Dynamic Modelling of Long-Term Care Decisions

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Abstract

This paper describes and analyzes research on the dynamics of long-term care and the policy relevance of identifying the sources of persistence in caregiving arrangements (including the effect of dynamics on parameter estimates, implications for family welfare, parent welfare, child welfare, and cost of government programs). We discuss sources and causes of observed persistence in caregiving arrangements including inertia/state dependence (confounded by unobserved heterogeneity) 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). We also present an overview of commonly used longitudinal data sets and evaluate their relative advantages/disadvantages. We also discuss other data issues related to noisy measures of wealth and family structure. Finally, we suggest some methods to handle econometric problems such as endogeneous geography.

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 does not consider 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 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 the elderly.

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) makes this point in the retirement literature.

The paper is organized as follows. In section 2, we examine the importance of considering dynamics for public policy. We present a general model of dynamics in section 3 that includes important potential sources of persistence in caregiving arrangements including unobserved heterogeneity, true duration dependence, and costs of changing caregivers. We also comment on econometric issues including the potential for endogenous geography; dynamics in discrete and continuous choices; and equilibrium issues (multiple equilibria, dynamic equilibria). In section 4, we evaluate the advantages of different potential data sources (AHEAD/HRS, BHPS, ELSA, NLTCS, PSID, and SHARE) and identify first-order data problems including noisy measures of wealth and family structure. We discuss the relatively small literature on the dynamics of long-term care in section 5 and suggest directions for the literature to make progress. In section 6, we conclude.

2 Policy Implications

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

Duration Dependence / Inertia in Care Arrangements As many of the studies to be highlighted will 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 probability of transitioning out of the arrangement and the possible destination. We often observe that care arrangements are characterized by state dependence (i.e., any effect that the present state has on future environment, preferences, or technology) and duration dependence, which is a specific kind of state dependence associated with how the transition rate is affected by present state and length of time in that state. Care arrangements may exhibit persistence due to the family's unobserved preferences (or constraints) or as a result of inertia (by which we mean true negative duration dependence). For example, a family's unobserved aversion to nursing home care may lead to persistence in informal care arrangements. True duration dependence could arise for many reasons such as caregiving human capital accumulation (not driven by unobserved heterogeneity) or the fixed costs of starting a caregiving episode. Duration dependence is likely to be more apparent if the costs of starting or 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. Dostie and Léger (2005) (hereafter DL) finds that duration dependence is an important characteristic of care arrangement transitions. Hiedemann, Sovinsky, and Stern (2012) (hereafter 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.

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 physical and/or emotional toll on the caregiver. As a result, caregivers may experience burnout, which could result in changes in care arrangements over time. 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. For example, an elderly individual's care arrangements may evolve as her health deteriorates or her spouse dies. Given that most disabled elderly people would prefer to receive care in the community and by family members, it is important to consider whether it is welfare-improving to compensate caregivers for their opportunity costs of time or provide them with relief as they experience burnout (Skira, 2012; Coe and Van Houtven, 2009) and, if so, how to do it.

There is evidence that transitions into nursing home care are impacted by the provision of home health care. For example, Pezzin, Kemper and Reschovsky (1996) finds such effects when they examine the probability of living in nursing homes after a social experiment that provided public home health care was instituted (the Channelling experiment). Their approach is static, which is reasonable given the nature of the program. Their results suggest that one way to reduce nursing home expenses may be to subsidize informal caregivers. This becomes more and more important as the number of disabled elderly people continues to grow resulting in a larger Medicaid burden for state budgets. However, if human capital accumulation in caregiving skills is important, then the estimated (Channeling) effects found in Pezzin, Kemper, and Reschovsky (1996) would be larger than reported, while, if burnout is important, then the effects are probably not as pronounced. This has the implication that, when considering what policies to implement, it is important to realize that controlling for dynamics may affect policy analysis significantly.

Costs to Government Most long-term care arrangements are not covered by Medicare or private insurance. However, nursing home stays cost $55,000 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 (Hubbard, Skinner, and Zeldes, 1995; Norton, 1995; Hoerger, Picone, and Sloan, 1996) or home- and community-based care

(Gardner and Gilleskie 2012, hereafter GG). This spending down of income is an inherently dynamic effect, and hence the appropriate policy prescription depends both on 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). Skira (2012) (hereafter Sk) measures the effect on labor market participation of potential care providers due to changes in Family and Medical Leave Act (FMLA) rules, which entitles employees to take unpaid job leave for specified family reasons under the same conditions as if the employee had not taken leave. This obviously also has implications for income tax revenues and government expenditures associated with reduced labor market participation (e.g., TANF, Social Security).

3 Modelling Dynamic Effects for Long-Term Care

3.1 Basic Model

Consider a family with $J+1$ members indexed by $j = 0, 1, 2, .., J$, with the parent (or parents) labeled 0. In each period t, each child j chooses a vector of actions, y_{jt}, which might include discrete variables such as whether to help the parent and/or continuous variables such as how much physical help or financial help to give the parent or how much sidepayments to provide to siblings. The parent can choose whether to live in the community or a nursing home and/or how much formal care to purchase. The utility of each family member other than the parent is

$$U_{jt} = U\left(j, U_{0t}, y_t, x_{0t}^b, z_{jt}^b\right)$$

where U_{0t} is the well-being of the parent; $y_t = (y_{0t}, y_{1t}, .., y_{Jt})$; x_{0t}^b is a vector of parent characteristics affecting the ease with which j can help the parent; and z_{jt}^b is a vector of characteristics of family member j that affects how much j cares about the parent's well being $\partial U_{jt}/\partial U_{0t}$ or how much j's actions affect j's well-being directly (e.g., burden of care). The parent's well-being is

$$U_{0t} = f\left(x_{0t}^q, z_t^q, y_t\right)$$

where x_{0t}^q is a vector of parent characteristics determining her base well-being (e.g., # ADLs) or the effect of child actions on her well-being (x_{0t}^q and x_{0t}^b may share many common elements); $z_t^q = (z_{1t}^q, z_{2t}^q, .., z_{Jt}^q)$; z_{jt}^q is a vector of child characteristics (possibly including previous actions or functions of previous actions) determining the effect of j's actions on U_{0t}. The family plays a game $G(\cdot)$ at t that determines actions,

$$y_t = G\left(x_{0t}^b, x_{0t}^q, z_t^b, z_t^q \mid \Psi_t\right) \tag{1}$$

where $\Psi_t = (\Psi_{0t}, \Psi_{1t}, .., \Psi_{Jt})$; and Ψ_{jt} is the information set at t for j. While it is not clear what $G\left(x_{0t}^b, x_{0t}^q, z_t^b, z_t^q \mid \Psi_t\right)$ looks like, it should satisfy equilibrium optimality (Nash) conditions,

$$y_{jt} = \arg\max_{y^{**}} V_{jt}\left(y^{**}, x_{0t}^{b}, x_{0t}^{q}, z_{t}^{b}, z_{t}^{q}\right) \mid \Psi_{jt}$$

where $y^{**} = (y^{**}, y^{**}, .., y^{**})$; y^{**} is the equilibrium value of y_{kt} for $k \neq j$;

$$\begin{aligned} V_{jt}\left(y^{**}, x_{0t}^{b}, x_{0t}^{q}, z_{t}^{b}, z_{t}^{q}\right) &= U\left(j, U_{0t}, y_{jt}, x_{0t}^{b}, z_{jt}^{b}\right) \\ &\quad + \beta E\left[V_{jt+1}\left(y^{**}, x_{0t+1}^{b}, x_{0t+1}^{q}, z_{t+1}^{b}, z_{t+1}^{q}\right) \mid \Psi_{jt}\right] \end{aligned} \tag{2}$$

is j's value function at t; and β is the one-period discount factor. For some games, especially with discrete actions, there may be no equilibrium $G(\cdot)$ or multiple equilibrium $G(\cdot)$s.

Consider, for example, a simple dynamic game similar in spirit to the (implicit) static game in Stern (1995). In particular, let y_{jt} consist of a binary indicator y_{jt1} for whether j provides physical help at time t, $\sum_j y_{jt1} \in (0,1)$, and a vector of sidepayments from j to each of the other family members y_{jt2}. As in Engers and Stern (2002), assume that sidepayments are determined so that all family members split the benefits equally (relative to some threat point) of the agreed action. In the static models in Stern (1995) and Engers and Stern (2002), the family chooses whichever choice maximizes the sum of family utilities. The dynamic analog is the choice that maximizes the sum of family value functions (see, for example, Ehtamo et al., 1988). Consider a case where there is a single parent characteristic x_{0t} (e.g., age) and two child characteristics: opportunity cost z_{jt1} and previous uninterrupted caregiving experience z_{jt2}. Then the variation within the family in opportunity cost will determine who the initial caregiver is when the parent's age warrants a caregiver. If $\partial f\left(x_{0t}^{q}, z_{t}^{q}, y_{t}\right)/\partial z_{jt2} > 0$ (skill-building in caregiving) or $\partial^2 U\left(j, U_{0t}, y_{jt}, x_{0t}^{b}, z_{jt}^{b}\right)/\partial y_{jt}\partial z_{jt2} > 0$ (learning how to reduce burden associated with providing care), then the first caregiver probably remains the only caregiver until the parent needs more intensive help in a nursing home or dies.[1] Alternatively, if $\partial f\left(x_{0t}^{q}, z_{t}^{q}, y_{t}\right)/\partial z_{jt2} < 0$ (burnout reduces quality of care provision) or $\partial^2 U\left(j, U_{0t}, y_{jt}, x_{0t}^{b}, z_{jt}^{b}\right)/\partial y_{jt}\partial z_{jt2} < 0$ (burnout directly affects the caregiver), then, at some point, an alternative child provides care. Also, $\partial f\left(x_{0t}^{q}, z_{t}^{q}, y_{t}\right)/\partial x_{0t}^{q}$ and $\partial^2 U\left(j, U_{0t}, y_{jt}, x_{0t}^{b}, z_{jt}^{b}\right)/\partial y_{jt}\partial x_{0t}^{b}$ affect transition frequencies.

The model must include some unobserved variables so that it will not be stochastically degenerate. The cleanest way to add randomness is to allow for unobserved variation, some time-varying and some constant over time, in the parameters associated with any of the structural functions in the model (e.g., Berry, Levinsohn, and Pakes, 1995; Dustmann and Meghir, 2005; Byrne et al., 2009). We typically refer to the time-constant source of variation as unobserved heterogeneity. Both unobserved heterogeneity and some of the state dependence effects previously mentioned cause observed inertia in the data. However, if both processes are specified, then the two effects can be identified separately usually because they each cause different patterns of duration dependence.

[1] Throughout the discussion, we abstract away from the issue that some elements of y_{jt} are discrete implying that no derivative exists.

The existence of unobserved heterogeneity and/or state dependence causes an initial conditions problem (Heckman, 1981). The existence of unobserved heterogeneity implies that different families will make different (endogenous) decisions in the initial sample period, and the existence of state dependence implies that choices observed in the initial data period depend endogenously on earlier choices causing left censoring problems (e.g., Lancaster, 1990). [2]

3.2 Modeling Family Equilibrium

None of the papers in the dynamic long-term care literature has addressed family equilibrium issues. We suggest three ways that future research might think about modeling equilibrium. The first would use a dynamic collective bargaining model probably following the lead of Chiappori and coauthors (e.g., Chiappori, 1988; Chiappori, 1992; Browning, et al., 1994) such as Mazzocco (2007) or even a more structural dynamic axiomatic bargaining model. Both the collective model and an axiomatic bargaining model might involve solving a problem such as maximizing

$$\sum_j \mu_{jt} V_{jt} \left(y^{**}, x_{0t}^b, x_{0t}^q, z_t^b, z_t^q, \mu_{jt} \right)$$

where μ_{jt} is the social welfare function weight for family member j at time t (or the equivalent weight derived from a Chiappori bargaining problem) and $V_{jt} \left(y^{**}, x_{0t}^b, x_{0t}^q, z_t^b, z_t^q, \mu_{jt} \right)$ is the value function defined in equation (2) and augmented to allow μ_{jt} to follow a Markov process (which would be the case if the determinants of μ_{jt} followed a Markov process).[3] However, especially since y^{**} tends to be discrete or characterized by the sum in one element of y^{**} (Checkovich and Stern, 2002), any such model should be characterized by a significant amount of sidepayments among family members. Yet, in the National Survey of Families and Households (Sweet, Bumpass, and Call, 1988), one observes very low frequency of financial transfers among adult siblings and no correlation of those transfers with informal care activity.

One could consider a noncooperative bargaining game. While such a game would be compatible with rare sidepayments (e.g., one could assume it is costly to make such transfers or very difficult to enforce any agreement involving transfers[4]), such an approach would present many problems of its own. First, as discussed in Engers and Stern (2002), there are many ways to set up such a game, and there are no data to discriminate among them with much statistical power. Second, they can be quite difficult to solve, even in a static framework. Finally, there is a high likelihood of multiple equilibria (see Bresnahan and Reiss, 1990) and, while the literature has made some progress on handling

[2] Note that different papers model unobserved heterogeneity using different distributional assumptions about the shape of the heterogeneity. Whether and how this heterogeneity enters the initial conditions is also of importance but not the focus of this paper.

[3] Gemici (2011) is a very simple special case.

[4] Mazzocco (2004) provides some evidence supportive of this assumption.

problems with multiple equilibria (e.g., Tamer, 2003) in static models, there are no empirical dynamic models with multiple equilibria yet. If one could commit to a noncooperative dynamic bargaining model with a unique equilibrium, then, maybe, solution techniques like those in Erickson and Pakes (1995) could be applied.

3.3 Sources and Causes of Dynamics

Most of the dynamic literature does not construct a dynamic model of optimizing behavior. To ease comparison with the rest of the literature, in the model, 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);[5]
- 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.

An important potential source of dynamics in these models is state dependence (DL; Heitmuller and Michaud 2006, hereafter HM; GG; and HSS all allow for state dependence). Persistence in behavior observed over time is captured in equation (3) by the inclusion of y_{ijt-1} in the model (assuming that $\alpha > 0$). As is well known (Heckman, 1986), persistence in behavior can arise from unobserved heterogeneity which can appear as (spurious) state dependence in the data. Therefore, in order to measure true state dependence, it is important to control for unobserved heterogeneity in the error in equation (3); thus most of the literature models the error in a form similar to

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

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 unobserved heterogeneity of a type similar to equation (4). In particular, HM

[5]Some of the time-varying child characteristics may be endogenous (such as work status and geographical distance).

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); and 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. They find 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. Their 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. Sk finds that first period state variables have important effects on unobserved heterogeneity type probabilities.

A second source of dynamics in the wider labor economics literature is the existence of match-specific effects. For example, Jovanovic (1979), Berkovec and Stern (1991), and Bontemps, Robin, and van den Berg (1999) 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 when 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.[6] 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) includes a job-starting cost and find it is, by far, the most important source of dynamic behavior in the job-changing 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

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

significant changes in work arrangements or relocation decisions (Sk). Such costs would result in state dependence of the type modeled in equation (3).

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. They cite 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 they cite 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), the authors 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. Coe and Van Houtven (2009) controls for endogenous caregiving and use a longer horizon and find significant burden effects. Hirst (2005) also finds significant effects but does not control for endogeneity. 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, i.e., all of the effects of burnout on duration dependence occur in the first discrete sample period.

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 α). 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. They attribute this to transition costs associated with care provision. All three results suggest that transition costs and human capital accumulation have a bigger effect on transitions 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.

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 has dynamics of this type among all of their dependent variables as well including asset spend-down. A dynamic generalization of Byrne et al. (2009) could also include such dynamics, especially in labor supply variables.

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

3.4 Related Issues

3.4.1 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 address the endogeneity problem. HSS explores 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.

3.4.2 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 restrict 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 $\delta > 0$.[8] Checkovich and Stern (2002) estimates $\delta < 0$, and HSS estimates $\delta > 0$.

[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] 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

A different issue is that, in models with multiple agents making discrete choices, there is a strong probability that multiple equilibria exist (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) applies 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.[9]

3.4.3 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).[10] In the empirical dynamic literature, DL, and HM consider only discrete choices and outcomes. GG allows for continuous measures of health and wealth, but their other dependent variables (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[11]

$$y^*_{ijt} = X_{it}\beta_j + Z_{ijt}\gamma + \alpha_d 1(y_{ijt-1} > 0) + \alpha_c y_{ijt-1} + u_{ijt}$$

and find 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., Sk; 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., Ericson and Pakes, 1995; Aguirregabiria and Mira, 2007). In the context of long-term care, one might think of each family member deciding whether to provide care as part of a dynamic problem and then how much care

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 $\delta < 0$.

[9] Exceptions are Mazzocco (2007) and Rainer and Siedler (2009). But Mazzocco (2007) is about savings behavior and risk preferences within a family, and Rainer and Siedler (2009), though extremely relevant to informal care, is not empirical.

[10] 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).

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

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 Data Sources and Empirical Considerations

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 six data sets that are more commonly used in the literature. These are the Study of Assets and Health Dynamics Among the Oldest Old (AHEAD)/Health and Retirement Survey (HRS), the British Household Panel Survey (BHPS), the English Longitudinal Study of Ageing (ELSA), the National Long Term Care Survey (NLTCS), the Panel Study of Income Dynamics (PSID), and the Survey of Health, Ageing, and Retirement in Europe (SHARE). Table 1 provides a summary.

All six surveys are longitudinal and contain information on respondents for at least four waves. AHEAD/HRS, ELSA, and SHARE were specifically developed with the intent to be comparable to each other, while each covers different world geographic regions. Each of the surveys contains 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 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 receipt is included in many surveys.

Assets are potentially important variables 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 and home health care. There are many well-known issues associated with obtaining accurate wealth and asset 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 his 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.

Survey	Countries Included	Survey Years	Sample Size	Age of Respondent	Long-Term Care Variables	Information on Caregiver	Information on Children	Health Measures (other than (I)ADLS)	Local Geography	Further Information
AHEAD/HRS	United States	1993, 1995, 1998 then every 2 years	8,222	70+ and spouses	nursing home, home formal care, financial and time informal care	yes	yes	health conditions	state	hrsonline.isr.umich.edu/
BHPS	United Kingdom	annually 1991-2008	10,300	16+	nursing home, family assistance, informal care	yes	yes	health conditions	region, area	iser.essex.ac.uk/bhps
ELSA	England	2002, 2004, 2006, 2008, 2010	13,500	50+	nursing home, family assistance financial and time			biomedical, life quality, health conditions		natcen.ac.uk/elsa/
NLTCS informal caregiver survey	United States	1982, 1984, 1989, 1994, 1999, 2004	20,000	65+	formal care, informal care	yes	yes	health conditions		nitcs.aas.duke.edu/
PSID	United States	annual 1968 to 1997 then every 2 years	18,000	18+	living arrangments					psidonline.isr.umich.edu
SHARE	19 European Countries, Israel	2004, 2006, 2008, 2010	45,000	50+	living arrangments, family assistance financial and time			self-reported well being, health conditions		share-project.org

Figure 1: **Table 1:** Overview of Common Data Sources

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; Juster et al., 2007). The large variation in asset changes is particularly problematic for dynamic studies where transitions are important.[12] 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). However, despite these problems GG, for example, successfully uses the available data to measure the relationship between savings, wealth, and nursing home care.

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.

The Study of Assets and Health Dynamics Among the Oldest Old

AHEAD was first administered in 1993 to a nationally representative sample of around 6,000 Americans aged 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 8,222 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).[13] These data continue to be collected every two years.

The survey focuses on the joint dynamics of health and demographic characteristics. The survey contains detailed information measures of 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 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.

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

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

British Household Panel Survey The BHPS is a nationally representative annual survey of Britain that started in 1991. It consists of interviews of more than 5,000 households with over 10,000 adults aged 16 or older. Most of the respondents are interviewed in all subsequent waves. Children of the adults are included as respondents once the children reach the age of 16. As a result, BHPS contains a lot of information on children who may be caregivers for their elderly parents. After 2010 the BHPS was combined with the "Understanding Society" study. These data continue to be collected annually.

The English Longitudinal Study of Ageing ELSA is a biennial 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, biological disease markers, physical tests, 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, household and family structure, and individual and household characteristics. It also contains information on social participation and mental health. Data for the fifth wave (2010-2011) will be available in the near future.

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 20,000, 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.

The Panel Study of Income Dynamics The PSID began in 1968 with a nationally representative sample of over 18,000 individuals living in 5,000 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 he/she is asked questions about his/her spouse if 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, and it continues to be collected biennially. 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.

The Survey of Health, Ageing and Retirement SHARE in Europe is a cross-national panel of more than $45,000$ individuals aged 50 or older that reside in one of 20 European countries.[14] The survey contains a number of elements useful to study the dynamics of care. 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. It contains information on self-reported health, health conditions and physical functioning, and use of health care facilities. It also contains information on biomarkers and psychological variables . 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). Collection for the fifth wave of the data are in process.

5 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 five papers that have moved the frontier in this area. We describe each paper in and of itself, and we fit each of the papers into a more general approach to modelling the dynamics of long-term care and family decision-making.[15]

Dostie and Léger (2005) Dostie and Léger (2005) is the first paper to address modeling the dynamics of long-term care. It specifies a transition matrix for four states indexed by l (and k): living alone, cohabiting, living in a nursing home, and death. The hazard rate from state l to k is specified as[16]

$$\log h_{lk}(t_l) = x_{0t}\eta_{lk} + \gamma_{lk} d_l + \lambda_{lk}\nu$$

[14] Eleven countries were involved in 2004 (Denmark, Sweden, Austria, France, Germany, Switzerland, Belgium, the Netherlands, Spain, Italy, and Greece). In the second wave, Israel, the Czech Republic, Poland, and Ireland were added.

[15] There are a number of notable papers that have provided extensions of those we highlight, including Viitanen (2005), Heitmuller (2007), Kyung Do (2008), Casado-Marín, García-Gómez, and López-Nicolás (2011), and Witvorapong (2011).

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

where d_l is duration in state l, x_{0t} is a vector of exogenous, possibly time-varying covariates, and ν is a single-factor unobserved heterogeneity term whose effects can vary across transitions (Heckman and Walker, 1990).

The basic dynamic model described above implies a set of (aggregated) transition rates. For example, to the degree that parent characteristics x_{0t} affect either the parent well-being function $f\left(x_{0t}^q, z_t^q, y_t\right)$ or the utility function for the children $U\left(j, U_{0t}, y_{jt}, x_{0t}^b, z_{jt}^b\right)$, they affect transition rates. As described above, when $\left|\partial f\left(x_{0t}^q, z_t^q, y_t\right)/\partial x_{0t}^q\right|$ is large, transition rates from living alone to cohabitation to nursing homes will be large. Since these transition rates do allow for care without cohabitation, it is difficult to say how changes in other derivatives of the model primitives change transition behavior as specified in DL.

In general, the estimated transition rates do not identify any of the parameters of the general structural model. For example, it is not clear whether changes in transitions are caused by changes in utility functions $U(\cdot)$, changes in parent well-being functions $f(\cdot)$, or both. However, estimated transition rates provide significant information about primitives. For example, observing negative duration dependence in transitions out of cohabitation suggest some type of skill-building on the part of the child, while observing positive duration dependence in transitions out of cohabitation suggest burnout dominating skill-building or acceleration of parental help requirements.

In DL, the included variables in x_{0t} are a limited set of demographic characteristics of the parent and some 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.

Heitmuller and Michaud (2006) Heitmuller and Michaud (2006) 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

$$h_{jt}^* = x_{jt}\beta_h + \phi_{hh}h_{jt-1} + \sum \phi_{hd}d_{jt-1} + u_{jt}^h \tag{5}$$

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

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

x_{jt} is a vector of exogenous covariates, d_{jt} is a dummy variable for care provision, and u_{jt}^h is an error. Care provision is modeled as $d_{jt} = 0, 1$ (HM considers two different definitions of caregiving). The equation determining the level of care to provide is

$$\begin{aligned} d_{jt}^* &= x_{jt}\beta_d + \phi_{dh}h_{jt-1} + \phi_{dd}d_{jt-1} + u_{jt}^d, \qquad (6) \\ d_{jt} &= 1\left(d_{jt}^* > 0\right). \end{aligned}$$

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

$$\begin{aligned} u_{jt} &= e_j + \varepsilon_{jt}; \\ Ee_j e_j' &= \Omega_e; E\varepsilon_{jt}\varepsilon_{jt}' = \Omega_\varepsilon \end{aligned}$$

with ε_{jt} serially independent. However, u_{jt} exhibits serial correlation because of its e_j component which is constant over time. The model is estimated using maximum simulated likelihood estimation using the British Household Panel Survey.

It should be noted that HM avoids multiple equilibrium problems by excluding d_{jt} from equation (5) and h_{jt} from equation (6) (Heckman, 1978). However, it is likely that work hours and care provision should be determined contemporaneously. One can imagine that equations (5) and (6) are reduced form equations associated with first order conditions from a well-specified dynamic programming model like the one above. HM also makes 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).

If there were other potential care providers (e.g., siblings), then their characteristics would enter into the reduced forms in equations (5) and (6). We could think of those characteristics as part of the error u_{jt}, but inclusion of such terms in the error would imply that u_{jt} is serially correlated, causing lagged values of h_{jt} and d_{jt} to be endogenous. This presents a good example of why it is difficult to ignore all of the important care alternatives available to the parent during estimation. Ignoring many care alternatives is the norm in most of the literature, but it is difficult to construct a model with multiple potential caregivers that lead to consistent estimation of the specified equation.

That said, HM still provides valuable clues about the magnitude of some of the dynamic effects a researcher might consider including in a model. 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) Gardner and Gilleskie (2012) constructs a dynamic, continuous-choice/discrete-choice model in the pseudo-structural sense of papers such as Mroz (1999), Mroz and Savage (2006), or Yang, Gilleskie, and Norton (2009) and controls for initial conditions problems following Heckman (1981). Using multiple waves of AHEAD, they estimate a dynamic model with endogenous health transitions, health insurance receipt, long-term care arrangement, and wealth. The long term care options are no care, informal care, formal care, and nursing home care.[17] An interesting issue they must tackle is how to use dynamic wealth data that is measured with large errors (see below). One can write the model in GG as

$$Y_{jt}^{*} = AY_{jt-1}^{*} + BY_{jt-1} + CX_{jt} + e_j + u_{jt} \tag{7}$$

where Y_{jt}^{*} is a $J \times 1$ vector of (possibly) latent dependent variables at time t for individual j, Y_{jt} is the observable vector of indicators associated with Y_{jt}^{*}, X_{jt} is a $K \times 1$ vector of exogenous variables, (A, B, C) are matrix-conformable matrices of parameters to estimate, e_j is a $J \times 1$ vector of individual-specific effects, and u_{jt} is a $J \times 1$ vector of idiosyncratic effects. The vector of dependent variables includes Medicaid enrollment, possession of private insurance, a measure of health, death, care arrangements including informal care as one of the options, assets, and gifts. The direct interpretation of the parameters is

$$\begin{aligned} A_{nm} &= \frac{\partial Y_{jtn}^{*}}{\partial Y_{jt-1m}^{*}}, \\ B_{nm} &= \frac{\partial Y_{jtn}^{*}}{\partial Y_{jt-1m}}, \\ C_{nk} &= \frac{\partial Y_{jtn}^{*}}{\partial X_{jtk}}. \end{aligned} \tag{8}$$

The structural model presented in section 3 ignores many of the dependent variables in GG including Medicaid enrollment, possession of private insurance, health (and death), assets, and gifts, while the focus of GG is on these dependent variables. However, since caregiving is the focus of the paper, we consider the caregiving results in GG.

Note that, in the structural model in section 3.3, we assume that health is exogenous, and it affects the well-being of the parent (see also Sk), while in GG, health is affected directly by, among other things, the care-giving decisions of the children last period. We model the health of the parent as exogenous because we have in mind children ameliorating the problems caused by the their parent's health problems rather than directly affecting the lifetime path of health. GG measures health as $(2 * \#ADLs) + \#IADLs$, and they find that the effect on health of informal caregiving by children is $1.39 - (0.23 Health)$. At low (healthy) levels of health ($Health < 7$), provision of informal care by children increases health levels, making the parent worse off. At high values of health, informal care provision helps the parent by lowering health levels. However, it is not clear why care from children would decrease either ADLs or IADLs.[18] It would be difficult to construct a structural model of informal care where children provide care that makes the parent decline in health.

[17] Witvorapong (2011) expands the set of long term care choices to interact informal and formal care with living alone and living with a child.

[18] In static models, Byrne et al. (2009) model care in the same way as the structural model; Van Houtven and Norton (2004) model health in the same way as in GG but do not estimate a health equation; and Bonsang and Bordone (2013) find a negative effect.

In terms of the structural model, the equilibrium $G(\cdot \mid \cdot)$ function in equation (1) determines the elements of (A, B, C) in equation (8) associated with the caregiving decision (once the vector of equilibrium caregiving decisions is aggregated into the simpler measure used in GG). The specification in equation (7) prevents one from separately identifying any of the structural parameters in the structural model, but it still provides very useful information about in what directions to move when constructing a more general structural model including the extra dependent variables in GG.

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. In some sense, the model is a special case of the structural model above where there is only one child, thus ignoring all issues associated with equilibrium among the set of potential caregivers. However, Sk expands the model above by expanding the choice problem faced by the child. In particular, Sk explicitly models and focuses on the effects of caregiving on the later labor market environment of the child. To fit this into the model above, we would need to expand the set of choices, y_{jt}, in the child's utility function, $U_{jt}(\cdot)$, and be more explicit about how past choices about caregiving (and labor market decisions) captured in z_{jt}^{b} affect the labor market environment in the present.

The estimates imply that dynamics are important in that present caregiving has large impacts on future labor market outcomes. First, Sk estimates a large initiation cost associated with beginning caregiving. However, since she does not allow the utility one gets from caregiving to vary with the duration of the caregiving episode, she cannot distinguish between an initiation cost or caregiving human capital accumulation. With respect to the effect of caregiving on future labor market opportunities, Sk finds that present caregiving significantly reduces the probability of future full-time and part-time job offers and shifts the wage offer distribution significantly toward lower offers (offers fall by 13%).[19] Sk shows, using her estimates, that the dynamic effects on labor market opportunities imply large costs to society even after controlling for present costs.

The estimated model is used to analyze a series of relevant government policies including FMLA amendments and caregiving subsidies. For FMLA, she

[19] In the empirical search literature, it is clear that it is difficult to identify job offer probabilities from the probability of rejecting received wage offers, even when accepted wage offers are observed. Furthermore, in the theoretical job search literature, the job offer arrival rate has to be higher when not employed than when employed to generate endogenous transitions from jobs (e.g., Rogerson, Shimer, and Wright, 2005). Given the data moments Sk uses to estimate her model, she, in fact, faces the same problem. However, while this is an important econometric point, the economic point can be generalized to say that caregiving significantly reduces labor market opportunities, whether they be through lower offer probabilities or lower offers.

simulates the effect of being able to take an extended leave and then return to one's job with certainty. The experiment essentially cancels the estimated penalties associated with temporary exit from the labor market. She finds that the extension of FMLA results in a modest increase in the proportion of women who choose to care for their parent and large increases in return to the labor market after the caregiving episode is finished. She compares the FMLA experiment to experiments where caregivers are paid for their caregiving services. Such pay causes interesting income and substitution effects but is very effective in increasing the supply of family caregivers, some of whom continue to work and some of whom stop.

Hiedemann, Sovinsky, and Stern (2012) HSS is a series of pseudo-structural models somewhat similar to HM (without endogenous work). The paper 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. None of the models in HSS capture all of the features of a structural dynamic model as above. The primary caregiver model is problematic in that it allows for only one caregiver (which is inconsistent with some observations); the multiple caregivers model ignores substitution issues across caregivers; and the hours model ignores equilibrium issues. However, the three together approximate the realm of possibilities in terms of modeling long-term care decisions. In a big-picture sense, all three models map into the structural model above the same way that GG does with the number of dependent variables J equal to one. 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.

The idea for dealing with unobserved heterogeneity and initial conditions is to pick a pick a point far enough in the past T_0 so that it is reasonable to assume that, at that age, parents do not need any assistance from children. Given T_0, HSS estimates inverse transition probability functions measuring how each of the exogenous variables in the model transition "backwards" from the initial condition period to T_0. Then the authors use those estimates inside the likelihood function to simulate paths between T_0 and the initial sample period. The advantage of this method is that one replaces the problem that choices made in the initial period are endogenous with the assumption that there are no endogenous choices to make at T_0.[20]

[20] One might think that Rainer and Siedler (2009) implies that geographic distance, one of

HSS explores the implications of ignoring available data on income and wealth of the parent somewhat motivated by the powerful results in GG associated with wealth and income interacting with government policy variables such as Medicaid income and asset limits. GG finds evidence that individuals spend down their assets as Medicaid coverage asset limits for home- and community-based services increase but no evidence for spenddown of assets associated with nursing home services. In the context of the three models used in HSS, they show, using a series of Lagrange multiplier tests, how much of the importance of wealth and income are direct effects, how much involve interactions of wealth and income with policy variables, and how sensitive the results are to the way in which policy variables are measured and the missing variables problem is handled. Overall, they find evidence of significant sensitivity of results to a number of the assumptions required to be made.

Finally, HSS explores issues associated with the potential endogeneity of the geographical distance between the parent and her children. It is found that a) children and parents rarely move closer to each other; that b) the parent's need for informal care (as measured by #ADLs) has an effect on geographical transitions; and that c) those children who do move closer are more likely to provide informal care. Thus, it appears that geography may be endogenous, but transitions occur infrequently enough to make estimation of the bidirectional relationship unlikely to result in statistically significant results. HSS suggests that a way to compromise is to use the distance variable in the initial sample period as a proxy for distance in every period and show that such a compromise works well (of course, assuming that the initial period distance is exogenous).[21]

the "exogenous" variables simulated, is really endogenous because the oldest child behaves strategically when deciding where to live. But the behavior of the child in the model depends only on the number of children in the family, i.e., not any of the endogenous variables or errors later when the family has to make a caregiving decision.

[21] Stern (1995) uses a similar approach in data with only two waves.

Paper	Dataset Used	Long-term Care Choices Modelled	Other Choices/ Outcomes	Unobserved Heterogeneity	Initial Conditions
Dostie and Leger (2005)	PSID	living arrangements : independent coresidence, nursing home	death	included	not included
Gardner and Gilleski (2012)	AHEAD	care provision: no care, informal care by child, formal care, nursing home	savings, gifting, health insurance, death	included	included
Heidemann, Sovinsky, and Stern (2012)	HRS/AHEAD	care provision: no care, informal care by children, formal care, nursing home	none	included	included
Heitmuller and Michaud (2006)	BHPS	informal care provision coresidence or extra-residential	labor force participation	included	included
Skira (2012)	HRS	child care provision by one child	labor force participation	included	included

Table 2: Overview of LTC Dynamic Literature

6 Conclusions

To develop public policies of long-term care provision for elderly individuals, it is necessary to understand the issues surrounding their future care requirements. Therefore, it is crucial for empirical researchers to examine the dynamic factors that affect the living arrangements of the elderly. There is currently a relatively small literature on the dynamics of long-term care. In this paper, we present a detailed review of this literature. We discuss issues that complicate empirical measurement, such as state dependence, costs of changing caregivers, the potential for endogenous location choices, and equilibrium issues. We also discuss some issues surrounding the data and give details about the relative advantages/disadvantages of commonly used data sources.

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