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To Leave or Not to Leave: The Distribution of Bequest Motives

WOJCIECH KOPCZUK
Columbia University

and

JOSEPH P. LUPTON
*Federal Reserve Board**

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We examine the effect of observed and unobserved heterogeneity in the desire to die with positive net worth. Using a structural life-cycle model nested in a switching regression with unknown sample separation, we find that roughly three-fourths of the elderly single population has a bequest motive. Both the presence and the magnitude of the bequest motive are statistically and economically significant. On average, households with a bequest motive spend about 25% less on consumption expenditures. We conclude that, among the elderly single households in our sample, about four-fifths of their net wealth will be bequeathed and approximately half of this is due to a bequest motive.

1. INTRODUCTION

By the end of 2005, the cohort of those aged 50 years or more had amassed a level of wealth never held before by a single generation. The disposition of this wealth over the next 50 years will have large consequences for the generations to follow. Will there be a massive surge in consumption in the decades to come? Or, will the next generation be the recipients of this golden egg? In this paper, we explore the possibility that, after accounting for lifetime resources, heterogeneity in the desire to leave bequests can explain much of the substantial variation in saving behaviour observed among the elderly. In doing so, we estimate both the magnitude of the desire to leave a bequest and the proportion of the elderly population that has this desire.

In two papers, Michael Hurd examines the importance of bequests by noting that the difference between the change in wealth for households with and without a bequest motive provides a measure of the strength of the bequest motive (Hurd, 1987, 1989). Hurd assumes that only people with children save for bequests. Contrary to the predictions of a strong bequest motive, Hurd (1987) finds that people with children decummulate their wealth *faster* than people without children. This finding holds even after controlling for differences in initial income and wealth. Hurd (1989) estimates the parameters of a life-cycle model augmented with a bequest motive and finds the bequest motive to be statistically significant but economically trivial.

The approach in Hurd (1989) is compelling because it controls for the complex relationship between mortality risk, annuity income, and liquidity constraints—a crucial requirement for examining bequest motives because U.S. law prohibits the use of social security benefits as collateral. We adopt this approach as well. However, it is not clear that simply having children implies a desire to die with bequeathable wealth. Nor is it clear that households without children lack

*No claim is made to original US government works.

such a desire. Large-scale heterogeneity in saving behaviour is due to a combination of differences in preferences and outcomes (Venti and Wise, 1998; Dynan, Skinner and Zeldes, 2002). In a sample of pension holders from Teachers Insurance and Annuity Association—College Retirement Equities Fund (TIAA-CREF), Laitner and Juster (1996) find heterogeneity in preferences for bequests despite homogeneity in earnings, occupation, and education. This heterogeneity exists across households with and without children and thus suggests a potential problem with the identification strategy used in Hurd (1987, 1989).

Little is known regarding why individuals desire to leave a bequest, if they do at all. Empirical tests of the importance of bequest motives in the literature rely on the assumption of an operative bequest motive, either by selecting a group that definitely has the motive as in Hurd (1987, 1989) or by positing that either everyone has the motive or that nobody does, as in Altonji, Hayashi and Kotlikoff (1997). An alternative approach is based on noting that, if a bequest motive is strong for a certain segment of the population, it will be evident in the relative consumption of this group after conditioning on the structural relationship between mortality risk, wealth, annuity income, and the possibility of future liquidity constraints. In this paper we examine consumption expenditures of the elderly in which both the presence of a bequest motive as well as its impact on spending is not assumed but is instead estimated. As in Hurd (1989), we assume the bequest motive is egoistic in that it is generated purely by a desire to have positive net worth upon death.[1] However, the estimation of our model is done in the framework of a switching regression where sample separation is unknown. In this context, whereas Hurd (1989) assumes perfect sample separation information regarding who has a bequest motive (households with children), we allow all households to have a bequest motive and let observed spending behaviour determine the extent to which bequests are of economic importance.

Using panel data that provide detailed information on the financial resources of a sample of elderly households, we estimate a bequest motive that is substantially larger than reported in Hurd (1989). Although we find the existence of children to be a marginally significant indicator of having a bequest motive, the hypothesis that it is a deterministic predictor is rejected. This result is consistent with Hurd's finding that households with children do not behave according to a bequest motive anymore than do households without children. However, rather than interpreting this as evidence against a bequest motive, we show that a significant portion of elderly households—with and without children—behave in a manner consistent with a statistically significant and economically meaningful bequest motive.

The more flexible estimation strategy utilized in this paper comes at the cost of not being able to distinguish between a bequest motive and alternative motives for holding wealth that are unrelated to utility from consumption, such as status (Carroll, 2000) or uncertain health expenses (Palumbo, 1999; Dynan, Skinner and Zeldes, 2002, 2004). However, it is unlikely for several reasons that the precautionary saving motive related to uncertain medical costs is having a large influence on the estimated presence and magnitude of the bequest motive. First, the empirical strategy compares consumption profiles across households, conditioning on wealth and income. Consequently, if households with similar resources face the same risk of medical costs, the precautionary saving motive should affect these households similarly and not affect the relative consumption profiles. Second, we show that households with private health insurance are no less likely to consume in a manner consistent with a bequest motive. Third, we show that households with higher self-reported expected future out-of-pocket medical costs are no more likely to consume in a manner consistent with a bequest motive than households with lower expected costs. Finally, we compare the results from the model to self-reported probabilities of leaving a

1. This is in contrast to bequests motivated by either the utility of the recipient—the altruistic motive—or the desire to manipulate the behaviour of the recipient—the strategic motive.

bequest after conditioning on self-reported expected future out-of-pocket medical costs. We find that among households with similar permanent income, wealth, and expected medical expenses, those who consume in a way that is more consistent with a bequest motive also reported having a higher likelihood of leaving a bequest. We conclude that, although the precautionary motive may be an important component of saving behaviour among the elderly, it does little to influence the bequest motive results in this paper.

The results in this paper suggest that roughly 75% of the elderly population has a bequest motive. Households with a bequest motive spend about 25% less on personal outlays on average. Of the 78% of net wealth that is estimated to be bequeathed by single households aged 70 and older, 53% is accounted for by a bequest motive. Although we also report results that are consistent with both an altruistic and strategic bequest motive, none of the evidence is significant. This is in line with the literature, which suggests the desire to die with positive net worth is largely for egoistic reasons.[2]

2. RELATED LITERATURE

The importance of bequests and other intergenerational transfers has been debated extensively for more than two decades. Kotlikoff and Summers (1981) argue that as much as 46% of household wealth is accounted for by bequests while Modigliani (1988) argues that a much smaller 17% is more accurate.[3] The methodology used to obtain these numbers is affected by assumptions regarding how flows of bequests are converted into stocks of inherited wealth. Alternative estimates of the importance of bequests have used micro-data, which ascertain either the amount of wealth that has been inherited or the amount of savings planned for bequests. Most of these studies have found inherited wealth to be in the range of 15–31% of total household wealth (Menchik and David, 1983; Modigliani, 1988; Hurd and Mundaca, 1989; Gale and Scholz, 1994; Laitner and Juster, 1996). However, it is not clear that individuals accurately answer how much of their wealth was given to them as opposed to being from the fruit of their own labour. Nor is it clear if returns to past inheritances are included in self-reported bequests. More importantly, measuring the amount of inheritances received does not distinguish between intended versus accidental bequests. On the other hand, simply asking individuals about expected future bequests is biased by past unexpected wealth changes and could say very little about saving behaviour.

Studies of bequests using micro-data have focused on wealth at different stages during the life cycle. This approach yielded an early critique of the life-cycle hypothesis. The standard life-cycle model predicts that wealth should begin to decline at some age and continue to do so until death. Although initial estimates using cross-section data suggest that household wealth increases with age (Menchik and David, 1983), later studies have shown a decline (Hurd, 1990). Moreover, studies examining panel data report a declining trajectory (*e.g.* Diamond and Hausman, 1984; Hurd, 1987). Nevertheless, Hurd (1987) proves that a declining wealth trajectory need not preclude the possibility of a binding bequest motive. The addition of a bequest motive to the standard life-cycle model simply flattens the wealth trajectory. Whether the trajectory switches from declining to increasing depends on the parameters of the model.

2. *E.g.* see Kuehlwein (1993), Laitner and Juster (1996), Wilhelm (1996), and Altonji *et al.* (1997).

3. These numbers are based on converting flows of bequests to a stock of inherited wealth. An alternative method is also used which is based on estimating life-cycle saving and then comparing the result to total wealth. With this method, Kotlikoff and Summers (1981) find total intergenerational transfers to be on the order of 81% while Modigliani (1988) finds 20%. The differences between the two estimates come from differences of opinion regarding (1) the timing of bequest transfers, (2) educational expenses, and (3) capital gains on received inheritances. Davies and Shorrocks (2001) surveyed the literature that was spawned by this debate and proposed a rough estimate of 34–45% for the contribution of inheritance to aggregate wealth.

Indirect evidence concerning the existence of a bequest motive is mixed but largely supportive. Individuals act to decrease their tax liability through intergenerational transfers (Bernheim, Skinner and Weinberg, 2001; Page, 2003; Bernheim, Lemke and Scholz, 2004; Joulfaian, 2004), and they offset public transfers by purchasing life insurance and selling annuities (Bernheim, 1991). Furthermore, the presence of a bequest motive aids in explaining the amount of total wealth in the U.S. as well as its distribution (Kotlikoff and Summers, 1981; Gale and Scholz, 1994; Bernheim *et al.*, 2001).

Despite the potential presence of a bequest motive, there is little evidence that individuals leave bequests for altruistic reasons. Linking parents' and childrens' income tax returns to parents' estate tax records, Wilhelm (1996) finds evidence inconsistent with the compensatory bequest implications of an altruistic bequest model. Although Laitner and Juster (1996) note that roughly half of TIAA-CREF annuitants conform to the altruistic model, they show little evidence of altruism toward one's children in the full sample. Estimating the first-order conditions of a model of altruism that is robust to uncertainty and liquidity constraints, Altonji *et al.* (1997) find that parents do not offset inter vivos transfers given an increase in their children's permanent income. They conclude that this is a strong rejection of intergenerational altruism. Laitner and Ohlsson (2001) find only weak evidence for parental altruism in the U.S. and Sweden. Finally the very rich who are subject to estate taxation, and who are virtually certain to leave a bequest, do not appear to pursue tax avoidance strategies such as inter vivos giving (McGarry, 1999; Poterba, 2001). On the whole, the evidence suggests motives other than the maximization of a dynastic utility function.

3. THE DATA

We use panel data from the Asset and Health Dynamics Among the Oldest Old (AHEAD) survey, a survey of households born in 1923 or earlier. At the time of the initial wave in 1993, these households had at least one eligible respondent of age 69 years or older. Households that maintained at least one living member were interviewed again in 1995, 1998, and 2000. Since the purpose of the AHEAD is to examine the relationship between age-related health changes and the economic resources available to these households, it is ideally suited for examining the effects of a bequest motive on behaviour.

The initial 1993 wave of the AHEAD consists of 6046 households of which 4362 had at least one living member who was interviewed in the subsequent three waves. In order to make the data consistent with the theoretical model described below, the sample is restricted to single households that claim to be retired and not working. With these restrictions, there are 1575 households present in all four waves. All analyses use compensatory household weights that control for unequal selection probabilities as well as geographic and race group differences in response rates. All dollar values are converted to 1996 constant dollars using the CPI-U. Because of a flawed methodology used in the wealth supplement to the initial wave of the survey, we do not use data from the 1993 survey.[4]

Households in the AHEAD were asked detailed questions about their economic resources. Respondents reported the amount of each type of income received.[5] For each source of non-asset

4. Rohwedder, Haider and Hurd (2004) conclude that a combination of question sequence and wording in the 1993 wave of the AHEAD survey led to a severe under-reporting of ownership rates of stocks, CDs, bonds, and checking and saving accounts. In a personal conversation, Bob Willis, director and co-principal investigator of the Health and Retirement Study/AHEAD survey, agreed with the Rohwedder *et al.* conclusion and noted that the flawed methodology was revised considerably in later waves of the survey. Consequently, Willis recommends the wealth data from the 1993 AHEAD not be used to make cross-year comparisons.

5. Total income includes social security income, supplemental security income, veteran's benefits, defined benefit retirement pensions, annuities, dividend and interest income, welfare, food stamps, and financial assistance from friends and family. Any "other" source of income is also reported.

TABLE 1

Mean wealth of the elderly

	1995	1998	2000
Total net wealth	181,598	170,731	167,783
Tangible wealth	96,358	91,230	85,681
Net equity in home	66,419	61,401	61,560
Financial wealth	85,240	79,501	82,102
Stocks/mutual funds	38,740	37,885	42,586

Notes: Sample includes all non-married, non-working heads of household present in the 1993, 1995, and 2000 AHEAD survey (1576 observations). Dollar values are in 1996 dollars.

related income, respondents reported how long the income is expected to last and whether it is adjusted for increases in the cost of living. This information is used to construct an inflation-adjusted non-asset income age profile for each household. Respondents also provided detailed balance sheet information, which is used to construct measured net wealth.[6] Along with balance sheet information, respondents were asked about the net transactions in each component of wealth. The sum of these transactions provides a measure of household saving between survey years.[7] In turn, the level of saving can be used to define capital gains (the difference between the change in wealth and saving) and consumption (the difference between total income between survey years and saving). We estimate the theoretical model using this measure of consumption. A more detailed description of how we construct wealth, income, and consumption using the AHEAD survey data is provided in the Appendix.

Table 1 shows the sample means of total net wealth and its components from each survey year. In general, the level of wealth is consistent with alternative surveys of household wealth.[8] Mean net wealth fell only slightly between 1995 and 1998 and fell again between 1998 and 2000. However, this cannot be interpreted as evidence against the standard life-cycle model since it neglects the influence of asset returns. Indeed, unexpected differential rates of return to wealth could bias any cross-household comparison of wealth changes. In the presence of unexpected returns to wealth, the standard life-cycle model is a hypothesis about saving and spending behaviour and not necessarily about *ex post* movements in wealth. For this reason, the analysis in this paper focuses on consumption rather than the change in wealth.

Table 2 reports the mean and median of saving, capital gains, total income, and consumption from 1995 to 1998 and 1998 to 2000. Before computing the sample statistics, the values are annualized by using the individual specific number of months between survey dates. As implied by the standard life-cycle hypothesis, average saving is negative in both periods. However, although capital losses contribute to the *decline* in wealth in the first period, capital gains offset

6. Measured net wealth includes equity in a main home, other real estate (including a second home), vehicles, owned business, investment retirement accounts, corporate equities and mutual funds, and transaction bank accounts, CDs and saving bonds, corporate and government bonds, assets in a trust, other assets (such as art, jewellery, and collectibles), and other non-collateralized debt (such as credit card debt or debts owing to medical treatment). Although it is not obvious that housing wealth should be included in bequeathable wealth, we argue below that this is more appropriate than excluding it. However, we also report results that exclude housing wealth.

7. Juster, Lupton, Smith and Stafford (2006) show that a similar survey instrument used to measure active saving in the Panel Study of Income Dynamics from 1984 to 1994 aligns well with movements in the personal saving rate from the National Income Accounts.

8. For comparison, data from the Panel Study of Income Dynamics indicate that, among unmarried individuals older than age 70 years that are alive in 1994 and 1999, mean wealth was $161,037 in 1994 and $196,714 in 1999. An alternative source of data is the Federal Reserve's Survey of Consumer Finance (SCF). Restricting the SCF to unmarried households aged 72 years and older in 1995, mean wealth was $182,536 in 1995, $179,869 in 1998, and $244,874 in 2001.

TABLE 2

Saving and consumption of the elderly: Annual average

	Mean		Median	
	1995–1998	1998–2000	1995–1998	1998–2000
Change in wealth	−4870	−1362	−1105	−251
Saving	−4118	−2678	−111	−101
Capital gains	−752	1315	0	0
Income	18,327	17,647	12,658	11,921
Consumption	22,449	20,325	13,071	12,139

Notes: Sample includes all non-married, non-working heads of household present in the 1993, 1995, 1998, and 2000 AHEAD survey (1576 observations). Values are annualized by individual specific number of years between survey interviews. Dollar values are in 1996 dollars.

about half of the decline in saving in the latter period. Consumption expenditures are relatively smooth across the two periods, both in terms of the mean—about \$21,000—and the median—about \$12,500.[9]

The results in Table 2 are insufficient to adequately assess the strength of the bequest motive. Household saving in the AHEAD is negative as indicated by the life-cycle model without a bequest motive, but household wealth does not appear to decline much over the five-year span of the AHEAD. In order to properly condition upon varying mortality risk, income profiles, and liquidity constraints, more structure is needed. The next section provides this structure.

Estimates of mortality hazard rates are based on survival statistics from the National Institute of Health (NIH). Although these statistics are arrayed by birth-cohort, age, and gender, a substantial literature has noted that mortality is also related to wealth and race (*e.g.* Smith, 1999; Deaton, 2003). We account for this important variation in mortality risk by combining the NIH statistics with a model of mortality that conditions on birth-cohort, age, gender, permanent income, and race. Permanent income is used in place of wealth for two reasons. First, it more adequately reflects the part of lifetime resources that have the potential to influence long-term health outcomes. Second, since lifetime income is likely to be more exogenous than wealth, it raises fewer concerns when used as a regressor in a model that estimates the bequest motive. Social security income is used as a proxy for permanent income.[10] The Appendix provides a detailed description of the mortality model and how it is used to modify the NIH survival statistics.

4. THEORETICAL MODEL

Taking income $\{y_t\}_{t=s}^{T}$ as given, single elderly households that are permanently out of the labour force optimally allocate their wealth (w_s) over their remaining life cycle. Following the life-cycle model of Yaari (1965), a household at age s is assumed to solve the following inter-temporal

9. Given the uniqueness of the net transaction data that allow total consumption to be measured, we assess the reliability of the data by comparing them to a more established survey measure of household consumption. The 1997 Consumer Expenditure Survey (CEX) suggests that, on average, non-married, non-working individuals older than 70 years spent about \$16,300 on consumption. The median of expenditures in the CEX is \$13,456. These estimates are roughly in line with the estimates from the AHEAD survey. See the Appendix for more details on the quality of the consumption data in the AHEAD.

10. As an alternative to social security income, we also considered education as a proxy for permanent income. The results presented in Section 6 were essentially unchanged when using this alternative.

allocation problem:

$$V(w_s) = \underset{c_s, c_{s+1}, \ldots, c_T}{\text{Max}} \sum_{t=s}^{T-s} \beta^{t-s}(a_t u(c_t) + m_t b(w_t))$$
$$\text{subject to } w_{t+1} = (1+r)w_t + y_t - c_t$$
$$w_s \text{ given,}$$

where w_t and c_t are the household's wealth and consumption at age t.[11] The probability of being alive at age t is given by a_t, and the probability of dying at age t is given m_t with the convention that death occurs at the beginning of the period. Households die with certainty by age T. Future utility is discounted by the factor of time preference β. Households place value on consuming while alive and leaving some wealth upon death. The period utility function is isoelastic, $u(c) = (1-\gamma)^{-1} c^{1-\gamma}$.

Utility from leaving a bequest is assumed to be linear in wealth, $b(w_t) = \alpha w_t$, where α is a constant. This specification is preferred for two reasons. First, much of the empirical evidence cited above favours this simple egoistic motive over a more complex motive of altruism. Second, the specification introduces an intuitive notion of bequests as a luxury good: as wealth increases, the marginal utility from bequests increases relative to the marginal utility of consumption. As noted by Cooper (1979) "Persons in the wealth category we are now discussing have more current income that they can expend. Beyond a certain point, the real value of greater wealth is power, control, and security". At the same time, less wealthy individuals still enjoy the possibility of leaving a bequest in the case of a premature death.

Constraints on the ability to borrow against future income are an important aspect of the allocation problem facing the elderly. In particular, U.S. law forbids using social security income as collateral. We explicitly model this constraint in the dynamic budget equation. At any age N,

$$w_{s+N} = (1+r)^N w_s + \sum_{t=s}^{s+N-1} (1+r)^{t-s}(y_t - c_t) \geq 0 \quad N = 1, \ldots, T-s. \tag{1}$$

Given isoelastic utility, it is straightforward to show that the optimal consumption profile satisfies the following Euler equation

$$\left(\frac{c_{t+1}}{c_t}\right)^{-\gamma} \leq \left(\beta(1+r)\left(\frac{a_{t+1}}{a_t}\right)\right)^{-1} - \left(\frac{m_{t+1}}{a_{t+1}}\right) \cdot \frac{\alpha}{c_t^{-\gamma}}. \tag{2}$$

Without mortality risk, the standard relationship between the rate of return on wealth and the degree of impatience defines the slope of the consumption profile until the penultimate period of life, at which point the bequest motive would be influential. In contrast, mortality risk not only affects the rate of time preference but, when combined with a linear bequest motive, generates an inverse relationship between the growth rate of consumption and the level of consumption. In general, any examination of the bequest motive based on the growth rate of consumption must also account for mortality risk.

There are three possible qualitative solutions to the life-cycle model depending on whether the liquidity constraint binds at the end of life (Hurd, 1989). The Euler equation determines the shape of the consumption profile, and its location is pinned down by the restriction that the optimal wealth trajectory yields positive or zero wealth at age T. In the first case, the wealth

11. We do not model the taxation of estates. Over the time period examined in this paper, estate taxes applied to estates larger than \$600,000. Only a few individuals in our sample have wealth in this range.

constraint is not binding at age T. If a household reaches age T with positive net worth, the optimal consumption path is given by

$$c_t^{-\gamma} = \alpha \sum_{j=t+1}^{T} \left(\frac{m_j}{a_{j-1}}\right) (\beta(1+r))^{j-t}. \tag{3}$$

This path does not depend on income or wealth. It is the "satiation" path of consumption that gives an upper bound for consumption at any given age. A household follows this path if it is able to finance it; that is, if following this path keeps wealth positive at all ages. If wealth is zero at age T, then consumption is low enough so that the marginal utility from consumption exceeds the guaranteed marginal utility from bequests. In the second case, wealth reaches zero precisely at age T. The slope of consumption is determined by the Euler equation and the level is determined so that wealth is exhausted by age T. In the third case, wealth reaches 0 at some age $N < T$. Until age N, the slope of consumption is determined by the Euler equation and the level is determined by condition (1), which implies that the present discount sum of dissaving between age t and N is equal to initial wealth. For age $t > N$, consumption follows the path of income if they satisfy the following condition:

$$a_t y_t^{-\gamma} \geq \beta(1+r)(a_{t+1} y_{t+1}^{-\gamma} + m_{t+1}\alpha). \tag{4}$$

When income is constant (*e.g.* if all income comes from a real annuity), this exhausts all possible solutions. However, if income varies with age, the constraint may be binding a number of times, and the solution consists of multiple segments in which consumption follows the Euler equation, but is separated by periods when the wealth constraint is active and consumption follows the path of income.

5. EMPIRICAL MODEL

In this section, an empirical model is developed that is used to obtain an estimate of both the presence and strength of a bequest motive. We assume that the theoretical model describes the behaviour of a household in one of two regimes: households with a bequest motive ($\alpha > 0$), and households without a bequest motive ($\alpha = 0$). The regime in which a household resides is correlated with various observable characteristics and depends on an idiosyncratic component that is unobserved by the econometrician. These characteristics, including the unobservable component, are fixed in time and so households do not switch regimes—the regime is a time-invariant characteristic of individual preferences. Put differently, a researcher who analyses a sample drawn from the population is not able to ascertain with full confidence the regime an individual is in, but is able to arrive at a probability that the individual is in a particular regime. To the extent that the sample is representative of the whole population, the probabilities correspond to the actual distribution of the presence of a bequest motive in the population.

5.1. *The likelihood function*

Define the function $g(x_i; \theta, \alpha, \tau)$ as the solution to the life-cycle model where $x_i = [w_{s_i}, \{y_t, a_t, m_t\}_{t=s_i}^{T}]$. The function $g(\cdot)$ takes the characteristics of a household along with a given set of parameters, solves for the optimal consumption profile between 1995 and the year the household turns 119 years old, and returns the optimal value of consumption from 1995 to 1998 for $\tau = 1$ and from 1998 to 2000 for $\tau = 2$.[12] The function $g(\cdot)$ depends on initial wealth in

12. For estimation purposes, the consumption data is converted to a two-year frequency using the household specific number of years (and months) between surveys, and the function $g(\cdot)$ also returns consumption at a two-year frequency.

1995, the lifetime path of income, survival and mortality probabilities, and the parameters of the model, $\theta = [\beta, \gamma, r]$, where β is the factor of time discounting, γ is the inverse of the elasticity of inter-temporal substitution, and r is the rate of return which is set to 2·6%.[13] The function $g(\cdot)$ also depends on the marginal utility of leaving a bequest, α. The econometric model is as follows:

$$\begin{cases} c_{i\tau} = g(x_i;\theta,\alpha,\tau) + \varepsilon_{1i\tau} & if\ I_i > 0 \text{ (bequest motive, regime 1)}, \\ c_{i\tau} = g(x_i;\theta,0,\tau) + \varepsilon_{2i\tau} & if\ I_i \leq 0 \text{ (no bequest motive, regime 2)}, \\ I_i = \lambda' z_i + \eta_i & \text{(switching equation)}, \end{cases} \tag{5}$$

where, z_i is a vector of bequest motive indicators, assumed to be pre-determined and constant after 1995, and λ is a vector of the corresponding coefficients. The switching equation determines the presence of the bequest motive while the magnitude of α determines its strength.

We assume that the unobserved idiosyncratic component in the switching equation, η_i, is normally distributed and reflects the econometrician's uncertainty regarding the presence of a bequest motive.[14] The error term in regime k is assumed to be "transitory measured consumption" and reflects the mis-measurement of true consumption. We model this error as $\varepsilon_{ki\tau} = u_\tau + e_{ki\tau}$, where u_τ is assumed constant across all households but allowed to vary over time, and $e_{ki\tau}$ is mean 0 and is normally distributed but serially correlated, $\text{corr}(e_{ki\tau+1}, e_{ki\tau}) = \rho$. We assume that the uncertainty regarding the presence of a bequest motive is unrelated to transitory measured consumption, $E[\eta_i \varepsilon_{ki\tau}] = 0$. So as to minimize the potential dependence of x_i on $\varepsilon_{ki\tau}$, the optimal consumption profile generated by $g(\cdot)$ is based on wealth as of 1995. That is, the value of wealth in 1998 is not used as an initial condition for computing optimal consumption between 1998 and 2000 because it may be correlated with ε_{ki1}.

Given the distributional assumptions, (5) can be estimated by maximum likelihood. Transitory measured consumption in regime k is given as $e_{ki\tau} = c_{i\tau} - g(x_i;\theta,\alpha_k,\tau) - u_\tau$, where $\alpha_k = \alpha$ for $k = 1$ and $\alpha_k = 0$ for $k = 2$. Because sample separation is unknown, each observation contributes a weighted average of two probabilities to the likelihood function:

$$l(x_i, z_i;\theta,\alpha,\lambda,\sigma) = \Phi(\lambda' z_i)\phi(e_{1i1}, e_{1i2};\sigma) + (1 - \Phi(\lambda' z_i))\phi(e_{2i1}, e_{2i2};\sigma), \tag{6}$$

where $\phi(\cdot)$ is the p.d.f. of a two-dimensional normal distribution with the second moments given by σ, a vector of the standard deviations in periods 1 and 2 (σ_1, σ_2) and the inter-temporal correlation (ρ), and $\Phi(\cdot)$ is the c.d.f. of a standard normal distribution. We assume that the standard deviation of transitory measured consumption is constant across regimes. Given the complex survey design of the AHEAD, we maximize the likelihood function using household level population weights.

5.2. *Identification*

The structural specification used to estimate the empirical model has several advantages over a reduced form specification. Foremost, the structural specification does not require assumptions regarding which households have a bequest motive. Second, the structural specification conditions on the whole path of annuities and mortality rates. A parsimonious reduced form specification could not adequately capture the effects of liquidity constraints and mortality risk and so

13. The real interest rate is set to the 1995 to 2000 average rate of return on a three-month treasury bill less the percentage change in the CPI-U.

14. The assumption of normality in the switching equation is not very restrictive, because most of the bequest motive indicators are dummy variables.

would be misspecified. Third, by using a fully specified structural model we are able to estimate behavioural parameters instead of reduced form coefficients that are difficult to interpret.[15]

The life-cycle model provides the structure to generate the conditional means of the respective regimes, and to estimate the behavioural parameters of the model. More specifically, consider the Euler equation (2) for a household of age s whose wealth constraint eventually binds at some age K where $K \leq T$. This excludes only those very high-wealth households consuming at their satiation level, as indicated by (3). Consequently, for most households, iterating the Euler equation forward from any age $t \geq s$ to age K yields

$$a_t c_t^{-\gamma} = \alpha \sum_{i=t+1}^{K} \beta^{i-t}(1+r)^{i-t} m_i + a_K c_K^{-\gamma} \beta^{K-t}(1+r)^{K-t}, \tag{7}$$

where c_K is consumption in the last period when the wealth constraint is not binding. Thus, consumption at any age can be expressed in terms of the single unknown c_K. Substituting (7) into the inter-temporal budget constraint and combining the result with the terminal conditional $W_K = 0$ yields the solution for $c_K = h(w_s, \{y_t, a_t, m_t\}_{t=s}^{K}, s)$, which can then be used to derive c_t from equation (7). This solution is then matched to the data.

There are three sources of independent variation across households that determine the optimal consumption path: mortality rate profiles, income profiles, and the level of initial wealth. Mortality rates vary exogenously with age, birth-cohort, gender, permanent income (reflecting inherent ability), and race. Income and initial wealth vary exogenously with inherent ability, *ex post* returns to lifetime saving, and the presence of a bequest motive. Together, income and initial wealth determine the level of consumption but, because of borrowing constraints, variation in their relative magnitudes has implications for both the level and the slope of the consumption profile. When combined with measured consumption, this variation is used to identify the behavioural parameters β, γ, and α.

First, note that in equation (7) c_K interacts with β but not α. Consequently, because the level of resources available to the households affects the level of current spending through its effect on c_K, the effect of variation in wealth and income on the contemporaneous marginal utility of consumption is scaled by β and not α. Second, even in the limiting case with no variation in c_K (very high-wealth households consuming at their satiation level), variation in mortality risk alone can separately identify β and α, as indicated by the first term of equation (7). Specifically, an increase in α strengthens the impact of mortality risk at any age, while an increase in β strengthens the impact of mortality rates in the near or far future depending on whether $\beta(1+r)$ is greater than or less than one. Therefore, variation in the shape of the entire mortality rate profile—rather than the immediate mortality risk—aids in separately identifying these two parameters. This variation would be hard to incorporate in a reduced form specification, but is naturally used by the structural approach. Finally, the inverse of the elasticity of inter-temporal substitution γ is identified off the functional form, as indicated by equation (7), as well as from the slope of the measured consumption profile—variation that is provided by having two periods of measured consumption. Although β, γ, and α all affect the slope of the consumption profile, as noted above, the identification of β and α does not rest on variation in the slope of the consumption profile across households. As a result, variation in the inter-temporal pattern of measured consumption can be used to separately identify γ.[16]

15. An alternative interpretation of our approach is as a simulation exercise that relies on data-driven rather than arbitrarily selected parameter values. We show that allowing for heterogeneity in the presence of a bequest motive yields results that fit the empirical patterns in consumption remarkably well.

16. The model has one more feature that is helpful for identification. From (7), the marginal utility of contemporaneous consumption depends on the number of years $K - t$. If the wealth constraint were never binding, this would simply

The separate identification of the strength and the presence of the bequest motive is based on the assumption that measured consumption is a mixture of two normal distributions after conditioning on the structural form of the life-cycle model. With regard to the population average of consumption, holding other parameters constant, there is no clear distinction between the two: Higher consumption could reflect either a weaker bequest motive or a smaller probability of having a bequest motive. However, the two parameters can be identified by the cross-sectional variation in measured consumption. Consumption increases with wealth, but the rate of this increase varies depending on the presence of the bequest motive. Intuitively, if consumption relative to wealth and income differs depending on the presence of a bequest motive, all else being equal, then the unconditional distribution of the error term would be bimodal. Maximization of the likelihood function pins down the strength of the bequest motive and its probability by fitting the mixture of the two conditional normal distributions to the regime residuals. Although the particular distributional assumption is relevant, it is less important so long as the underlying consumption distribution is bimodal. The distance between the means of the two distributions—centred on the respective conditional consumption functions for the two regimes—provides an estimate of the *magnitude* of the bequest motive, while the relative density at the two means provides an estimate of the *presence* of the bequest motive.

5.3. *Measurement error*

Although measurement error is incorporated into the empirical model as discussed above, there remains a potential for extreme outliers to bias the results. In general, we consider two sources of measurement error: regular inaccuracies in the reporting of the value of assets conditional on owning the asset and the misreporting of the ownership of an asset that leads to the omission of the asset's value completely. Although active saving is directly measured independently from the reported asset values for categories of assets that are heavily influenced by capital gains (such as corporate equities, real estate, and personal businesses), active saving is simply measured as the change in the value of the asset between survey years for the remaining categories (checking accounts, for example). Consequently, the misreporting of the ownership of a particular asset in one survey year but not another may give rise to extreme outliers.

The data include two periods of consumption for each household. Large swings in consumption resulting from extreme measurement error could bias the parameter estimates. The sample distribution of *changes* in consumption over the two periods is trimmed so as to reduce the impact of these influential outliers. We assume the measurement error remaining in the sample is adequately captured by the error structure in (5). However, trimming the data could also eliminate valid observations. This implies a truncated error distribution, which is endogenous to the model parameters. A modified likelihood function that accounts for the potential of sample selection bias is used to estimate the model.[17] The truncated sample restricts the change in annual consumption to be between −\$70,000 and less than \$70,000. Our final sample includes 1126 observations.[18] Variances of the parameter estimates are computed as the outer product of the contributions to the first derivatives of the log-likelihood function with respect to the parameters.

reflect age and therefore age variation would further help in separately identifying β and α. When the wealth constraint binds, the age at which wealth is exhausted, K, becomes an endogenous variable that responds among other things to wealth and the relative importance of future income in the present value of resources. Therefore, the interaction of these two dimensions of the data with the parameters β and α provide an extra source of identification.

17. A formal presentation of the modified likelihood function is provided in the Appendix.

18. Our estimates are robust to more restrictive trims (−\$50,000 to \$50,000) as well as to less restrictive trims (−\$120,000 to \$120,000). These results are available upon request. In addition, there are 40 households with negative net wealth that we set to 0. However, excluding them from the sample has no effect on the results.

6. RESULTS

Various specifications of the switching equation are used in estimating the empirical model. The results are reported in Tables 3–5. The estimates correspond to consumption at a two-year frequency. For expositional purposes, the estimated bequest motive parameter is reported as $\alpha^{-1/\gamma}$. This transformation provides an intuitive dollar-value interpretation: for households that do not exhaust their wealth by the end of life, (3) implies that consumption at age T is $\alpha^{-1/\gamma}$. That is, $\alpha^{-1/\gamma}$ is the level of consumption that makes one indifferent between consuming and leaving a bequest in the last period of life. When consumption is less than this amount at age T, the marginal utility of consumption exceeds the marginal utility of leaving a bequest, and consumption is more attractive. In general, a large value of $\alpha^{-1/\gamma}$ implies a weak bequest motive.[19]

6.1. *Model estimates*

The first column of Table 3 reports the results assuming with certainty that only households with children have a bequest motive. This is the assumption made in Hurd (1989), and it implies that 82% of the sample has a bequest motive. We estimate the model by imposing that households with children have a bequest motive and that the switching equation error is 0 with a zero variance.[20] Although the estimate of the time discount factor is implausible, the implication of the magnitude of the bequest motive is the same as reported in Hurd (1989).[21] The level of consumption over two years that makes households indifferent between consuming and leaving a bequest in the last period of life is \$246,318. This level of consumption is well above what most households could afford suggesting that bequests are largely due to uncertain mortality.

Comparing the predicted consumption profiles with and without a bequest motive reveals the implied strength of the desire to leave a bequest. As indicated in the penultimate row of Table 3, predicted consumption over the sample period for households with children (bequest motive) is only 0·2% less than the predicted consumption for households without children (no bequest motive). The difference is trivial, implying that, conditional on the identifying assumption that only those households with children have a bequest motive, the bequest motive is essentially inactive. This is the same conclusion found in Hurd (1989).

The second column in Table 3 reports the estimated parameters of the model assuming imperfect sample separation information with only a constant in the switching equation. The behavioural parameters are within the range of values typically reported in the literature and are fairly tightly estimated. Abstracting from mortality risk, future utility is discounted at a rate of 0·91 over two years, and the estimated elasticity of inter-temporal substitution is 0·29. Transitory measured consumption has a standard deviation of roughly \$23,000 and is somewhat persistent with an inter-temporal correlation of 0·25. Overall, allowing the presence of a bequest motive to vary across all households greatly improves the fit of the model. The specification in the first column of Table 3 is a special case of the switching regression and can be formally compared to the specification in the second column using the likelihood ratio test. The difference in the log likelihood between the two specifications is overwhelmingly significant.

Although the presence of children is clearly not a definitive predictor of the presence of a bequest motive, it is still a useful indicator. The results in the third column of Table 3 control for the presence of children in the switching equation. Neither the behavioural parameters nor

19. Standard errors are computed directly for this transformed parameter.

20. In terms of (6), $\Phi(\lambda' z_i)$ equals 1 for households with children, and it equals 0 for households without children.

21. These results were obtained by restricting the discount factor to be no larger than 2 and the standard errors of the remaining parameters were obtained as if the discount factor was set to be equal to 2. There was no interior solution for the discount rate even if we relaxed this restriction to allow for discount factors as large as 8, although the impact of this relaxation on the likelihood value was minor.

TABLE 3

Model estimates

	i	ii	iii	iv	v	vi
			Behavioural parameters			
Time discount factor (β)	2·00	0·91	0·90	0·93	0·85	0·90
	(n.a.)	(0·03)	(0·03)	(0·03)	(0·03)	(0·03)
Elasticity of substitution ($1/\gamma$)	0·059	0·287	0·284	0·380	0·379	0·283
	(0·005)	(0·026)	(0·027)	(0·051)	(0·036)	(0·027)
Bequest motive ($\alpha^{-1/\gamma}$)	246,318	48,090	47,687	47,842	43,826	48,132
	(5159)	(1973)	(1968)	(2983)	(2058)	(2026)
			Transitory measured consumption			
Constant, period 1 (u_1)	2373	−6503	−6578	−6973	−1560	−6618
	(1217)	(1189)	(1188)	(1326)	(952)	(1196)
Constant, period 2 (u_2)	−684	−7328	−7362	−6824	−2141	−7408
	(1134)	(1137)	(1138)	(1205)	(929)	(1143)
S.D., period 1 (σ_1)	26,880	22,903	22,866	22,586	22,803	22,910
	(354)	(342)	(341)	(380)	(322)	(342)
S.D., period 2 (σ_2)	27,111	24,327	24,336	23,210	24,286	24,349
	(550)	(550)	(548)	(569)	(544)	(554)
Inter-temporal correlation ($\sigma_{1,2}$)	0·43	0·25	0·25	0·24	0·22	0·25
	(0·02)	(0·03)	(0·03)	(0·03)	(0·03)	(0·03)
			Switching equation			
One or more children			0·45			
			(0·26)			
Life insurance policy						0·39
						(0·25)
Constant		0·67	0·34	0·82	0·63	0·54
		(0·12)	(0·22)	(0·14)	(0·13)	(0·15)
			Predicted sample averages			
Prob (Having a bequest motive)	0·820	0·748	0·757	0·794	0·735	0·752
Bequest effect on consumption	0·998	0·741	0·741	0·732	0·756	0·743
Log likelihood	−10,425·8	−10,279·4	−10,277·8	−8378·4	−10,258·8	−10,278·0

Notes: The results in column i assume perfect sample separation information: households with children have a bequest motive. The average probability of having a bequest motive in column i is simply the fraction of the sample with children. The results in column iv restrict the sample to households with children and assume no sample separation information. The results in column v exclude housing equity from the measure of total net wealth. See text for estimation procedure. Standard errors are in parentheses. Dollar values are in 1996 dollars and the model is estimated at a two-year frequency. The bequest effect on consumption is the ratio of predicted consumption over the sample period assuming all households have a bequest motive to predicted consumption assuming no households have a bequest motive. Column iv is based on 923 observations; all others are based on 1126 observations.

the properties of transitory consumption are significantly altered from the specification in which no bequest motive indicators are included. The level of consumption over two years that makes households indifferent between consuming and leaving a bequest in the last period of life is significant and equal to $47,687, considerably lower than the level implied by the assumption that only households with children have a bequest motive.

The estimated effect of having at least one child on the presence of a bequest motive is significant at a 10% level, and it implies that households with children have a 79% probability of having a bequest motive, while those without children have a 63% probability. These do not correspond to the probabilities of leaving a bequest because households can die with positive net worth due to uncertain mortality. Indeed, the parameters of the model indicate that only 14% of the sample are consuming at the satiation level of consumption as given by (3). Households below the satiation level of consumption may or may not leave a bequest depending on their length of life. As indicated in Figure 1, roughly 10% of the sample is predicted to have zero net wealth by

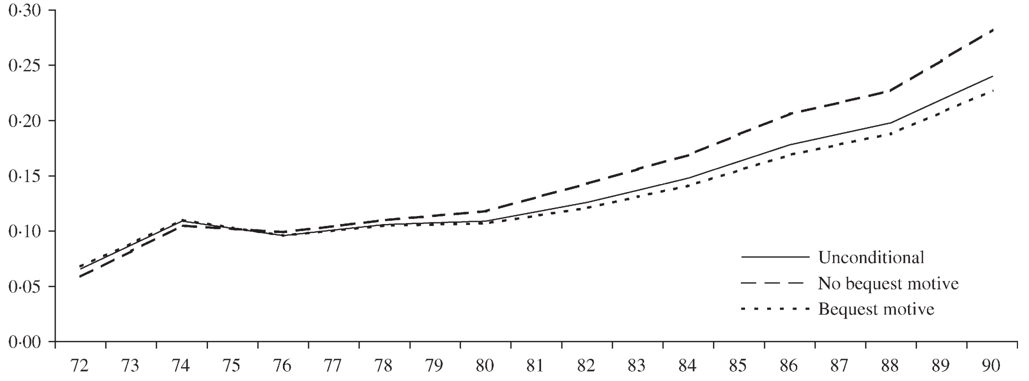

FIGURE 1

Percentage of households with binding wealth constraint

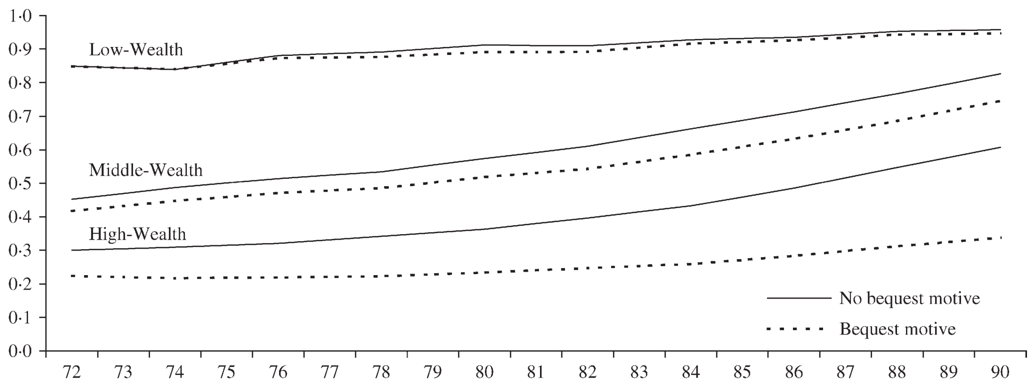

FIGURE 2

Average propensity to consume out of cash-on-hand by age

the age of 80. Naturally, the fraction of households affected by the wealth constraint grows with age but it also varies with the presence of the bequest motive. Individuals who have a bequest motive are significantly less likely to face a binding constraint at any age than households without a bequest motive. However, the existence of a bequest motive still does not preclude a binding wealth constraint, suggesting that the bequest motive is infra-marginal for most of the population: although leaving a bequest provides utility on the margin, most households are planning to run out of wealth if they live long enough. Conditional on not having a bequest motive, the fraction of the sample with a binding wealth constraint rises to almost 30% by age 90. The presence of a bequest motive reduces the fraction of households with a binding wealth constraint by almost 10 percentage points.

Whether the wealth constraint binds depends largely on the level of initial wealth. Consequently, the effect of the bequest motive on spending is largest for wealthy households. The effect of the bequest motive on spending can be seen in Figure 2, which shows the sample mean of the average propensity to consume out of cash-on-hand, defined as the sum of wealth and current income, by age. The age profiles are conditional on either having (the dashed line) or not

TABLE 4

Alternative specifications for the switching equation

	i	ii	iii
Number of children			−0·06
			(0·15)
One child	0·16	−0·42	
	(0·35)	(0·51)	
Two children	0·85	0·25	
	(0·36)	(0·52)	
Three or more children	0·38	−0·35	
	(0·30)	(0·54)	
One or more grandchildren		0·74	0·76
		(0·46)	(0·80)
		Children characteristics	
Financially better off than parents			−0·77
			(0·65)
Financially same as parents			−0·84
			(0·72)
High-school degree			1·72
			(1·23)
Some college			−0·34
			(0·77)
College degree			−0·18
			(0·65)
Own a home			1·39
			(0·71)
Live within 10 miles of parents			0·10
			(0·82)
Constant	0·34	0·34	−0·48
	(0·22)	(0·22)	(1·11)
		Predicted sample averages	
Prob (Having a bequest motive)	0·756	0·758	0·798
Bequest effect on consumption	0·743	0·745	0·726
Log likelihood	−10, 276·1	−10, 274·9	−6555·4

Notes: Only the estimated parameters of the switching equation are shown. The results in columns i and ii are based on the full sample (1126 observations), and the results in column iii restrict the sample to households with children (721 observations). See text for estimation procedure. Standard errors are in parentheses. Dollar values are in 1996 dollars and the model is estimated at a two-year frequency. The bequest effect on consumption is the ratio of predicted consumption over the sample period assuming all households have a bequest motive to predicted consumption assuming no households have a bequest motive.

having (the solid line) a bequest motive, and are stratified by initial net wealth: less than \$25,000, \$25,000 to \$100,000, and greater than \$100,000.[22]

The average propensity to consume is lowest for households in the high-wealth group regardless of whether a bequest motive is present. For a 75-year-old household with no bequest motive, the average propensity to consume out of cash-on-hand is 0·32 in the high-wealth group, and 0·86 in the low-wealth group. The presence of a bequest motive decreases the average propensity to consume considerably for households in the high-wealth group and has essentially no effect on households in the low-wealth group. This differential impact based on wealth clearly characterizes bequests as a luxury good. Despite the presence of a bequest motive, the marginal utility of consumption for households in the low-wealth group significantly exceeds the marginal utility of leaving a bequest. This is in contrast to households in the high-wealth group where the presence of a bequest motive damps considerably spending relative to cash-on-hand. On average, if all

22. These three wealth groups split the sample roughly into thirds.

TABLE 5

Model estimates

	i	ii	iii
		Behavioural parameters	
Time discount factor (β)	0·85	0·90	0·90
	(0·05)	(0·03)	(0·04)
Elasticity of substitution ($1/\gamma$)	0·297	0·284	0·286
	(0·046)	(0·027)	(0·032)
Bequest motive ($\alpha^{-1/\gamma}$)	57,394	47,787	51,610
	(3394)	(1966)	(2448)
		Transitory measured consumption	
Constant, period 1 (u_1)	−14, 243	−6615	−7600
	(2343)	(1186)	(1532)
Constant, period 2 (u_2)	−16,017	−7392	−7959
	(2185)	(1139)	(1455)
S.D., period 1 (σ_1)	28,819	22,866	24,015
	(812)	(342)	(434)
S.D., period 2 (σ_2)	30,483	24,366	25,741
	(1220)	(554)	(707)
Inter-temporal correlation ($\sigma_{1,2}$)	0·22	0·25	0·26
	(0·05)	(0·03)	(0·03)
		Switching equation	
Long-term health-care policy		0·23	
		(0·64)	
Private health insurance policy		0·56	
		(0·24)	
Prob (Medical costs exhaust wealth)			0·60
			(0·48)
Constant	0·68	0·28	0·52
	(0·15)	(0·20)	(0·20)
		Predicted sample averages	
Prob (Having a bequest motive)	0·751	0·746	0·776
Bequest effect on consumption	0·732	0·741	0·731
Log likelihood	−5391·0	−10, 276·3	−7502·1

Notes: The results in column i are based on households with wealth greater than $50,000 (569 observations). The results in the second column are based on the full sample (1126 observations), and the results in the last column are based on households that self-reported the probability their future medical expenses would exhaust all their wealth within five years (814 observations). See text for estimation procedure. S.E. are in parentheses. Dollar values are in 1996 dollars and the model is estimated at a two-year frequency. The bequest effect on consumption is the ratio of predicted consumption over the sample period assuming all households have a bequest motive to predicted consumption assuming no households have a bequest motive.

households had a bequest motive, predicted consumption would be 74% of what it would be if no households had a bequest motive, as indicated in the penultimate row of third column of Table 3.

Restricting the sample to households with children has little effect on the results, as reported in the fourth column of Table 3. The time discount factor is a touch stronger but so is the elasticity of inter-temporal substitution. The constant in the switching equation indicates that households with children have a 79% probability of having a bequest motive, identical to the probability when using the entire sample and including an indicator for having children.

A more detailed examination of the effect of children on the presence of a bequest motive is provided in Table 4, which reports the results from several alternative specifications of the switching equation. The estimates of the behavioural parameters are very similar to those reported in Table 3 and so are not shown. As indicated in the first column, households with two children have the largest and most significant probability of having a bequest motive. However, the effect of children on the presence of a bequest motive is insignificant when grandchildren are included in the specification. The point estimates in the second column of Table 4 suggest that, among households without grandchildren, the probability of having a bequest motive is roughly 50% for those with either one child or more than two children, and is 70% for those with two children. The presence of grandchildren increases the probability of having a bequest motive by roughly 25 percentage points. At 91%, households with two children and at least one grandchild have the highest probability of having a bequest motive. However, this result is insignificant at conventional levels of significance.

Households with a bequest motive are assumed to receive utility from having wealth at death primarily for egoistic reasons. However, the financial characteristics of a household's children could influence the presence of a bequest motive in so far as households desire to leave bequests for altruistic reasons. To examine the possibility of an altruistic bequest motive, the model is estimated over households with children, and various financial and demographic characteristics of the children are included in the switching equation.[23] The switching equation also controls for the number of children and the presence of grandchildren. Although this may not conclusively reveal the type of bequest motive because the model is still restricted to a constant bequest motive parameter, it does indicate how the presence of a bequest motive varies across households with children.[24] These results are reported in the final column of Table 4.

In general, the point estimates are consistent with an altruistic bequest motive. However, none of the characteristics are significant, suggesting that the assumption of an egoistic bequest motive is plausible. Among households with the same number of children, those with children who are financially the same or better off have a lower probability of having a bequest motive relative to those with children that are worse off. Having children that are college educated also lowers the probability of having a bequest motive. In so far as a college education implies more human capital, this could be interpreted as intergenerational altruism. However, it could also indicate a substitution of inter vivos transfers in the form of college expenses for bequests. Regardless, the effects are insignificant. In contrast, households with children that own their own home are more likely to have a bequest motive.

An alternative to the egoistic and altruistic bequest motive is the strategic motive, which suggests that bequests are used as compensation for services rendered by the beneficiaries (Bernheim, Shleifer and Summers, 1985). All else being equal, it is likely that children who live near their parents spend more time attending to the needs of their parents, and that this, in turn, could lead to larger intended bequests. To examine this hypothesis, the number of children that live within 10 miles of the parent is included in the switching equation. Of course, this variable is likely endogenous: children of parents willing to pursue such a bequest motive strategy should locate close to their parents. Nevertheless, we would still expect a positive association between location and the presence of a bequest motive if this type of motive is present, even though interpreting the magnitude of the estimate is difficult. The sign of the point estimate, reported in the final column of Table 4, is consistent with the strategic bequest motive hypothesis but small. Relative to the typical household, those with an additional child that lives within ten miles have only roughly a five-percentage point higher probability of having a bequest motive. Moreover, the effect is insignificant.

Returning to Table 3, the last two columns examine the influence of housing equity and life insurance, respectively, on the estimated presence and magnitude of the bequest motive.

23. The interpretation of these results must be tempered by the fact that the indicators are not necessarily time-independent. However, because we only use pre-determined values as of 1995, the potential for endogeneity is somewhat mitigated.

24. We considered a Tobit specification that allowed the bequest motive parameter α to vary by certain household characteristics. Because the results were largely insignificant and did not change the main results, we do not report them here. They are available upon request.

Hurd (1989) excludes housing equity from his baseline estimates, arguing that high transaction costs make it difficult to change the level of housing consumption services, and importantly, that non-housing consumption is completely financed only out of non-housing wealth. While it is likely that housing equity was fairly illiquid for the households in Hurd's sample, which covered 1969–1977, financial deregulation and new technologies over the past two decades have reduced transaction costs to allow the creation of new instruments that permit previously illiquid obligations to be securitized and traded. Consequently, the difficulties in extracting housing equity have been reduced considerably. Moreover, it is not clear that non-housing consumption is unaffected by housing equity, regardless of how it is financed. Many households could think of their home as a future bequest and consume a larger share of their non-housing wealth than they would otherwise. Excluding housing equity from total wealth could thus bias the result towards finding no bequest motive. Indeed, Hurd (1989) finds some support for a sizable bequest motive when housing equity is added to total wealth.

Despite this argument, we estimate the model excluding housing equity from total wealth for completeness. The results are reported in the fifth column of Table 3. As in Hurd (1989), the exclusion of housing equity reduces the time discount factor suggesting that households are somewhat less willing to consume their housing equity regardless of whether they have a bequest motive. Although less patient, households appear more sensitive to interest rate changes, as the elasticity of inter-temporal substitution is larger than in the second column of Table 3. More importantly, the bequest motive parameter is just as significant and is somewhat larger than when housing equity is included in total wealth. The effect of the bequest motive on predicted consumption is unchanged: the bequest motive reduces consumption by roughly 25%.

Measured wealth does not include the value of life insurance. If households consume more out of measured wealth knowing that their heirs will receive a life insurance pay-out, then the exclusion of the value of a life insurance settlement could in principle bias the results against finding a significant bequest motive. About 16% of the sample owns a whole-life insurance policy, and 27% own a term-life insurance policy. Given the relative liquidity of whole-life policies, we estimated the model including these policies in measured wealth.[25] The effects are negligible and are not reported. However, as shown in the final column of Table 3, there is some evidence that owning a life insurance policy is associated with the presence of a bequest motive. Owning either a whole- or term-life insurance policy is associated with a 12-percentage point higher probability of having a bequest motive, and is significant at a 10% level.

Finally, we considered various alternative model and data specifications to examine the robustness of the results. First, we considered a more robust model of the error term. In particular, we allowed the error term in each regime equation to vary with the log of initial net wealth. While this variable was itself significant, it had little effect on the estimates of the parameters of interest. We also allowed the standard deviation of the error term in each regime equation to vary with the log of initial net wealth. Although this form of heteroscedasticity was significant, it had little effect on the estimated magnitude of the bequest motive. Second, we added to initial net wealth those resources that were transferred out of the household in the form of financial assistance or gifts. Given that these transfers were relatively minor, adding them back to wealth had little effect on the results. Third, we considered alternative trims of the data. Allowing for a more restrictive trim (change in spending between −\$50,000 and \$50,000, dropping 100 additional observations) and less restrictive trims (change in spending between −\$120,000 and \$120,000, adding 200 observations) both yielded fairly similar results to those reported in Table 3.

25. The value of the policy was added to initial wealth and treated as completely fungible with all other forms of wealth. Wealth in later periods is not used in the empirical model and so no adjustment is required.

6.2. *Bequest vs. precautionary motive*

The empirical results above imply that roughly 75% of the elderly population consume in a manner consistent with a life-cycle model modified to include the desire to leave a bequest, and that this desire reduces spending by about 25% on average. However, because no assumptions were made regarding which households have a bequest motive, the observed patterns of spending relative to wealth may indicate a desire to save for uncertain medical expenses rather than for a bequest. Distinguishing between the bequest and precautionary motive is made difficult by the fact that precautionary savings can also serve the bequest motive (Dynan *et al.*, 2002, 2004). Estimating a model that accounts for both the bequest motive and the risks associated with future medical expenses is beyond the scope of this paper. Nevertheless, we consider several potential alternative hypotheses suggesting a weaker bequest motive in favour of a stronger precautionary motive and provide evidence against each.

The precautionary motive is a response to uninsurable risk, and thus the saving response to uncertain medical costs is largely mitigated by access to both social and private insurance. Indeed, the effect of asset-based means tested social insurance programmes, such as Medicaid, *reduces* the saving of households (Hubbard, Skinner and Zeldes, 1995). All else being equal, this would bias the results toward finding no bequest motive. However, the fact that Medicaid affects the saving behaviour of some households more so than others could be influencing the empirical results. A potential alternative hypothesis to the bequest motive is that Medicaid creates two groups of people: those who do not save in order to maintain eligibility for Medicaid and, in so doing, consume in a manner inconsistent with a bequest motive, and those who are wealthy enough to make self-insuring utility maximizing and, in so doing, consume in a manner consistent with a bequest motive. We argue the effect of Medicaid on the estimated presence and magnitude of the bequest motive is small for two reasons. First, although some self-insuring occurs, most wealthy households purchase insurance and so have less of a need to save. In the AHEAD sample, roughly 85% of households in the top third of the wealth distribution have health insurance beyond Medicare and Medicaid, and 14% have long-term health-care insurance. Second, and more importantly, the empirical model conditions on initial wealth and so is implicitly comparing the consumption profiles among households with similar wealth. This is clear from Figure 2, which indicates that the identification of the bequest motive is largely based on households with wealth greater than \$25,000. The estimates presented in the first column of Table 5 imply that the bequest motive damps spending by roughly the same magnitude (25%) when estimating the model on households with wealth greater than \$50,000 (roughly the median) as when estimating over the full sample. The estimates of behavioural parameters are also quite close to those based on the full sample.

Still, not all high-wealth households purchase private health insurance beyond Medicare, and even fewer purchase long-term care insurance. Thus, a second alternative hypothesis could be that there are some high-wealth households that self-insure and, in so doing, consume in a manner consistent with a bequest motive, and there are other high-wealth households that prefer to purchase private health insurance and, in so doing, consume in a manner inconsistent with a bequest motive. To test this hypothesis, we include in the switching equation indicators of whether a household has access to private health insurance and long-term care insurance.[26] As indicated in the second column of Table 5, access to long-term care insurance is insignificant and so is not associated with either having or not having a bequest motive. Although access to private health insurance is significant, it is associated with *having* a bequest motive, contrary to the alternative hypothesis.[27]

26. As with all characteristics included in the switching equation, only pre-determined values as of 1995 are used.

27. To determine if private health insurance were simply acting as a proxy for initial wealth, we considered a specification that also includes the log of initial wealth in the switching equation. The result was unchanged.

Despite access to social or private health insurance, most households face some risk of out-of-pocket medical costs. Consequently, to the extent that this risk differs across households, a third alternative hypothesis is that all households self-insure by saving, but those with a higher risk save more and, in so doing, consume in a manner more consistent with a bequest motive, while those with a lower risk save less and, in so doing, consume in a manner less consistent with a bequest motive. To test this alternative, we include in the switching equation a unique survey instrument in the AHEAD that asks households their expected probability that future medical costs will exhaust their wealth within the next five years. If the precautionary motive is heavily influencing the estimated bequest motive, households with a high probability of large medical costs should save more and consume in a manner that we mistakenly attribute to a bequest motive. As indicated in the last column of Table 5, a higher probability of large medical costs is indeed associated with having a bequest motive, but the effect is not significant.

We conclude that, although the precautionary motive is likely present, the saving patterns observed in the data are largely consistent with a significant bequest motive.[28] In general, precautionary saving models with uncertain medical expenses alone cannot explain these patterns precisely because most of aggregate personal saving is done by high-wealth households (Dynan *et al.*, 2004). Palumbo (1999) concludes that the precautionary saving motive for uncertain medical expenses damps spending by roughly 7%. Using his estimates, even if one were to argue that the effect of the bequest motive estimated in this paper was misidentified one-for-one with the precautionary motive, this would still imply the bequest motive damps spending by about 18%, more than twice as large as the effect of the precautionary motive.

6.3. *Model predictions*

As an alternative check on the validity of the results, we examine self-reported probabilities of leaving a bequest. Survey respondents were asked to report the subjective probability that they would leave a bequest larger than \$0, \$10,000, and \$100,000. The self-reported probabilities are compared to the predicted probability of leaving a bequest. For each household, the predicted probability of leaving a bequest conditional on having or not having a bequest motive is created by first creating an indicator variable that reflects whether wealth is larger than the intended bequest (\$0, \$10,000, or \$100,000) at each age. The probability of leaving a bequest of a given size conditional on the bequest motive regime is the weighted average of the indicator variable over the lifetime of the household where the weights reflect the probability of dying at a given age. The unconditional probability of leaving a bequest is then obtained by weighing the two conditional probabilities by the probability of having the bequest motive.

In addition to the predicted probability of leaving a bequest, we create an indicator variable that provides a binary estimate of whether a household has a bequest motive. The variable is based on the individual household's likelihood function and equals 1 if $\phi(\hat{e}_{1i1}, \hat{e}_{1i2}; \hat{\sigma}) > \phi(\hat{e}_{2i1}, \hat{e}_{2i2}; \hat{\sigma})$, and equals 0 otherwise. About half of the households in the sample have a likelihood that is greater when imposing the estimated bequest motive with certainty: for a given level of wealth and income and a known path of survival probabilities, these households consume in a way that is more consistent with having a bequest motive than not having one.

We verify the strength of the association between the predictions from our model and the self-reported probability of leaving a bequest by estimating a probit probability model with the self-reported probability as the dependent variable, expressed as a number between 0 and 1. In addition, we also examine the relationship with the self-reported probability that a household's

28. Although we do not show the results, including the indictors for long-term health care, private health insurance, and the probability of large medical costs directly in the regime equations (additively) did not affect the estimates of the parameters of interest.

TABLE 6

Self-reported probability of leaving bequest and model predictions

	Self-reported probability of leaving a bequest					
	>$0		>$10,000		>$100,000	
Constant	−1·55 (0·20)	−0·95 (0·15)	−1·62 (0·18)	−1·18 (0·16)	−1·96 (0·20)	−1·96 (0·21)
Wealth	0·0142 (0·004)	0·0259 (0·003)	0·0108 (0·004)	0·0294 (0·004)	0·0108 (0·004)	0·0302 (0·003)
Social security income	0·42 (0·15)	0·46 (0·14)	0·49 (0·15)	0·56 (0·15)	0·35 (0·19)	0·49 (0·19)
Prob (Medical costs exhaust wealth)	−0·52 (0·14)	−0·51 (0·14)	−0·61 (0·15)	−0·64 (0·15)	−0·63 (0·22)	−0·60 (0·21)
Prob (Leave bequest)	1·29 (0·21)		1·44 (0·20)		1·54 (0·25)	
Bequest motive indicator		0·34 (0·10)		0·31 (0·10)		0·18 (0·13)
Log likelihood	−455·8	−469·8	−411·3	−434·0	−220·6	−239·3

Notes: The sample is restricted to households that self-reported the probability their future medical expenses would exhaust all their wealth within five years (800 observations). Models are estimated by maximum likelihood using a probit specification for a continuous dependent variable between 0 and 1. Wealth and social security income are in tens of thousands of 1996 dollars and the probability of large medical expenses is the self-reported probability that medical expenses will deplete all wealth within the next five years. The predicted probability of leaving a bequest is the predicted probability of dying with wealth larger than $0, $10,000, or $100,000. The bequest indicator is equal to 1 if the individual observation's contribution to the likelihood function would be greater if a bequest motive were present with certainty, and 0 otherwise.

future medical expenses will exhaust all its wealth. The results are reported in Table 6. The probability of leaving a bequest is clearly correlated with the level of wealth and income. Moreover, consistent with the precautionary saving motive, households that expect large future medical expenses report having a small probability of leaving a bequest. Although the effect is significant, the magnitude is somewhat small. Evaluating the probability at the mean, a 10-percentage point increase in the self-reported probability of large future medical expenses reduces the self-reported probability of leaving a bequest by only about two percentage points, regardless of the self-reported size of the bequest. The self-reported and predicted probabilities of leaving a bequest are significantly related. Among households with the same level of wealth and income, as well as the same probability of large future medical expenses, a 10-percentage point increase in the predicted probability of leaving a bequest suggests a five-percentage point increase in the self-reported probability of leaving a bequest.[29] This relationship is similar for bequests larger than $0, $10,000, and $100,000.[30]

The generated bequest motive indicator has a similar significant relationship. This approach is more compelling than the previous one, because the bequest motive indicator reflects the fit of the two regimes for a particular individual, and is a function of the individual specific consumption-to-wealth relationship. Households whose individual likelihood is greater when imposing the estimated bequest motive with certainty have 13-, 11-, and five-percentage point larger self-reported probability of leaving a bequest larger than $0, $10,000, and $100,000, respectively.

29. The marginal effect is evaluated at the mean.

30. Of course, because the predicted probability of leaving a bequest is a non-linear function of income and wealth, adding higher-order polynomials of income and wealth to the regression weaken the estimated relationship between the model predictions and the subjective probabilities. The results in Table 6 simply highlight the non-linear structural predictions perform much better in explaining variation in the subjective probabilities than a reduced form linear specification in wealth and income.

TABLE 7

Distribution of probability of leaving a bequest larger than $10,000

			Self-reported	
Probability	Self-reported	Predicted	Bequest motive	No bequest motive
0–0·2	53·6	27·2	44·2	65·0
0·2–0·4	5·7	8·4	7·1	4·0
0·4–0·6	15·3	12·0	17·4	12·9
0·6–0·8	4·6	15·6	5·1	3·9
0·8–1·0	20·8	36·8	26·2	14·1

The table reports the percentage of households whose probability of leaving a bequest larger than $10,000 is within a given 20-percentage point range. Sample weights are used in all calculations. The predicted unconditional probabilities reflect the weighted average of the probability of leaving a bequest with and without a bequest motive, where the weights reflect the probability of having a bequest motive. The last two columns show the self-reported probabilities of leaving a bequest larger than $10,000 separated by the predicted presence of a bequest motive. The sample is separated into those households whose individual contribution to the likelihood would be greater if a bequest motive were present with certainty and those households whose individual contribution would be greater if a bequest motive were absent with certainty. Sample includes all households used in the estimation and that reported a probability of leaving a bequest (1027 observations).

The significant relationship between the model predictions and the self-reported probabilities, all else being equal, is suggestive of a bequest motive and serves as an external validation of the results.

The distributions of self-reported and predicted probabilities of leaving a bequest larger than $10,000 are reported in Table 7. Overall, the distribution of the predicted probabilities is reasonably aligned with the distribution of the self-reported probabilities. About 20% of the sample reported a probability of leaving a bequest larger than $10,000 that was greater than 80%. This is smaller than the 37% predicted by the model. Correspondingly, whereas about half of the sample reported a probability less than 20%, the model predicts that only about a quarter of the sample has a probability in that range. However, 28% of households have wealth greater than $10,000 and yet report a zero probability of leaving a bequest. Such over-reporting of low probabilities cannot be matched by our model because there is a non-zero probability of immediate death, which implies that the probability of leaving a bequest is greater than 0.

The last two columns of Table 7 report the distribution of the self-reported probability of leaving a bequest greater than $10,000, separating the sample by the generated bequest motive indicator described above. Households that reported a probability of leaving a bequest as less than 20% constitute 44% of those who consume in a way that is more consistent with a bequest motive, while they constitute 65% of those who consume in a way that is more consistent with not having a bequest motive. In contrast, households that reported a probability of leaving a bequest that was larger than 80% constitute 26% of those who consume in a way that is more consistent with a bequest motive while they constitute only 14% of those who consume in a way that is more consistent with not having a bequest motive.[31]

We next compare the predicted consumption profile from the estimated model to independent data on expenditures in the Consumer Expenditure Survey (CEX). Restricting the CEX to single, non-working households that are age 70 years and higher, total expenditures are regressed

31. The differences in expected medical expenses between households with and without a predicted bequest motive are minor.

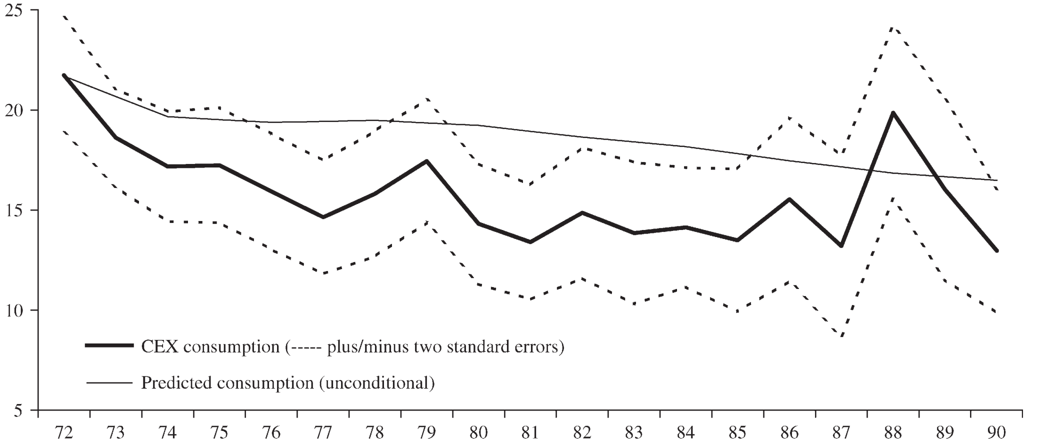

FIGURE 3

Total expenditures of non-married, non-working households by age (thousands of 1996 dollars)

on a full set of single-year age indicators. The sample is restricted to the 1993–1997 waves of survey to match the same cohorts in the AHEAD. The fitted expenditure profile is shown in Figure 3 along with two S.E. bands. This is compared to predicted consumption from the estimated life-cycle model that includes a constant and an indicator of children in the switching equation (specification iii in Table 3). Consumption is predicted for each household assuming a bequest motive, $\{\hat{c}_{1it}\}_{t=s_i}^{T}$, and also generated assuming no bequest motive, $\{\hat{c}_{2it}\}_{t=s_i}^{T}$. A weighted average yields each household's unconditional consumption profile where the weights are given by the probability of having a bequest motive, $\hat{c}_{it}^{u} \equiv \hat{p}_i\hat{c}_{1it} + (1-\hat{p}_i)\hat{c}_{2it}$ with $\hat{p}_i = \Phi(\hat{\lambda}'z_i)$. Averaging $\hat{c}_{it}^{u}$ by age is not comparable to the fitted CEX profile since the CEX is subject to mortality bias. Correcting for survival rates that are conditioned by age, gender, cohort, race, and permanent income, the predicted unconditional consumption profile is given by $\{\bar{c}_t^u = N^{-1}\sum_{i=1}^{N}\hat{a}_{it}\hat{c}_{it}^{u}\}_{t=72}^{90}$ and shown in Figure 3. The predicted level of consumption is roughly in line with expenditures in the CEX, and the two profiles share the same downward trajectory. However, the predicted consumption profile masks a sizable degree of heterogeneity that depends on the presence of a bequest motive. As indicated in Figure 4, households without a bequest motive consume a fair bit more on average than the unconditional average.[32]

The difference in consumption between households with and without a bequest motive provides the necessary information needed to determine the fraction of wealth attributable to the bequest motive. Using the predicted conditional consumption profiles, along with the budget constraint, a wealth profile is generated for each household assuming a bequest motive is present, $\{\hat{w}_{1it}\}_{t=s_i}^{T}$, and another wealth profile is generated assuming no motive is present, $\{\hat{w}_{2it}\}_{t=s_i}^{T}$. The share of bequeathed wealth attributed to the desire to leave a bequest is then computed as

$$\frac{\sum_{t=70}^{119}\sum_{i=1}^{N}\hat{m}_{it}\hat{p}_i(\hat{w}_{1it}-\hat{w}_{2it})}{\sum_{t=70}^{119}\sum_{i=1}^{N}m_{it}(\hat{p}_i\hat{w}_{1it}+(1-\hat{p}_i)\hat{w}_{2it})}.$$

Although uncertain mortality still plays a large role, much of bequeathed wealth is due to the desire to leave a bequest. Of the 78% of net wealth that is estimated to be bequeathed by single households aged 70 years and older, 53% is accounted for by a bequest motive.

32. The conditional profiles in Figure 4 are weighted by the survival probabilities in the cross-section.

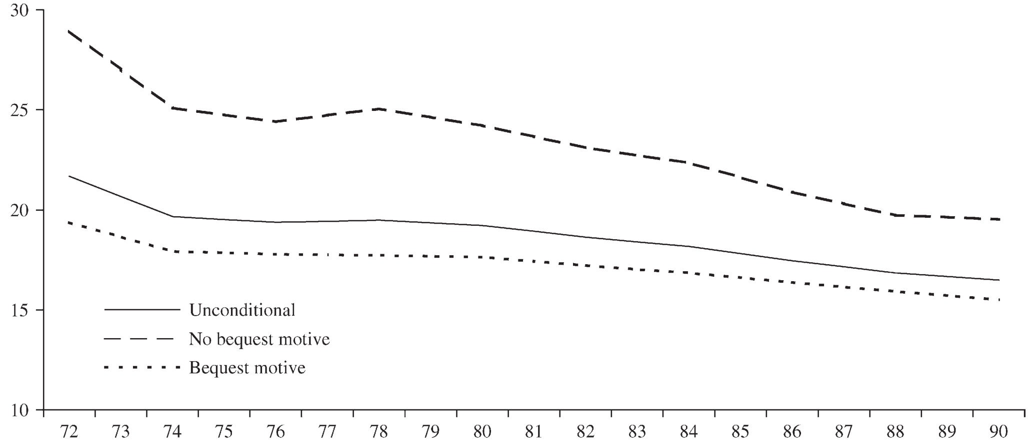

FIGURE 4

Predicted consumption by age (thousands of 1996 dollars)

7. CONCLUSIONS

Assumptions regarding the desire to leave bequests are a crucial element to policy prescriptions related to the distribution of wealth, taxation, government debt, and charitable contributions, to name a few. Our perception of wealth inequality relies heavily on whether a significant portion of household wealth is attributable to bequests as opposed to life-cycle saving. If bequests are merely a result of an uncertain length of life, estate taxes may have no direct effect on saving. The neutrality of government spending rests on a belief that all later generations are equally cared for by the current generation in terms of discounted utility. Moreover, social security reform requires knowledge of the saving response to changes in payments. Under an operative bequest motive, an increase in payments may simply be saved. In general, the nature of why households save relates to the effects of many policy instruments. Without considering the full range of saving behaviour, government actions can have diluted or even the opposite desired effects.

We estimate that about 75% of a representative sample of elderly single households has a desire to leave an estate with positive net worth. The magnitude of this desire is both statistically and economically significant. All else being equal, households with an operative bequest motive spend about 25% less on personal outlays. This implies that of the almost four-fifths of household wealth we estimate will be bequeathed, about half will be due to a bequest motive. As in Hurd (1989), we show that elderly households with children do not consume in a way that is any more consistent with a bequest motive than do households without children. However, we argue that this is not evidence against the importance of the bequest motive. The assumption of children as a definitive indicator of a bequest motive is rejected. Although the estimated probability that a household with children has a bequest motive is 79%, the probability for households without children is 63%. This lack of a large difference in the desire to leave a bequest between households with and without children is consistent with self-reported subjective probabilities of leaving a bequest, which likely combines intentional and unintentional bequests. In our sample, the self-reported subjective probability of leaving a bequest greater than $10,000 is actually slightly higher for people without children (39%) than for people with children (36%), and so is the number of those who report that they will leave such a bequest with certainty (23% of those with children and 18% of those without). More direct evidence about intended bequests was documented by Laitner and Juster (1996). In a survey of TIAA-CREF participants, roughly

45% of individuals with children reported a desire to leave a bequest while 23% of individuals without children reported a similar sentiment. Although these figures are notably smaller than those estimated in this paper (perhaps due to the fact that a person with a non-operative bequest motive need not answer this question affirmatively), it remains the case that a significant number of households without children report a desire to leave a bequest.

In general, the life-cycle model with an egoistic bequest motive fits the data much better when the presence of a bequest motive is allowed to vary across all households, as opposed to restricting it to households with children. Assuming a deterministic bequest motive results in estimates of the time discount factor and elasticity of inter-temporal substitution that are highly implausible, while relaxing this assumption yields estimates that are consistent with estimates typically reported in the literature. We find little evidence to support either the altruistic or strategic bequest motives.

In terms of out-of-sample fit, the predicted probability of leaving a bequest aligns well with self-reported probabilities. Moreover, we show that the estimated bequest motive is not simply reflecting the desire to accumulate wealth for future medical expenses. Slightly more than one-fourth of households that consume in a way that is consistent with a bequest motive reported a probability of leaving a bequest that was greater than 80%. In contrast, only about one-seventh of households that consume in a way consistent with no bequest motive reported a probability of leaving a bequest greater than 80%.

The results in this paper are relevant for the assessment of the efficiency cost and desirability of estate taxation. We find that most of the population has a bequest motive but for a majority, at least some of bequests are of an accidental nature. Only at high wealth levels does the difference between having and not having a bequest motive become clearly visible. A tax on small bequests is unlikely to have a large impact on individual decisions, while a tax on large bequests may be distortionary because some of the large bequests appear motivated by bequest considerations. The existence of some accidental bequests among the wealthy suggests a peculiar policy prescription that resembles the current U.S. estate tax: imposing a tax on bequests but allowing for relatively cheap avoidance. Under this policy, the tax could apply to bequests left by people without a bequest motive while cheap avoidance could allow others to escape taxation without a real reduction in wealth and thereby reduce the efficiency cost. Of course, our results say nothing about the potential influence of bequests on the saving behaviour of the recipient.

Future research is needed to better understand the effect of heterogeneous preferences toward leaving bequests. Most previous studies rest on the assumption that all households have a bequest motive and proceed to measure empirically the economic significance of the motive and its impact on various dimensions of household behaviour. Some studies assume that only households with children have a bequest motive and use the relative behaviour between households with and without children as an indicator of the strength of the bequest motive. In this paper, we show that both of these assumptions are suspect, suggesting that better indicators of the desire to die with positive net worth would greatly improve our understanding of household wealth determination.

APPENDIX

A.1. *Measuring wealth, income, and consumption in the AHEAD*

Total household net wealth in the AHEAD is the sum of 12 components: (1) main home equity, (2) real estate equity other than main home equity, (3) a farm or private business net of any loans, (4) automobiles, motor homes, or boats net of any loans, (5) investment retirement accounts or Keoghs, (6) checking and saving accounts, money market funds, (7) certificates of deposit, government saving bonds, treasury bills, (8) equities in publicly traded corporations or mutual funds, (9) municipal, government or foreign bonds, or bond funds, (10) trust funds, (11) other savings or assets, such as jewellery, money owed by others, a collection for investment purposes, beneficiary rights in a trust or estate, (12) less total non-collateralized debt, such as credit card balances, medical debts, and loans from relatives. Note that equity in the main home and other real estate excludes the value of reverse mortgages, and that any income generated from reverse mortgages is included in income.

Measured net wealth is missing two components. First, defined contribution pensions are excluded because these data were not available. However, our focus on individuals born prior to 1923—a cohort with very little exposure to defined contribution pension plans—largely mitigates any potential bias in measured wealth. Moreover, because we focus on individuals older than 70 years, it is likely that most of the few defined contribution pensions that did exist were either liquidated and placed into one of the financial accounts noted above or converted to an annuity, which is included in measured income. Second, measured wealth excludes the value of life insurance policies. Because roughly 40% of the sample has a life insurance policy, the effect of life insurance on our results is considered in more detail in Section 6.

In 1998 and 2000, respondents were asked about their "active" saving since the previous survey, defined as the net acquisition of assets. These questions were specific to the components of wealth where capital gains are most relevant. Measured active saving in the main home, other real estate, and farm or private business, depend on ownership status. If there was no change in ownership status between the survey years, active saving is defined as the change in the mortgage or loan principal plus investments and improvements. If there was a change in ownership status, the active saving is simply the change in net equity. Active saving in transportation assets is defined as the change in the self-reported value of the assets between survey years after depreciating the asset at a rate of 20% per year. Active saving in investment retirement accounts or Keoghs and in equities for publicly traded corporations or mutual funds are defined as the self-reported acquisition of assets less withdrawals in these accounts. Active saving in all other assets are defined as the change in the self-reported value of the assets between waves, based on the assumption that capital gains in these assets are relatively small. Total saving is the sum of active saving in each component. Given both the change in wealth and active saving, capital gains in each asset is derived as the change in the value of that asset less active saving in that asset.

Respondents provided detailed information regarding all sources of income over the previous calendar year, or previous month. These include self-reported social security income, supplemental security income, veteran's benefits, defined benefit retirement pensions, annuities, dividend and interest income, welfare, food stamps, and financial assistance from friends and family. Combining these sources of income yields a measure of all resources that flowed into the household in the previous calendar year. This is scaled by the number of years between survey waves for each household to generate a measure of total inter-survey-year income that is at the same frequency as measured active saving. The difference between total income and active saving yields measured consumption between survey years. In Table 2, income, consumption, and capital gains values are annualized by the individual specific number of months between surveys. For the purposes of estimating the empirical model, consumption and income are converted to a two-year frequency.

Table A.1 reports the mean, median, and standard deviation of measured consumption in the AHEAD (restricted to the sample we use in our estimation) and two alternative surveys: the Consumer Expenditure Survey (CEX) and the Panel Study of Income Dynamics (PSID). Consumption in the AHEAD and the CEX are comparable, reflecting total household outlays, including owner occupied housing expenditures such as mortgage payments. Consumption in the PSID only includes outlays for food and housing. All figures reflect spending during the mid to late 1990's and are at annual rates. Measured consumption in the AHEAD is roughly in line with the CEX and, as indicated in the last column of the table, the ratio of the standard deviation of outlays to its mean in the AHEAD is 0·29 points greater than the CEX and only about 0·05 points more than the PSID. Given that measured consumption in the AHEAD relies on self-reported active saving, the level of wealth, and income, all of which are likely subject to more measurement error than the direct consumption measure in the CEX, we view this as evidence that the AHEAD data are not excessively dominated by errors.

The projected income profile for each household is based on the self-reported description of the income source. In each wave of the survey, respondents noted the amount of each type of income received, how long the income is expected to last, and whether the income source is adjusted for increases in the cost of living. This information is used to construct an age profile of total income for each survey which is then combined to create a single profile that utilizes the most current information: income from 1995 to 1998 is based on the 1995 survey, income from 1998 to 2000 is based on the 1998 survey, and income from 2000 forward is based on the 2000 survey. Each income source is assumed to last for as long as the respondent claims it will last. If the income source is adjusted for cost-of-living increases, the level of income is held constant in real terms. Otherwise, future income values are discounted by the CPI-U as forecasted by Social Security Administration in the 1998 OASDI Trustees Report. Non-regularly occurring income, such as financial assistance from friends and family are added to earnings in the relevant survey period but assumed to not continue into the future. Roughly one-fourth of the sample either received (or gave) transfers from (or to) friends and family. The average annual net transfer out of the household is about $600. The assumption that these transfers do not continue in the future has little impact on our results. Because dividend and interest income are accounted for in the return to wealth, these sources of income are excluded.

TABLE A.1

Household consumption (annual rate)

	(1)	(2)	(3)	(4)
	Mean	Median	S.D.	(3) / (1)
CEX	15,613	12,607	11,324	0·73
PSID	8222	6354	7971	0·97
AHEAD	15,788	12,115	16,066	1·02

Notes: All samples are restricted to single, unemployed individuals older than 70. The CEX includes the years 1995–1997 (671 obs.), the PSID includes the years 1995–1997 (743 obs.), and the AHEAD includes the years 1995–2000. As is done in the model estimation, observations in the AHEAD are dropped if the change in consumption between 1995–1998 and 1998–2000 is outside the range of $-\$70,000$ to $\$70,000$. Consumption in the AHEAD and CEX reflect total outlays including owner occupied housing payments (*e.g.* mortgage payments). Consumption in the PSID only includes total outlays for food and housing expenses (including owner occupied costs). Consumption is reported at an annual rate.

A.2. *Mortality rates*

Survival statistics from the National Institute of Health (NIH) are used which provide the number of individuals alive out of 100,000 for each age from 0 to 119 separately by birth-year cohort and gender. Note that for future values, these are NIH projections. These values are assumed to reflect the true age-mortality profile but neglect the effect of permanent income and race. It is further assumed that the true probability distribution function of mortality is given as

$$\text{Prob(Die at age } t) \equiv \pi(t) \equiv f(t)\exp(\omega' X_{it})\exp(-F(t)\exp(\omega' X_{it})),$$

where $F(t)$ reflects the true, but unknown, age effect from the NIH survival statistics and $f(t) \equiv F'(t)$. We assume the age effect is scaled by a quadratic in log-permanent income relative to the median and race, as indicated by $\omega' X$. Social security earnings are used for permanent income and truncated at the 10-th and 90-th percentile. These effects are estimated using the mortality data from the AHEAD, where we approximate the true age effects with age dummy variables. Because the exact time of death is unknown—it is only known if an individual died by wave II in 1995, wave III in 1998, or wave IV in 2000, estimating the hazard model cannot be done using standard procedures. Instead the likelihood function needs to be modified. To see this, note that

$$\text{Prob(Alive in wave } k \text{ and dead by wave } k+1) = \int_{t_k}^{t_{k+1}} \pi(t)du = D(t)\,\Big|_{t_k}^{t_{k+1}} = -S(t)\,\Big|_{t_k}^{t_{k+1}}$$
$$= S(t_k) - S(t_{k+1}),$$

where t_k is the age in wave k, $\pi(t)$ is the probability of dying at age t, $D(t)$ is the probability of being dead by t, and $S(t)$ is the probability of surviving to age t. Approximating the true age effect by $F(t) \approx \tau \exp(\delta A)$ for the wave I age, A, and $\tau \equiv t - A$, the survival function is given by

$$S(\tau, A) = 1 - \int_0^t \pi(u)du = \exp(-F(t)\exp(\omega' X)) \approx \exp(-\tau\exp(\omega' X + \delta A)).$$

The number of years following wave I until an individual dies, τ, is censored at 7 (wave IV) and, if death occurs before wave IV, must be equal to 2 or 5. Consequently, the likelihood function is given by

$$L(\omega, \delta) = \prod_{i=1}^{N} d_i \left[S_i\left(\tau_i', A_i\right) - S_i\left(\tau_i'', A_i\right)\right] + (1 - d_i)S_i(7, A_i),$$

where d_i is one if the individual is dead by wave IV and 0 otherwise, τ' is the number of years between wave I and the last wave an individual is known to be alive, and τ'' is the number of years between wave I and the first wave an individual is known to be dead. Maximizing $L(\omega, \delta)$ separately by gender yields an estimate for $\hat{\omega}$.

The survival statistics from the NIH are converted to hazard rates that only account for age and birth-year cohort variation by gender, $\mu_{\text{NIH}} \equiv f(t)$. These are then adjusted to yield individual specific hazard rates as follows:

$$\mu(t, X_{it}) = f(t)\exp(\omega' X_{it}) \approx \mu_{\text{NIH}} \exp(\hat{\omega}' X_{it}).$$

A.3. *Truncated switching regression*

We modify the likelihood function implied by (6) in order to account for the potential sample selection bias due to trimming the data. Denote the lower and the upper bound of the trimmed sample of changes in consumption as L and H, respectively. Conditional on being in regime $k = 1$ or 2 ($\alpha_k = \alpha$ in for $k = 1$ and $\alpha_k = 0$ for $k = 2$), an observation is included in the sample if $L < (g(x_i;\theta,\alpha_k,2)+u_2+e_{ki2}) - (g(x_i;\theta,\alpha_k,1)+u_1+e_{ki1}) < H$. The distribution of $e_{ki2} - e_{ki1}$ is a truncated normal with the truncation points given by

$$\tilde{L}(x_i,\theta,\alpha_k) = L - (g(x_i;\theta,\alpha_k,2)+u_2 - g(x_i;\theta,\alpha_k,1) - u_1)$$

$$\tilde{H}(x_i,\theta,\alpha_k) = H - (g(x_i;\theta,\alpha_k,2)+u_2 - g(x_i;\theta,\alpha_k,1) - u_1),$$

with variance equal to $\sigma_1^2+\sigma_2^2-2\sigma_1\sigma_2\rho$. Predicted consumption depends on the value of the bequest motive parameter and so is dependent upon the regime for which it is being predicted. These values modify the p.d.f.'s for regimes 1 and 2 in (6) as follows:

$$\frac{\phi(e_{ki1}, e_{ki2}; \sigma)}{\Phi\left(\tilde{L}(x_i;\theta,\alpha_k)\Big/\left(\sigma_1^2+\sigma_2^2-2\sigma_1\sigma_2\rho\right)^{1/2}\right) - \Phi\left(\tilde{H}(x_i;\theta,\alpha_k)\Big/\left(\sigma_1^2+\sigma_2^2-2\sigma_1\sigma_2\rho\right)^{1/2}\right)},$$

for $k = 1$ and 2, respectively. These two p.d.f.'s, weighted by the probability of being in the respective regime, are used to define the log-likelihood function for the truncated switching regression model.

A.4. *Estimation procedure*

The programmes used to estimate the empirical model along with a description of the estimation procedure can be found on the *Review of Economic Studies* website.

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