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COMPARING ECONOMIC WELL-BEING AMONG ELDERLY AMERICANS

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Income-only and income-net worth measures of elderly economic well-being are derived from a single public welfare function-optimizing model of household production and intertemporal resource allocation. These measures are estimated with data on United States elderly in 1984 from the Survey of Income and Program Participation. The income-net worth measure also incorporates independently estimated work-life expectancies and earnings replacement rates. Under both measures, minority, moderately disabled, and unmarried female elderly are the poorest sub-populations. Increasing poverty with age is found under the income-only measure, but not the income-net worth measure.

1. INTRODUCTION

Comparisons of economic well-being among the elderly are useful for the identification of economically vulnerable elderly sub-populations, for answering questions about equity between elderly sub-populations, and for investigation into the causes of poverty among the elderly. Critical for any comparison is the method of well-being measurement. Although this issue has received considerable attention in recent years (Danziger, van der Gaag, Smolensky, and Taussig, 1984; Torrey and Taeuber, 1986; U.S. Bureau of the Census, 1988; Quinn, 1988; Crystal and Shea, 1990; Hurd, 1990; Radner, 1990; Wolff, 1990), no consensus has been reached. Therefore the present study addresses theoretical as well as substantive aspects of elderly economic well-being comparisons.

Measures of elderly economic well-being can be divided into two types: (1) "income-only" measures, in which wealth is ignored except for the current period income, and possibly also asset services, it generates; and (2) "income-net worth" measures (Weisbrod and Hansen, 1968), in which wealth is annuitized over the remaining lifetimes of the elderly person or couple. We develop a public welfare function-optimizing resource allocation model here that builds on the model of Moon (1977), sharing the conceptual notion that current period well-being is given by the consumption level the elderly person is able to achieve in the current period whilst maintaining the ability to achieve a similar consumption level over

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all future periods of his or her life. However, instead of developing a model-based income net-worth measure and contrasting this with an arbitrary income-only measure as Moon does, we set up a model that generates both income net-worth and income-only measures, depending on the consumption horizon assumed for the elderly person or couple. Under an infinite horizon assumption, an income-only measure of elderly person well-being results. Under an own-lifetimes (finite) horizon assumption, an income-net worth measure, which allows complete dis-saving from assets over remaining lifetime, results. When the elderly person or couple shares the household with other persons, our income-net worth measure of well-being allows the elderly person/couple sub-unit to allocate resources according to a finite time horizon while other household members allocate resources according to an infinite consumption horizon. Most other persons in the household will have own-lifetime horizons distant enough to make an infinite horizon assumption empirically reasonable. The current-period consumption allocation is adjusted for reductions in both income and efficiency of household production upon expected year of widowhood. The income-only measure here differs from the usual income-only measure by using a single real rate of return for all persons rather than the time- and person-varying income actually received from assets.

The income-net worth measure is shown to be the correct measure under a public welfare function that emphasizes the prevention of poverty. Leisure time and the privacy attained by living in an independent household are not valued under this function, and no time preference is permitted. This is consistent with a "goods and services only" public welfare function implicitly chosen in the poverty literature (e.g., Atkinson, 1987)—identifying the poor only on the basis of their monetary resources and resource utilization efficiency via household sharing. However, it contrasts with pure consumer theory measurement of welfare (Taussig, 1973; Moon, 1977; Pollak and Wales, 1979; Holden, 1988), which would ideally have leisure and independent living measured for their contribution to welfare, and which typically specifies a preference for current over future consumption. Also, by using official (Social Security Administration) minimum food budget-based poverty thresholds here (i.e., thresholds based on achieving standards of adequate nutrition), the form of the household production function is given by a public welfare valuation appropriate to consumption levels about the poverty threshold.[1]

The most critical public-welfare function assumption, however, is that the consumption horizon of the elderly person or couple is equal to the expected last period of life of whoever of the elderly person or spouse survives longest. Current public policy in the United States points towards the validity of this assumption. Asset tests that suppose that persons should completely spend down their assets to maintain their own lifetime well-being are used in determining welfare program eligibility (Leavitt and Schultz, 1988). Further, the legal duty of parents to financially support their children ends when the children attain majority age, usually well before the expected times of death of the parents. Thus from a public welfare viewpoint, the elderly should, in general, have all their

[1]See Ruggles (1990) for a discussion of the limitations of this set of poverty thresholds.

assets available to finance consumption expenditure within their own lifetimes, leaving no bequests.[2]

The own-lifetimes horizon assumption is critical because the income-net worth variant of our model results from it. Unfortunately, more parameters have to be estimated for the income-net worth than for the income-only measure. However, the more parsimonious, income-only measure is inappropriate under our welfare-function assumptions unless the distorting effect of assuming infinite instead of own-lifetimes consumption horizons for the elderly person or couple is empirically small. By estimating both measures, we demonstrate that the distorting effect is large, and that therefore income net-worth measures should be used whenever possible. The present work's estimates of the direction and magnitude of the bias induced by income-only measurement for various elderly sub-populations should be useful for interpreting work that uses income-only measures.

Estimation is from detailed income and wealth data of the 1984 panel of the Survey of Income and Program Participation (SIPP). These data allow assets owned by the elderly person or couple to be distinguished from assets owned by other household members, and market valuations to be made of non-cash government program benefits (including implicit and explicit rent subsidies, food stamps, and energy subsidies). The impact of taxes and reporting error, on the other hand, are not estimated in the present work.[3,4] Supplementary estimates from non-SIPP data are also used to estimate certain parameters of the income-net worth measure. To estimate the effect of transaction costs on annuity yields used in computing the income-net worth measures, rates of return on annuities are based on differences between real rates for government bonds and the somewhat lower effective real rates on private annuities in the 16 years preceding the survey. Annuities transaction costs have been arbitrarily chosen in previous work. Also, independently-derived estimates of length of time until cessation of work, and

[2]The empirical fact that many elderly persons do make substantial bequests merits attention because elderly persons might implicitly trade bequests for care from children or other beneficiaries should it be required, or in return for the assurance that care would be provided (Bernheim *et al.* 1985). The holding of bequeathable wealth may also result in substantial unintentional bequests due to uncertainty about exact age of death (see also Kotlikoff and Spivak, 1981; Hurd, 1989). The measurement problem with bequest-care trades is that bequests occur upon the death of the elderly person, while care, or the assurance of care, occurs typically over a number of years prior to death. The well-being of elderly engaging in such bequest-for-care trades is increasingly overstated with advancing years, since more and more of their wealth has effectively already been allocated to previous periods. The present study ignores such overstatement, while acknowledging that further work is called for to better address the problem. Note also that our measurement model does not consider the welfare effects of elderly co-residence on other household members. See Speare and Avery (1993) for an explicit treatment of this.

[3]Tax impact estimation is a complex task, and work on this by the U.S. Bureau of the Census (1988) finds the effect in sub-population well-being comparisons to be minor.

[4]Crystal and Shea (1990) adjust from aggregate data for respondent underreporting of financial assets. Adjusting for misreporting based on aggregate data requires the strong assumption of equal probability of misreporting across individuals, and is therefore not attempted here. Radner (1990) notes that house and vehicle equity are typically overreported by respondents. Since house and vehicle equity constitutes the major proportion of assets of many elderly approaching poverty, our failure to adjust for misreporting may bias elderly poverty rates downwards, and understate the difference in median well-being between poorer and richer groups. This downward bias for poverty rates may be offset somewhat by underreporting of income (see, e.g., U.S. Bureau of the Census, 1989a, Appendix C).

of the level of social security and private pension replacement retirement income upon cessation of work, are used to calculate replaceable and non-replaceable earnings for those elderly persons currently working. The only previous work to adjust for non-replaceable labor income (Moon, 1977) makes arbitrary assumptions about length of remaining working life, and does not account for private pensions in estimating the replaceable proportiun labor income.

The remainder of the paper is set out as follows. In section II, we present our model of the current-period economic well-being of elderly persons. In section III, we describe our data and procedures for estimating the variables, functions, and constants of the measurement model of the previous section. In section IV we identify the most economically vulnerable elderly sub-populations according to the infinite- and finite-horizon measures, and demonstrate the distorting effect of using the infinite-horizon-based measure for such identification. Interpretation of the results and suggestions for further research follow in section V.

2. A Model of Current Economic Well-being Measurement for the Elderly

The well-being measurement model developed here solves the problem of allocating remaining lifetime resources to the current period by reference to a model of household consumption good-maximizing behavior. Exogenous time paths of income and household composition are specified from current-period variables.[5] Simplifying assumptions about these time paths mean that current-period consumption expenditure is in most cases nothing but current-period income plus, in the case of finite-horizon elderly, an asset annuity that takes into account household production efficiency reduction upon spouse death. In the case of elderly with earnings, a portion of current-period earnings is allocated directly to current-period consumption expenditure, and a portion allocated by annuity.

Formally, we suppose that a sequence of consumption expenditures $\{x_t\}_{t=0}^{T}$ is chosen to maintain the highest possible constant per-person consumption level c over the remaining lifetime of the household, subject to the constraints that the sum of consumption expenditures x_t may not exceed the sum of current-period assets A_0 and current and future period non-asset income y_t and asset income y_t^a, and that consumption good c_t is produced according to a household production function f whose arguments are consumption expenditure and household size n_t and composition z_t. The household production function formalizes the notion of economies of scale in household consumption. The household's problem is then

$$\max_{\{x_t\}} c = c_t, \qquad t = 0, 1, \ldots, T, \tag{1}$$

$$\text{s.t.} \quad \sum_{t=0}^{T} x_t = \sum_{t=0}^{T} y_t + \sum_{t=0}^{T} y_t^a + A_0, \qquad t = 0, 1, \ldots, T, \tag{2}$$

[5]In reality they are likely to be at least partially endogenous. Incorporating this endogeneity would add considerable complexity to the optimizing problem (see Rust, 1989, 1990), and is thus left for future work.

and

$$c_t = f(x_t, n_z, z_t), \qquad t = 0, 1, \ldots, T. \tag{3}$$

The form of the household production function f is given here by multiplying the official Social Security Administration (SSA) poverty thresholds by 1.25. Here we accept the assertion of Girshick and Williamson (1984) that the official poverty threshold is biased downwards by the political nature of its construction, and thus is not as good a public welfare criterion as would be a somewhat higher level. The 25 percent increase is arbitrary, though consistent with previous work (e.g., Ruggles and Williams, 1989). The household production function is then written as

$$c_t = f(x_t, n_t, z_t) = x_t / p(n_t, z_t), \tag{4}$$

where the poverty threshold p_t is a function of the household size and composition vector (n_t, z_t). The poverty threshold increases with n_t, but at a decreasing rate. The one-person household poverty threshold is approximately 80 percent of the two-person threshold. Poverty thresholds are lower for elderly-headed households than for non-elderly-headed households because the elderly are assumed under SSA thresholds not to have work-related expenses.

Since our goal is to formulate a model of elderly current-period economic well-being measurement we are only interested in the (optimally-chosen) current-period consumption expenditure x_0^*, and the current-period consumption good c_0^* that results from combining x_0^* with exogenously given household composition variables n_0 and z_0. Well-being of a given elderly person is thus given by the per person poverty threshold level consumption good $c_0^* = f(x_0^*, n_0, z_0)$ for that person's household. Aggregate measures of sub-population well-being can then be derived from the vector of consumption goods $c_0^* = (c_{0,1}^*, \ldots, c_{0,P_k}^*)$ for the P_k members of the sub-population.

Looking at the maximization problem given by equations (1), (2), and (3), we would expect expenditure function $x(\cdot)$ to be in the general form

$$x_0^* = x(\{y_t\}_{t=0}^T, \{n_t\}_{t=0}^T, \{z_t\}_{t=0}^T, A_0), \tag{5}$$

that is, in terms of current and future period variable values. Instead we require that the function be specified completely in terms of variables that may be observed in the current period:

$$x_0^* = x(y_0, n_0, z_0, A_0, v_0), \tag{6}$$

where v_0 is a vector of observable current-period variables. Our strategy is to begin by specifying expenditure functions that correspond to income-only and income-net worth measures, and then proceed to develop a set of assumptions that are consistent with each. The result is that to achieve theoretical consistency, both our income-only and income-net worth measures ultimately depart somewhat from previous measures.

The elderly person or couple's horizon is the parameter that determines whether an income-only or income-net worth measure is the correct solution function. When horizon T is specified to be infinite, the solution is a "real income-only" expenditure function:

$$x_0^* = y_0 + rA_0, \tag{7}$$

where r is the constant real interest rate, representing an average of future period real interest rates. The assumption that y_t, n_t, and z_t are unchanged at their current-period values y_0, n_0, and z_0 is sufficient to generate the expenditure function solution of equation (7), since the only value of assets in the infinite horizon is the constant stream of real income (including real asset services) they yield. The per-period proportion of this stream is given by rA_0, and so optimal expenditure in the current period is just the sum of per-period non-asset income y_0 and per-period real asset income rA_0.

The usual (nominal) income-only function uses current-period (nominal) asset income y_0^a in place of average real return on assets rA_0. The expenditure function is thus:

$$x_0^* = y_0 + y_0^a, \tag{8}$$

which is best interpreted as a variant on the real income-only expenditure function. It is not clear *a priori* which of (7) and (8) will be greater. The use of nominal asset income in (8) inflates that component, while the usual practice of not including asset services from house equity in y_0^a deflates it. The standard income-only measure (8) also ignores non-cash government transfers. Here we will include them in y_0.

When horizon T is specified to be finite for the elderly person or couple, and infinite for other members, if any, of the household, the expenditure function is more complicated. Given the right sets of assumptions, however, the expenditure function may be specified as the sum of an income-net worth expenditure function for the elderly person or couple and a real income-only expenditure function for other household members. First, divide the household into an elderly person/couple sub-unit and an other-persons sub-unit, letting variables for the elderly person or couple sub-unit be denoted by the subscript *pc*, and variables for the other-persons sub-unit be denoted by the subscript *o*. Define unearned non-asset income $y_{0,pc}^o$, and the replaceable (by pensions and Social Security income) and non-replaceable components of earnings, $y_{0,pc}^r$ and $y_{0,pc}^n$. The latter are specified as functions $y^r(\cdot)$ and $y^n(\cdot)$ of total current period earningq $y_{0,pc}^e$ and other observable variables. Then optimal current-period consumption expenditure for the finite-horizon elderly person/couple household is given by the sum of optimal expenditure for the elderly person/couple sub-unit, $x_{0,pc}^*$, and for the other-persons sub-unit (if any), $x_{0,o}^*$:

$$x_0^* = x_{0,pc}^* + x_{0,o}^*, \tag{9}$$

where other-persons-sub-unit expenditure is given by the infinite-horizon expenditure function

$$x_{0,o}^* = y_{0,o} + rA_{0,o}, \tag{10}$$

and elderly person/couple sub-unit expenditure is given by the finite-horizon expenditure function

$$x_{0,pc}^* = y_{0,pc}^o + y_{0,pc}^r + a_0^*, \tag{11}$$

where a_0^* is the elderly person or couple's T-period-optimizing annuity amount in period $t=0$. We now develop an annuity function $a_0^* = a(\cdot)$ whose arguments are assets, nonreplaceable earnings, remaining years of working life, and remaining years of life, all of which are expressed as functions of current-period observable variables.

As in the infinite-horizon case, z_t is assumed unchanged at its current-period value z_0. However, now we assume that n_t falls by one upon the death of one of the elderly couple. Define T_1 as the last period of life for whoever of an elderly couple dies first, and T as the last period of life for the survivor. Then $n_t = n_0$ for periods 0 to T_1, and $n_t = n_0 - 1$ for periods $T_1 + 1$ to T.[6] Non-asset income of the elderly person/couple, $y_{t,pc}$, is allowed to vary over time in two ways in the finite-horizon case. First, we assume a one-time reduction in non-asset income upon the cessation of work by the elderly person or spouse. The reduction corresponds to the non-replaceable part of earnings. Second, we assume a one-time reduction upon the first death in a couple. The nature of these reductions is given by[7]

$$
\begin{aligned}
(12) \qquad y_{t,pc} &= y_{0,pc}^o + y_{0,pc}^e && t = 0, 1, \ldots, W \\
&= y_{0,pc}^o + y_{0,pc}^r && t = W+1, \ldots, T_1 \\
&= (y_{0,pc}^o + y_{0,pc}^r)b && t = T_1 + 1, \ldots, T,
\end{aligned}
$$

where replaceable earnings $y_{0,pc}^r$ will be less than or equal to total earnings $y_{0,pc}^e$, and the constant $b = p(n_0 - 1, z_t)/p(n_0, z_t)$, which is the ratio of widowhood poverty threshold to pre-widowhood poverty threshold. Multiplication by b forces non-asset income to follow an assumed time path that is consistent with a constant consumption good before and after T_1. This assumption corresponds, for example, to a reduced survivor benefit pension plan. It allows us to allocate exactly the unearned non-asset income $y_{0,pc}^o$ plus replaceable earned income $y_{0,pc}^r$ to current-period expenditure in equation (11) above.[8] Elderly person/couple assets are then combined with the sum of remaining lifetime non-replaceable earnings to produce an annuity stream consistent with providing constant consumption good until the death of the elderly couple. Given our assumptions about the time paths of the household size and composition, the annuity will be equal over the periods until the first death in the elderly couple (and equal throughout the remaining life of an unmarried elderly person), and be reduced by the same ratio b, for the surviving person's remaining lifetime after spouse

[6]For a household containing an elderly couple and other persons, the time paths assumed for n_t are partly inconsistent between the couple and the others when the couple has a finite-horizon. For the couple, $n_t = n_0 - 1$ in the periods $t = T_1 + 1, \ldots, T$, while $n_t = n_0$ for the others in the household in the same period. Empirically this is likely to be of little consequence.

[7]For expositional ease, W is the single retirement date for either one or two earners of the elderly person or couple. Separate retirement dates are estimated in our empirical work. Also, T_1 need not come before W. If it did not, then the second and third lines of (12) would have $y_{0,pc}^o + y_{0,pc}^r$ replaced by $y_{0,pc}^o + y_{0,pc}^r + y_{0,pc}^3$.

[8]A more accurate assumption about the time path of $y_{0,pc}^e$ would be that it falls until retirement, through reduced wage rate and/or reduced hours. By making a constant $y_{0,pc}^e$ assumption, we introduce a bias towards overallocating resources to current-period consumption.

death. The current-period annuity is then

$$a_0^* = a(A_0, y_{0,pc}^n, W, T_1, T) \tag{13}$$

$$= \left(A_0 + \sum_{t=0}^{W} \frac{y_{0,pc}^n}{(1+r)^t}\right) \frac{r_a}{1-(1+r_a)^{-N_0}},$$

where r is the real rate of return on assets, r_a the real rate of return on an annuity, with $r_a \leq r$ due to annuity transaction costs. N_0 for an unmarried elderly person is just the person's life expectancy, $N_0 = T$, while for a married elderly person, N_0 is a joint life expectancy that adjusts for the reduction in efficiency of the household production function upon the first death in the couple:

$$N_0 = T_1 + (T - T_1)b. \tag{14}$$

Treatment of most government-provided cash and non-cash welfare program goods is as a component of unearned non-asset income y_t^o. We assume that non-cash goods are transformed into current-period household income at their market value y_0^g. Under a public welfare function, this assumption could understate the efficiency of y_0^g in producing units of consumption good, since the government's providing specific goods (e.g., housing) rather than cash implies a stronger public-welfare weighting to these goods. However, we might also expect offsetting inefficiencies in government expenditures since they are not made from the household's own budget. Note that y_t^g must also be assumed to be reduced to by_t^g upon the first member's death in the case of a finite-horizon elderly couple.

The exception to this welfare program goods treatment is government-provided medical benefits. Clearly some loss of efficiency in household production of consumption good from consumption expenditure results from illness or disability associated with medical benefits. We assume here that the loss of efficiency exactly offsets the extra income in medical benefits. Therefore we exclude from income the value of government-provided medical benefits, and retain a constant household production function that does not depend on the health of the elderly person. A more reasonable assumption, however, might be that efficiency in the production of well-being declines stochastically with the age of the elderly person/couple, and depends on the elderly person/couple's current-period physical well-being.[9] If the elderly person is unable to complete activities of daily living without assistance, such assistance must often be paid for either monetarily or in reductions of leisure time or paid work time of other household members. Events that lower efficiency in the household production of well-being can be partially insured against, for example with long-term care insurance, and are to some extent insured against through government medical programs. To the extent that they cannot be insured against, current-period well-being is biased upwards by our measures. In the case of currently disabled persons, their well-being relative to non-disabled persons is overstated. Future work might usefully address this problem.

[9]One way this might be incorporated into the present model is by simply adding to the discount rate, r_a, in equation (13) an efficiency-decline factor that would operate on the expenditure function like a negative time-preference. It is not obvious, however, how such a factor might be estimated.

3. Data and Estimation

Current-year model parameters are estimated mostly from data collected on the households of members of the 1984 panel of the Survey of Income and Program Participation (SIPP) who were over 65 for the year up to Wave 4.[10] The sample consists of the 5,211 persons who were still on the panel in Wave 4 and had nonzero weights, and for whom data are available on all the variables.[11,12] We correct for biases in attrition rates by employing weights which are adjusted for differential attrition between Waves 1 and 4 by race, sex, and initial marital status.[13] The total estimated population of 24.5 million elderly will slightly underestimate the United States non-institutionalized over 65 population, as no adjustment was made for immigrants, persons leaving institutions, the homeless, and cases lost due to missing data, and because our "year of birth" selection criterion misses some 65 year olds.[14]

The income, asset, and household composition variables are obtained directly from the SIPP. The current period $t=0$ is the year given by Waves 2, 3, and 4 (Waves 1, 3, and 4 for rotation group 4), approximating the calendar year 1984. The year (as opposed to a shorter period) has the advantage of smoothing out irregular income paths within the year. The usual problem of distortions due to household membership changes during the year (Burkhauser *et al.*, 1986) is avoided here by summing the poverty thresholds and household incomes of over the 12 months of the year, where monthly incomes and poverty thresholds are those of the household of the elderly person for that month. Assets are, however, measured only at year's end. Non-cash benefits y_0^g consist of rent subsidies or implicit subsidies on public housing rents, plus the cash value of food stamps and energy subsidies. Their value is estimated from observed SIPP values (respondent estimates) and, for subsidized government housing, from the difference between rent paid and average market rent values of private units with government rent subsidies in Wave 1 of the SIPP. The value of government-provided medical programs is excluded as discussed above. All cash income data are from the SIPP Longitudinal file, which includes longitudinal imputations. Poverty thresholds and non-cash government subsidies are from the SIPP Access files. Asset holdings of the elderly person/couple, $A_{0,pc}$, and of other household members, $A_{0,o}$, and

[10]Ages are approximate since they are based on year of birth. The youngest elderly included in this study are those born in 1918. Thus the sample is of persons who turned 65 in calendar year 1983.

[11]Zero weights were assigned by the Bureau of the Census to 40 cases in which interviews were not obtained.

[12]Complete income and non-cash subsidy data were not available for another 45 cases. These cases were discarded from our sample. Disability data are unavailable for the 57 cases who were not in Wave 3. We took out these cases for the disability sub-population analyses, but included them in all other analyses.

[13]The Wave 4 weights supplied by the Bureau of the Census are not appropriate because they apply to the total sample, which includes persons who entered the sample households after the initial interview. We included only initial sample members in our analysis. Therefore we derived our weights from their Wave 1 weights, adjusted for attrition from Wave 1 to Wave 4.

[14]The estimated non-institutionalized population of the United States aged 66 and over was 24.6 million on July 1, 1984, and 25.1 million on July 1, 1985 (U.S. Bureau of the Census Current Population Reports, Series P-25, No. 1022), using the 5.3 percent rate of institutionalization among the elderly from the 1980 Census. Averaging these numbers yields 24.8 million for the end of 1984, a little larger than our weighted estimate of 24.5 estimate of 65 year olds who survived to age 66.

retirement income due data for computing replaceable earnings proportions, are from the Wave 4 Topical Modules. Disability status data are from the Wave 3 Topical Module. Topical Module data were all obtained from SIPP Access.

The life expectancy, work-life expectancy, and replaceable and non-replaceable earnings functions T_1, T, W, y^n, and y^r, and the constants for rate of return on assets, r and r_a, are estimated using non-SIPP data. Remaining lifetime functions T_1 and T are estimated by life expectancy forecasts for the year 2005 for males and females by single year ages (United States Bureau of the Census, 1989b).[15] Sex and age are then the observable variables in the data set from which T_1 and T are estimated. Remaining working lifetimes W_i of the i-th currently working member of the elderly couple are estimated from Rendall and Avery (1990) and U.S. Bureau of Labor Statistics (1986). For elderly persons 65 and over, the Rendall and Avery results for 1979–80 are used, in which work life expectancy given currently working is a function of age, sex, race, marital status, and education. For the non-elderly spouses of elderly persons, Bureau of Labor Statistics estimates for 1979–81 are used, in which work life expectancy given currently working is a function of age, sex, and education. The functions y^n and y^r are derived using the results of Parnes and Less' (1985) analysis of transitions to retirement by earnings in the last year of fulltime employment, and by pension and Social Security income due statuses.[16]

A projected sequence of real interest rates and real rates of return on annuities must also be estimated. The public-welfare function might require the household to allocate assets to current-period consumption according to forecasted rates or according to an assumption of rates that are unchanged from either the present rate or an average of past rates. Our choice for the main results is to adopt an "average of past rates" criterion, taking advantage of annuity yields over the 16 years prior to 1984 (1968 to 1983 inclusive) already computed in Friedman and Warshawsky (1990) on annuities for those persons who purchase annuities.[17] The average real interest rate on 10 year treasury bonds for this period of 2.0 percent, using the alternative CPI-U-X1 cost-of-living index is used to estimate r. The regular CPI is considered inappropriate for elderly because it weights too highly new home prices (Smeeding and Holden, 1989). Real annuity rates, at −0.4 percent, were on average 2.4 percent lower than real interest rates. Friedman and Warshawsky cite the low effective rates of return on annuities as one reason for their rarity in the portfolios of elderly in the United States. Real interest rates over the 1980s period averaged 5.3 percent, considerably higher than for the 1968 to 1983 period used here. Thus to evaluate the effect of rate choice assumption, we also produce estimates of well-being using a hypothetically forecasted constant 4.0 percent real interest rate, with annuity rates again 2.4 percent lower (at 1.6 percent) to reflect transaction costs.

[15]Forecasts are available separately for blacks and whites, but as differences after age 65 are small, we assign the total male and female population expectancy forecasts to both races. A small understatement of life expectancies will result from applying total (institutionalized and non-institutionalized) population forecasts to the non-institutionalized elderly population as we do here. Institutionalized elderly make up approximately 5 percent of all elderly. This will introduce a slight bias towards the overallocation of assets to current period consumption.

[16]Details are given in the Appendix.

[17]We use their rates that are corrected for selectivity of annuity purchasers.

In computing the annuities for married elderly, for computational convenience we take the ratio b to always be the ratio of the two-person elderly household poverty threshold to the one-person elderly household poverty threshold, $b = 0.793$. Although this is not strictly consistent with our model assumptions, it may be a better approximation to reality, as living with no other persons in the household by the time widowhood occurs is likely to be prevalent in the U.S. elderly population (see Speare and Avery, 1991, for analysis of the composition of extended family households). Our assumption that income falls upon widowhood to 0.793 times the pre-widowhood level is between long-run male and female income falls observed longitudinally (Ellwood and Kane, 1990, p. 130), estimated at 0.90 for widowers and 0.59 for widows.

An elderly person is defined here as poor if he or she lives in a household with allocated consumption expenditure below the poverty threshold, $c_0^* < 1$. The total number of poor elderly in sub-population k of size P_k is denoted by P_k^p. Our first aggregate measure, the poverty rate for sub-population k is then P_k^p / P_k. Our second aggregate measure is median consumption c_0^* (in units of poverty threshold consumption good). These measures are again chosen for their assumed reflection of an unobserved public welfare function. That they are both nonparametric measures also deals with the problem of income and asset topcoding (see U.S. Bureau of the Census, 1984).

We compare the well-being of the elderly by age, race, gender and marital status, and disability. Race and gender are important variables in debates on equity among groups. Age, disability, and widowhood often arise in identifying those elderly persons with special vulnerability. For disability, we created a five-category scale, ordering the severity from ADL (unable to perform activities of daily living) to no disability. We classified Hispanics separately from (non-Hispanic) whites and blacks. One effect of measure choice on well-being outcomes may be anticipated from previous work (e.g., Moon, 1977; Crystal and Shea, 1990): finite horizon elderly measures will result in improved well-being outcomes compared with infinite horizon elderly measures. For this to hold requires only that increases in the value of assets via annuitization, given by $a(A_0^{pc}) - rA_0^{pc}$, will on average dominate decreases in the value of earnings due to the annuitization of the non-replaceable component of earnings, given by $y_{0,pc}^n - a(\sum_{t=0}^{W} y_{0,pc}^n / (1+r)^t)$.

4. Results

This section is organized as follows. First, we consider the results of assessing the well-being of potentially vulnerable sub-populations under the income-net worth measure, having previously argued that this measure should be favored over income-only measures. Second, we investigate the empirical effect of assuming an infinite consumption horizon instead of an own-lifetimes consumption horizon for the elderly person or couple. Third, we test the sensitivity of the measures to the interest rate chosen. Throughout this section, we use the terms poverty and multiples of poverty level threshold consumption as they are defined in the previous sections, i.e., the poverty threshold used here is 1.25 times that of the Social Security Administration's poverty threshold, the latter having been argued to be a less valid parameter of an unobserved public welfare function.

Elderly sub-populations commonly identified as potentially vulnerable economically are older, minority, and female elderly, and those who have experienced particular disadvantaging events—the disabled, the widowed or never-married, and, perhaps paradoxically, those who have lived longer than anticipated. Of these, we find that blacks are the most economically threatened, followed by Hispanics, the moderately disabled, and unmarried women. Each of these sub-populations has more than 10 percent of its members living in poverty, and has a median consumption level less than 2 times the poverty threshold consumption level. Older elderly do not appear particularly vulnerable economically, nor do the more severely disabled non-institutionalized elderly.

These income-net worth measure results are shown in the "finite horizon" columns of Table 1. The total elderly population poverty rate is 8.9 percent, and the median well-being 2.42 units of poverty threshold level consumption. Black elderly have a poverty rate of 28.3 percent, and a median well-being of just 1.32 units of poverty threshold level consumption. This contrasts with a 6.7 percent poverty rate and median well-being level of 2.57 units of poverty threshold consumption for white elderly. Hispanic elderly have a 17.8 percent poverty rate and a median well-being of 1.64 units of poverty threshold consumption. Other minorities have a high poverty rate (22.8 percent), but a median well-being level not much below the elderly population average (2.24 compared to 2.42).[18]

The disability/well-being relationship is U-shaped, with particularly low median consumption levels (1.82) and particularly high poverty rates (14.9 percent) exhibited only by those elderly who have mobility and communication impairments but who are able to perform essential and instrumental activities of daily living. The more severely (ADL and IADL) disabled have (household) poverty rates of 11.2 and 10.7 percent, and median well-being 2.03 and 2.06 times the poverty level.[19] Unmarried women are poorly off, especially compared to married elderly men and women. Their 13.4 percent poverty rate (10.7 percent for unmarried men), and median consumption of 1.90 (2.29 for unmarried men) compare especially unfavorably with the high levels of well-being experienced by married elderly: median well-being levels near 3 times poverty-level consumption, and poverty rates of between 4 and 6 percent. However, the median well-being of the oldest age group, over 80 year olds, is identical to the elderly population average, and their poverty rate is only slightly higher than average at 9.5 percent.

The well-being/marital-status relationship for elderly men and women is broken down by age-group in Table 2. Again focusing on the finite-horizon results, unmarried female well-being is lowest at the younger ages: 15.4 percent of 65 to 69 and 70 to 74 year old unmarried women are poor, while 12.2 percent of 75 to 79 year old and 10.8 percent of over 80 year old unmarried women are poor under this measure. Similarly, median well-being is lowest for 65 to 69 and 70 to 74 year old unmarried women (1.79 and 1.81 times poverty-level consumption

[18]Since the sample size for this group is small (59 persons) we give it little attention in describing the results.

[19]From tabulations not shown here, the U-shaped disability/well-being relationship is found to hold for all four elderly age-groups, although the small numbers of severely disabled in the younger age-groups limit these analyses.

TABLE 1

POVERTY RATE AND MEDIAN WELL-BEING BY ELDERLY PERSON/COUPLE CONSUMPTION HORIZON, REAL INTEREST RATE 2 PERCENT

Measure	Weighted *N* ('000)	Sample *N*	Poverty Rate			Median Well-being		
			Infinite Horizon	Finite Horizon	Ratio	Infinite Horizon	Finite Horizon	Ratio
Age								
65–69	8,584	1,904	10.1	8.3	1.22	2.04	2.53	0.81
70–74	6,792	1,430	13.9	9.4	1.48	1.78	2.29	0.78
75–79	4,912	1,003	18.6	8.8	2.11	1.53	2.38	0.64
80+	4,246	914	22.9	9.5	2.41	1.43	2.42	0.59
Race								
White	21,669	4,596	13.1	6.7	1.96	1.82	2.57	0.71
Black	1,915	452	32.9	28.3	1.16	1.26	1.32	0.95
Hispanic	657	142	22.2	17.8	1.25	1.55	1.64	0.95
Other	293	59	25.6	22.8	1.12	1.82	2.24	0.81
Sex and marital Status								
Married male	7,479	1,605	8.7	5.9	1.47	2.08	2.72	0.76
Married female	5,337	1,155	8.0	4.4	1.82	2.04	2.94	0.69
Unmarried male	2,509	513	16.3	10.7	1.52	1.59	2.29	0.69
Unmarried female	9,209	1,978	24.1	13.4	1.80	1.37	1.90	0.72
Disability status								
ADL	1,284	269	18.7	11.2	1.67	1.60	2.03	0.79
IADL	2,253	472	19.6	10.7	1.83	1.52	2.06	0.74
Mobility and comm.	3,488	750	26.6	14.9	1.79	1.34	1.82	0.74
Mobility or comm.	5,151	1,102	17.9	11.2	1.60	1.62	2.19	0.74
No disability	12,044	2,557	9.6	5.7	1.68	2.03	2.76	0.74
All persons	24,534	5,251	15.1	8.9	1.70	1.77	2.42	0.73

Notes:

1. Well-being is measured in units of poverty threshold level consumption. Poverty thresholds used here are 1.25 times those of the Social Security Administration. Poverty rates and well-being are estimated from weighted data throughout.
2. Infinite horizon corresponds to a real income-only worth measure; finite horizon corresponds to a real income-net worth measure.
3. Ratio is of the infinite horizon measure to the finite horizon measure.
4. Disability statuses are listed in decreasing order of severity: ADL disability indicates inability to perform essential activities of daily living; IADL disability indicates inability to perform instrumental activities of daily living; Mobility and comm. indicates both mobility and communication impairments; Mobility or comm. indicates one or the other is impaired.

respectively, compared to 2.18 times for over 80 year olds). Married women are considerably better off than unmarried women at all ages, though. Married men are better off than unmarried men at ages 65 to 79, but the differences are much less than for women. For ages over 80, married men are no better off than unmarried men in terms of poverty rates (respectively 8.0 and 8.3 percent) and are worse off in terms of median well-being (2.56 vs. 2.92 times poverty-level consumption). Together, these age-marital status findings point to the absence of an earning spouse prior to old age (whether through widowhood or never married) as being more economically disadvantaging than losing a spouse during old age.

TABLE 2

POVERTY RATE AND MEDIAN WELL-BEING FOR MARRIED AND UNMARRIED MEN AND WOMEN BY AGE-GROUP; REAL INTEREST RATE 2 PERCENT

Measure	Weighted N ('000)	Sample N	Poverty Rate Infinite Horizon	Poverty Rate Finite Horizon	Poverty Rate Ratio	Median Well-being Infinite Horizon	Median Well-being Finite Horizon	Median Well-being Ratio
Age 65–69								
Married male	3,131	678	7.0	6.0	1.17	2.31	2.74	0.84
Married female	2,565	578	6.0	4.4	1.36	2.21	2.90	0.76
Unmarried male	674	137	10.8	10.2	1.06	1.88	2.26	0.83
Unmarried female	2,214	509	19.1	15.4	1.24	1.54	1.79	0.86
Age 70–74								
Married male	2,157	462	8.5	6.5	1.31	2.06	2.61	0.79
Married female	1,586	328	6.9	3.8	1.82	2.07	2.95	0.70
Unmarried male	688	142	14.8	10.8	1.37	1.59	2.14	0.74
Unmarried female	2,361	597	23.1	15.4	1.50	1.37	1.81	0.76
Age 75–79								
Married male	1,348	283	7.4	3.6	2.06	1.96	3.06	0.64
Married female	857	180	14.9	5.0	2.98	1.63	2.99	0.55
Unmarried male	544	104	21.2	13.8	1.54	1.40	2.21	0.63
Unmarried female	2,163	434	26.5	12.2	2.17	1.30	1.88	0.69
Age 80+								
Married male	844	181	17.2	8.0	2.15	1.56	2.56	0.61
Married female	329	68	10.3	6.2	1.66	1.61	3.12	0.52
Unmarried male	604	128	19.7	8.3	2.37	1.59	2.92	0.54
Unmarried female	2,470	537	27.3	10.8	2.53	1.30	2.18	0.60

Notes:

1. Well-being is measured in units of poverty threshold level consumption. Poverty thresholds used here are 1.25 times those of the Social Security Administration. Poverty rates and well-being are estimated from weighted data throughout.
2. Infinite horizon corresponds to a real income-only worth measure; finite horizon corresponds to a real income-net worth measure.
3. Ratio is of the infinite horizon measure to the finite horizon measure.

To assess empirically the appropriateness of an infinite-horizon assumption-based elderly well-being measure, poverty rates and median well-being rates under an infinite-horizon (income-only) measure are also presented, in the "infinite horizon" columns of Table 1 and 2. Ratios of infinite-horizon to finite-horizon measures are presented to aid comparisons. For an infinite-horizon measure to be a satisfactory empirical approximation, the ratios should be near 1. We see that they are in most cases far from 1. The elderly population poverty rate is 15.1 percent under the infinite-horizon assumption, as against 8.9 percent under the finite-horizon assumption, while infinite-horizon median well-being is 1.77 units of poverty threshold level consumption as against 2.42 units under the finite-horizon assumption.

The worst approximation of the infinite-horizon-based measure to the finite-horizon-based measure occurs, as would be expected, for the oldest age groups. The infinite-horizon poverty rates of 18.6 percent and 22.9 percent respectively for 75 to 79 year olds and over 80 year olds are more than double the finite-horizon rates (respectively 8.8 percent and 9.5 percent), and infinite-horizon median well-being is respectively only 64 and 59 percent that of finite-horizon median well-being. A particularly large discrepancy is also seen for white elderly, whose infinite-horizon poverty rate is 1.96 times their finite-horizon rate, and whose infinite-horizon median well-being level is only 71 percent of their finite-horizon level. This contrasts with relatively small differences between the infinite-horizon and finite-horizon poverty rate and median well-being levels for minority elderly. The infinite-horizon black poverty rate of 32.9 percent is only 1.16 times the finite-horizon black poverty rate, and infinite-horizon median black well-being is 95 percent of finite-horizon median well-being. Hispanic and other minorities also have finite-horizon poverty rates and median well-being that differ relatively little from the infinite-horizon measures.

Using the infinite-horizon, income-only measure to examine the well-being of unmarried women (and to a lesser extent, unmarried men) gives very different results from those of finite-horizon, income-net worth measure. Unmarried women's poverty rates *rise* from 19.1 percent for 65 to 69 year olds to 27.3 percent for over 80 year olds, whereas they fall from 15.4 percent to 10.8 percent under the finite-horizon measure. Similarly, their median well-being falls from 1.54 times poverty-level consumption at ages 65 to 69 to 1.30 times at ages over 80, whereas median well-being rises from 1.79 to 2.18 under the infinite-horizon measure.

The overwhelming importance of the asset allocation method for well-being measurement can be seen from Table 3. Here we divide total current-period household consumption expenditure allocation into its asset and non-asset components. Median total household income allocations and mean poverty thresholds and number of persons in the household are also presented. Asset allocations under the infinite-horizon model are on average only 26 percent of the allocations under the finite-horizon model: median $1,320 allocation versus median $5,158 allocation. The empirical importance of the consumption horizon assumption is clearly large. The effect on sub-group comparisons is also great. For example, the median asset allocation for blacks is only $644 higher under the finite-horizon assumption while for whites the increase is $4,501. Comparing younger and older elderly, the finite-horizon assumption works through both asset and non-asset income allocations to even out total household allocations over different age groups. Asset allocations increase with age under the finite-horizon assumption, from $4,772 for 65 to 69 year olds to $5,873 for over 80 year olds, whereas they decrease with age under the infinite-horizon assumption, from $1,501 for 65 to 69 year olds to $1,208 for over 80 year olds. Although non-asset income allocations decrease with age under both the infinite- and finite-horizon measures, the range is smaller under the finite-horizon measure, from $13,672 to $9,160 instead of from $14,656 to $9,208. The empirical importance of annuitizing non-replaceable earnings rather than allocating all earnings to the current period, being the only difference between infinite- and finite-horizon non-asset income allocations, is small overall, however. Median non-asset income allocation for the whole elderly population is reduced by less than five percent.

A further advantage of the finite-horizon measure over the infinite-horizon measure appears to be robustness to the real interest rate assumption. This is

TABLE 3

MEANS AND MEDIANS OF COMPONENTS OF WELL-BEING MEASURE BY ELDERLY PERSON/COUPLE CONSUMPTION HORIZON; REAL INTEREST RATE 2 PERCENT

Measure	Mean Poverty Threshold	Mean Number of Persons in Household	Median Asset Allocation			Median Non-asset Income Allocation			Median Total Household Allocation		
			Infinite Horizon	Finite Horizon	Ratio	Infinite Horizon	Finite Horizon	Ratio	Infinite Horizon	Finite Horizon	Ratio
Age											
65-69	8,303	2.11	1,501	4,772	0.31	14,656	13,672	1.07	16,627	20,585	0.81
70-74	7,938	1.94	1,284	4,897	0.26	11,980	11,428	1.05	13,540	17,722	0.76
75-79	7,715	1.82	1,220	5,901	0.21	9,888	9,744	1.01	11,386	17,880	0.64
80+	7,775	1.82	1,208	5,873	0.21	9,208	9,160	1.01	10,526	18,064	0.58
Race											
White	7,859	1.90	1,434	5,935	0.24	12,156	11,708	1.04	13,789	19,779	0.70
Black	8,534	2.15	320	964	0.33	9,384	9,070	1.03	9,939	10,432	0.95
Hispanic	9,470	2.57	510	1,273	0.40	12,512	12,296	1.02	13,739	16,861	0.81
Other	11,779	3.63	1,483	4,541	0.33	14,820	14,820	1.00	17,610	23,262	0.76
Sex and marital status											
Married male	8,546	2.30	1,667	6,411	0.26	14,818	13,924	1.06	17,255	22,707	0.76
Married female	8,386	2.22	1,749	8,160	0.21	14,240	13,460	1.06	16,407	24,261	0.68
Unmarried male	7,479	1.63	916	4,424	0.21	9,855	9,666	1.02	11,150	16,817	0.66
Unmarried female	7,455	1.61	940	3,446	0.27	8,224	8,098	1.02	9,056	13,402	0.68
Disability status											
ADL	9,173	2.45	1,089	3,493	0.31	12,564	12,308	1.02	13,760	17,877	0.77
IADL	8,147	2.01	844	3,375	0.25	10,326	10,264	1.01	11,159	16,575	0.67
Mobility and comm.	7,689	1.79	799	3,175	0.25	8,776	8,620	1.02	9,845	13,682	0.72
Mobility or comm.	7,837	1.88	1,168	4,434	0.26	10,576	10,304	1.03	12,063	16,481	0.73
No disability	7,993	1.97	1,644	6,629	0.25	17,457	15,968	1.09	15,718	21,655	0.73
All persons	7,993	1.95	1,320	5,158	0.26	12,032	11,488	1.05	13,522	18,956	0.71

shown in Table 4, in which measures are estimated additionally according to a 4 percent real interest rate assumption, with corresponding annuity rate increase from −0.4 percent to 1.6 percent. Only among minority elderly does the real interest rate assumption change result in a more than 1 percentage point change to their poverty rates. Even then, black elderly poverty rates are reduced only to 25.9 percent from 28.3 percent. On the other hand, poverty rates among several sub-populations change substantially between the 2 and 4 percent interest rate assumptions for the infinite-horizon measure. Median well-being changes are also larger for the infinite-horizon measure.

TABLE 4

POVERTY RATE AND MEDIAN WELL-BEING BY ELDERLY PERSON/COUPLE CONSUMPTION HORIZON; FOR REAL INTEREST RATES 2 AND 4 PERCENT ($r = 0.02$ and $r = 0.04$)

	Poverty Rate				Median Well-being			
	Infinite Horizon		Finite Horizon		Infinite Horizon		Finite Horizon	
Measure	$r = 0.02$	$r = 0.04$	$r = 0.02$	$r = 0.04$	$r = 0.02$	$r = 0.04$	$r = 0.02$	$r = 0.04$
Age								
65–69	10.1	8.6	8.3	7.6	2.04	2.27	2.53	2.70
70–74	13.9	10.9	9.4	8.4	1.78	1.96	2.29	2.43
75–79	18.6	14.7	8.8	8.1	1.53	1.75	2.38	2.50
80+	22.9	17.3	9.5	9.2	1.43	1.62	2.42	2.53
Race								
White	13.1	9.9	6.7	6.3	1.82	2.04	2.57	2.73
Black	32.9	31.0	28.3	25.9	1.26	1.31	1.32	1.35
Hispanic	22.2	20.5	17.8	14.5	1.55	1.62	1.64	1.73
Other	25.6	25.6	22.8	20.7	1.82	1.99	2.24	2.41
Sex and marital status								
Married male	8.7	6.9	5.9	5.3	2.08	2.32	2.72	2.88
Married female	8.0	6.0	4.4	4.2	2.04	2.27	2.94	3.12
Unmarried male	16.3	13.8	10.7	10.5	1.59	1.78	2.29	2.40
Unmarried female	24.1	19.1	13.4	12.2	1.37	1.53	1.90	2.01
Disability status								
ADL	18.7	16.2	11.2	11.2	1.60	1.75	2.03	2.13
IADL	19.6	15.8	10.7	9.8	1.52	1.66	2.06	2.13
Act unable	26.2	20.5	14.9	13.9	1.34	1.48	1.82	1.94
Act difficulty	17.9	15.3	11.2	10.2	1.62	1.80	2.19	2.31
No disability	9.6	7.1	5.7	5.1	2.03	2.28	2.76	2.93
All persons	15.1	12.0	8.9	8.2	1.77	1.97	2.42	2.57

5. SUMMARY AND CONCLUSIONS

We first set up a theoretically consistent, empirically estimable model of well-being measurement. To make explicit the resource allocation assumptions underlying the two main types of current well-being measure used in the literature, income-only and income-net worth, we set up a single model with elderly person/couple consumption horizon as the key parameter distinguishing income-only and income-net worth measures. We then argued that our finite-horizon measure meets reasonable public-welfare function assumptions, while the infinite-horizon measure does not.

Our main empirical results, using the finite-horizon "income-net worth" measure, are that minority elderly, especially blacks, are the most economically vulnerable elderly sub-populations. Unmarried female elderly and moderately disabled elderly are also relatively poorly off. We also find that the relative well-being of white and minority elderly is distorted considerably by the use of infinite-horizon well-being measures, white elderly appearing considerably worse off under the infinite-horizon measure than under the finite-horizon measure. This reflects the substantially larger asset holdings of whites than nonwhites. Asset holdings are undervalued under the infinite-horizon measure for their contribution to current period well-being. The relative black versus white difference here for 1984 data (median well-being of whites 1.95 times higher than that for blacks) is very similar to that found by Moon (1977) for 1967 data (mean economic status measure for whites 1.86 times higher than that for nonwhites). Blau and Graham's (1990) finding from 1976 and 1978 data that young black families on average hold only 18 percent of the wealth held by young white families suggests that future generations of elderly may differ little in this respect.

Our findings also indicate that, contrary to results under an infinite-horizon assumption measure, the older elderly are not particularly economically disadvantaged, and nor are the more severely disabled non-institutionalized elderly. The finding of an inverted-U disability/economic well-being relation points to the continuing importance of elderly support by family.[20] The age/well-being finding suggests that the elderly do, in general, provide well-enough for anticipated and unanticipated longevity. Together, these results indicate that life-time earnings opportunities are probably the most important determinant of elderly well-being. Even the economically-disadvantaging event of widowhood during old age appears to be less important for women than absence of a husband prior to old age—whether through early widowhood or never marrying.

Critical to our conclusions, however, is our assumption that the elderly may consume completely from assets, including house equity, to increase their own well-being. This points to both the importance of the availability of financial instruments for the achievement of this, and to the need for more research into the disadvantages of such an imposed consumption strategy. Alternative strategies might consider the trade of bequests for care during old age, the use of reverse equity mortgages to allow elderly persons to occupy their house while still tapping the asset value, and financial provision for reductions in the efficiency of household production with age.

6. Appendix. Estimation of Replaceable and Nonreplaceable Components of Earnings

From Parnes and Less' (1985) analysis of Retirement History Survey (RHS) transitions to retirement, we are able to predict the fraction of earned income in

[20]One of the reviewers also points out a possible selection effect whereby the severely disabled who remain in the community are more likely to be those who are recent additions to the severely disabled, wealthier, and with more income.

the full time year prior to retirement that will be replaced by retirement income (the earnings replacement ratio). The prediction is a function of earnings in the year prior to retirement, and whether the individual is due Social Security only upon retirement, or due both Social Security and private pension income. We also make the replacement ratio a function of age at retirement, increasing the Parnes and Less replacement ratio by 1.03 for every year past age 65, up to age 70, that the individual works. This is in accordance with the Social Security Administration's actuarially fair upward adjustment to the benefit level of recipients who delay first recipiency until after age 65. Formally, let us denote the replacement rate m_i for an individual currently working full time as

$$m_i = h(y_{0,i}^{e'}, s_i, w_i),$$

where $y_{0,i}^{e'}$ is current period earnings in 1980 dollars, s_i retirement income due status (due Social Security only or due both Social Security and private pension income), and w_i is the age of the individual at his or her last year of work minus 65, estimated from Rendall and Avery (1990) and U.S. Bureau of Labor Statistics (1986) as for W_i in the main text, with the exception that individuals who will work past age 70 are assigned $w_i = 5$.

The Parnes and Less replacement ratios are used to specify the replacement rate function h. They give a unique replacement ratio for each combination of four ranges of final year earnings $y_{0,i}^{e'}$, and two retirement income due statuses $s_{0,i}$. The final year earnings ranges are, in 1980 dollars, less than \$10,000, \$10,000 to \$19,999; \$20,000 to \$29,999; and \$30,000 and above. The two retirement income due statuses are Social Security only due, pension(s) due. The Parnes and Less replacement ratios are the best available for our purposes, but have the disadvantages of having been estimated using only male data, and for retirement transitions mostly in the 1970s.

Non-replaceable earnings $y_{0,i}^{n}$, and replaceable earnings $y_{0,i}^{r}$, are then estimated as follows:

(1) For individuals already receiving both Social Security and private pension income, or receiving Social Security and not due any pension income,

$$y_{0,i}^{n} = y_{0,i}^{e},$$

$$y_{0,i}^{r} = 0,$$

and except in the case that the individual's current earnings are in excess of the Social Security earnings test limit. In that case,

$$y_{0,i}^{r} = 0.5 * \max\,(y_{0,i}^{e} - l, q - l),$$

where l is the earnings test limit and q is the maximum level of Social Security benefit.

(2) For individuals currently working full time and not currently receiving any retirement income, earnings are divided into replaceable and non-replaceable components according to the retirement age-adjusted Parnes and Less replacement rate function:

$$y_{0,i}^{r} = y_{0,i}^{e} m_i,$$

$$y_{0,i}^{n} = y_{0,i}^{e}(1 - m_i).$$

(3) For individuals currently working full time and receiving one type of retirement income (Social Security or private pension) and due the other upon retirement, replaceable earnings are estimated by the predicted increment in retirement income upon retirement, given by

$$y^r_{0,i} = y^e_{0,i} m_i - r_{0,i},$$

where $y^r_{0,i}$ is the i-th individual's current period retirement income, or, in the case where Social Security benefits currently received are reduced under the earnings test criterion, by

$$y^r_{0,i} = y^e_{0,i} m_i - r_{0,i} - r_{0,i} + 0.5 * \max\,(y^e_{0,i} - l,\, m - l).$$

Non-replaceable earnings are in both cases

$$y^n_{0,i} = (1 - m_i) y^e_{0,i} - r_{0,i}.$$

(4) For individuals working part time and due at least one additional type of retirement income, we assume

$$y^r_{0,i} = y^e_{0,i}$$

and

$$y^n_{0,i} = 0.$$

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