children Over the Life Course.” Unpublished manuscript.

[32] Hubbard, R. Glenn, Jonathan Skinner, and Stephen P. Zeldes (1995). “Precautionary Saving and Social Insurance.” *Journal of Political Economy* 103(2): 360-399.

[33] Johar, Meliyanni and Shiko Maruyama (2012). “Externality and Strategic Interaction in the Location Choice of Siblings under Altruism toward Parents.” Unpublished manuscript.

[34] Jovanovic, Boyan (1979). “Job Matching and the Theory of Turnover.” *Journal of Political Economy.* 87(5, pt. 1): 972-990.

[35] Juster, F. Thomas, Cao, Honggao, Perry, Michael and Couper, Mick P. (2006). "The Effect of Unfolding Brackets on the Quality of Wealth Data in HRS." Michigan Retirement Research Center Research Paper No. WP 2006-113.

[36] Kassner, Enid (2004). “Long Term Care Insurance.” Fact Sheet #7R. American Association of Retired Persons Public Policy Institute.

[37] Keane, Michael and Kenneth Wolpin (1997). “The Career Decisions of Young Men.” *Journal of Political Economy.* 105(3): 473-522.

[38] Lawton, M., M. Moss, M. Kleban, A. Glicksman, and M. Rovine (1991). “A Two-Factor Model of Caregiving Appraisal and Psychological Well-Being.” *Journal of Gerontology: Psychological Sciences.* 46: 181-189.

[39] Li, L., M. Seltzer, and J. Greenberg (1999). “Changes in Depressive Symptoms Among Daughter Caregivers: An 18-Month Longitudinal Study.” *Psychology and Aging.* 14: 206-219.

[40] Lundberg, Shelley and Robert Pollak (1993). “Separate Spheres Bargaining and the Marriage Market.” *Journal of Political Economy.* 101(6): 988-1010.

[41] Mazzocco, Maurizio (2007). “Household Intertemporal Behaviour: A Collective Characterization and a Test of Commitment.” *Review of Economic Studies.* 74: 857-895.

[42] McFall, S. and B. Miller (1992). “Caregiver Burden and Nursing Home Admission of Frail Elderly Persons.” *Journal of Gerontology: Social Sciences.* 47: S73-S79.

[43] Montgomery, R. and K. Kosloski (1994). “A Longitudinal Analysis of Nursing Home Placement for Disabled Elders Cared for by Spouses vs. Adult Children.” Journal of Gerontology: Social Sciences. 49: S62-S74.

[44] Mroz, Thomas (1999). "Discrete Factor Approximation in Simultaneous Equation Models: Estimating the Impact of a Dummy Endogenous Variable on a Continuous Outcome." Journal of Econometrics. 92(?): ?-?.

[45] Mroz, Thomas and David Guilkey (1992). “Discrete Factor Approximations for Use in Simultaneous Equations Models with Both Continuous and Discrete Endogenous Variables.” Unpublished manuscript.

[46] Mroz, Thomas and Timothy Savage (2006). “The Long-Term Effects of Youth Unemployment.” *Journal of Human Resources.* 41(2): 259-293.

[47] Norton, Edward (1995). "Elderly Assets, Medicaid Policy, and Spend-Down in Nursing Homes." *Review of Income and Wealth* 41(3): 309-329.

[48] Perren, S., R. Schmid, and A. Wettstein (2006). "Caregivers' Adaptation to Change: The Impact of Increasing Impairment of Persons Suffering from Dementia on Their Caregivers' Subjective Well-Being." *Aging and Mental Health.* 10(5): 539-548.

[49] Pezzin, Liliana, Robert Pollak, and Barbara Schone (2007). "Efficiency in Family Bargaining: Living Arrangements and Caregiving Decisions of Adult Children and Disabled Elderly Parents." *CESifo Economic Studies.* 53(1): 69-96.

[50] Pezzin, Liliana, Peter Kemper, and James Reschovsky (1996). "Does Publicly Provided Home Care Substitute for Family Care? Experimental Evidence with Endogenous Living Arrangements." *Journal of Human Resources.*31(3): 650-676.

[51] Pezzin, Liliana and Barbara Schone (1999a). "Intergenerational Household Formation, Female Labor Supply and Informal Caregiving: A Bargaining Approach." *Journal of Human Resources.* 34(3): 475-503.

[52] Pezzin, Liliana and Barbara Schone (1999b). "Parental Marital Disruption and Intergenerational Transfers: An Analysis of Lone Elderly Parents and Their Children." *Demography.* 36(3): 287-297.

[53] Pruchno, R., J. Michaels, and S. Potashnik (1990). "Predictors of Institutionalization Among Alzheimer Disease Victims with Caregiving Spouses." *Journal of Gerontology: Social Sciences.* 45: S259-S266.

[54] Pruchno, R., N. Peters, and C. Burant (1995). "Mental Health of Co-Resident Family Caregivers: Examination of a Two-Factor Model." *Journal of Gerontology: Psychological Sciences.* 50B: 247-256.

[55] Panel Study of Income Dynamics, public use dataset. Produced and distributed by the Institute for Social Research, Survey Research Center, University of Michigan, Ann Arbor, MI

[56] Rainer, Helmut and Thomas Siedler (2009). "O Brother,Where Art Thou? The Effects of Having a Sibling on Geographic Mobility and Labour Market Outcomes." *Economica.* 76(303): 528–556.

[57] Roth, D., W. Haley, J. Owen, O. Clay, and K. Goode (2001). "Latent Growth Models of the Longitudinal Effects of Dementia Caregiving: A Comparison of African American and White Family Caregivers." *Psychology and Aging.* 16(3): 427-436.

[58] Schulz, R. and G. Williamson (1991). "A 2-Year Longitudinal Study of Depression Among Alzheimer's Caregivers." *Psychology and Aging.* 6: 569-578.

[59] Scott, W., K. Edwards, D. Davis, C. Cornman, and C. Macera (1997). “Risk of Institutionalization Among Community Long-Term Care Clients with Dementia.” *The Gerontologist.* 37: 46-51.

[60] Seltzer, Marsha and Lydia Li (2000). “The Dynamics of Caregiving: Transitions During a Three-Year Prospective Study.” *The Gerontologist.* 40(2): 165-178.

[61] Skira, Meghan (2012). “Dynamic Wage and Employment Effects of Elder Parent Care.” Unpublished manuscript.

[62] Sloan, Frank, Gabriel Picone, and Thomas Hoerger (1997). “The Supply of Children’s Time to Disabled Elderly Parents.” *Economic Inquiry.* 35(2): 295-308.

[63] Stabile, Mark, Audrey Laporte, and Peter Coyte (2006), “Household Responses to Public Home Care Programs.” *Journal of Health Economics.* 25: 674-701.

[64] Stern, Steven (1995). “Estimating Family Long-Term Care Decisions in the Presence of Endogenous Child Characteristics.” *Journal of Human Resources.* 30(3): 551-580.

[65] Tamer, Elie (2003). “Incomplete Simultaneous Discrete Response Model with Multiple Equilibria." *Review of Economic Studies.* 70(1): 147-167.

[66] Townsend, A., L. Noelker, G. Deimling, and D. Bass (1989). “Longitudinal Impact of Interhousehold Caregiving in Adult Children’s Mental Health.” *Psychology and Aging.* 4: 393-401.

[67] Van der Klaauw, Wilbert (1996). “Female Labor Supply and Marital Status Decisions: A Life-Cycle Model.” *Review of Economic Studies.* 63(2): 199-236.

[68] Van Houtven, Courtney and Edward Norton (2004). “Informal Care and Health Care Use of Older Adults.” *Journal of Health Economics.* 23: 1159-1180.

[69] Yang, Zhou, Donna Gilleskie, and Edward Norton (2009). “Health Insurance, Medical Care, and Health Outcomes: A Model of Elderly Health Dynamics.” *Journal of Human Resources.* 44(1): 47-114.

[70] Zarit, S. and C. Whitlatch (1993). “The Effects of Placement in Nursing Homes on Family Caregivers: Short and Long Term Consequences.” *The Irish Journal of Psychology.* 14: 25-37.