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3 Estimating Changes in Well-Being Across Life: A Realized vs. Comprehensive Income Approach

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Fear of living too long is paradoxically one of the major concerns of old age. This, together with the fear that a serious and prolonged illness or some unanticipated economic disaster could turn a life-style of independent retirement into one of dependence on children or other relatives, are real concerns to all of us as we think about retirement. They no doubt are responsible for the widespread support of government programs to lessen this uncertainty—i.e., Social Security retirement and health insurance.

In making a decision to retire, a worker is concerned not only with income in the next year but with income in all future years of expected life.[1] Yet in anticipating future retirement income many factors are unclear. Changes in health and in the real value of Social Security, pension benefits, and other assets are all factors that can affect future income and economic well-being but that cannot be anticipated with certainty.

In this chapter we look at the long-term consequences of retirement on the relative well-being of a group of workers who retired in the 1970s. We first develop a theoretically superior measure of well-being—comprehensive income—and using this measure compare and then predict how well-being changes over a ten-year period for our sample of men as they move from work to retirement. Finally, we look at the effect of initial levels of

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1. A wide literature now exists that incorporates life-cycle values of Social Security and pensions into the retirement decision. See Mitchell and Fields 1982 for a review of this literature.

income on the percentage change in that income over time in a model that incorporates unexpected changes into a standard human capital model of income distribution.

3.1 Realized versus Comprehensive Measures of Well-Being

In the United States and elsewhere economic well-being is defined almost exclusively in terms of income. Yet it is a person's ability to reach a given consumption level, not his or her income, that determines "well-being." Realized income is at best only an imperfect measure of consumption power. Much of the recent criticism of empirical measures of poverty has centered on the degree that different sources of income (in-kind versus money transfers) should be included in measures of well-being.[2] We raise an additional problem. A single-year realized income measure of well-being is misleading because it does not include important wealth effects generated over the life cycle.

Wealth, accumulated savings from previous time periods, can provide an important source of consumption ability. Two persons with the same realized income but different wealth holdings command different potential consumption bundles. For example, the ability to obtain a mortgage on a home can be used to generate funds for current consumption or unexpected health problems. A comprehensive measure of economic well-being must include both wealth and income components. Thus a more accurate measure of economic well-being not only includes the usual sources of income (wage earnings, realized flows from wealth—rents, interest, dividends, etc.), but also the potential consumption ability generated by accumulated wealth.[3]

Here using multiperiod data we construct a comprehensive measure of economic well-being and compare it with a more traditional realized income measure by examining income distributions for a sample of working males before and after retirement.[4] Because it incorporates the potential consumption ability generated by wealth, our comprehensive measure is a theoretically superior measure of well-being. Furthermore, we show that it provides significantly different predictions of future well-being from those occurring in retirement. In the next section we show that our measure also leads to different results with regard to unanticipated changes over the decade.

2. For example, see Smeeding 1984.

3. Intrafamily transfers are undoubtedly an important source of well-being for many of the aged. Unfortunately quantifying the extent of these income and in-kind transfers was beyond the scope of our data and was not included in our comprehensive measure of economic well-being.

An ideal measure of well-being would also include the value of leisure. Quantification of this value creates many formidable problems.

4. For studies that have used panel study data to look at issues related to single versus multiperiod measures of well-being, see for example, Benus and Morgan 1975 and Steuerle and McClung 1977.

Our analysis is conducted within a life-cycle framework.[5] Moon (1977) was the first to use a life-cycle concept of income that was specifically designed for application to the elderly. A life-cycle framework emphasizes the importance of using a comprehensive measure when evaluating the well-being of the aged population. First, life-cycle consumption theories suggest that people build up a stock of wealth during working years. At older ages it is expected that consumption expenditures will exceed income and that the difference will be financed out of wealth. Thus realized income measures will in general underestimate potential consumption. For this reason comparisons of pre- and postretirement income levels are likely to overstate the fall in well-being of the retired population. Second, in looking at the effect of unexpected changes, our comprehensive measure gives a more accurate measure of their true effect on well-being across the income distribution.

Standard measures of well-being are usually composed only of realized income variables as seen in equation (1).

$$RI = Y + RA + GT. \tag{1}$$

Realized income (RI) includes wage and salary earnings (Y), income from privately held assets such as interest, rents, dividends, and pension payments (RA), and government transfers (GT)—Social Security and other income transfers. Note that in preretirement years, pension payments and Social Security are not received and thus not counted by this measure.

Our comprehensive measure of income will include the annuitized value of all wealth currently held.[6] In equation (2) we estimate the stock value,

$$SW = NR + NF + NS, \tag{2}$$

of wealth (SW), which includes the present value of real assets minus debt of business, farm, house, and real estate (NR); net financial assets (NF)

5. Life-cycle consumption models argue that consumption and hence well-being in any one period is based on total expected lifetime income rather than income in that single period. In fact under the strong assumption of homotheticity with respect to time, lifetime utility can be shown to be maximized by equalizing consumption in each time period over the life cycle. While consumption is expected to be relatively constant over time under such assumptions, income flows for most people are not. Given perfect foresight and information, a person's stock is just depleted on the last day of his life. Life-cycle hypotheses suggest that some decreases in consumption later in life are attributable to uncertainty and imperfect information. See Kotlikoff 1979 and Kotlikoff, Spivak, and Summers 1982 for recent discussions of this point.

6. It is important to note that the annuitized wealth flow we construct used the same technique as Weisbrod and Hansen 1968. It does not take into consideration whether people do or can convert wealth into an income flow. We want to derive a measure of economic well-being, and there are strong theoretical reasons for including a wealth component. To the extent that people do not convert wealth to flows, then there is evidence that people prefer the stock to the flow it can generate, or there are imperfections in capital markets that make the transformation of stocks to flows difficult or impossible. Some evidence on which of these hypotheses are valid may come from the reverse mortgage experiment now underway in Wisconsin.

composed of the stock value of annuities, bonds, stock certificates, saving and checking accounts; and the net present value of Social Security and pension benefits (NS). Note that like other forms of wealth, Social Security and pensions have a stock value regardless of whether workers are currently receiving a flow of realized income from them.

For most older workers two major sources of wealth are private pension and Social Security retirement benefits. For those actually receiving benefits these sources of wealth are already annuitized since this income includes the interest on principal as well as consumption of the principal. But other sources of wealth are not annuitized. Rents, interest, and dividends do not include consumption of the principal. This is also true of housing. Therefore for all wealth currently held we estimate an annuitized value that includes both interest and total consumption at death. Wealth is converted into an income measure through equation (3):

$$FV = \frac{PV}{\sum_{i=1}^{n} \frac{P_i}{(1+r)^i}}, \tag{3}$$

where PV is the present value of the wealth variable. FV is the annuitized value. P is the probability of living through the ith period; r is the real rate of interest and n is the last period considered.[7]

Equation (4) combines the value of accumulated stocks, as measured by equation (2), with the value of current income measured in equation (1) to equal comprehensive income (CI).

$$CI = RI + SW' - RF - SS. \tag{4}$$

For accounting purposes it is necessary to transform current stock values (SW) into flow units (SW'). This was done using equation (3). To avoid double counting we subtracted realized income from assets (RF) and pensions and Social Security (SS) because SW' includes both realized and unrealized income from these sources.

3.1.1 Empirical Results

This research is based on data from the Retirement History Study (RHS), a ten-year longitudinal survey of the retirement process by the Social Security Administration. The RHS began in 1969 with a sample of 11,153 men and nonmarried women aged fifty-eight through sixty-three, who were then reinterviewed at two-year intervals through 1979. Attrition occurred at the time of each reinterview because respondents had died,

7. We are discounting by a real interest rate of 5 percent. No inflation premium is added because all calculations use constant 1979 dollars. Life expectancy is based on data from *Vital Statistics of the United States*, vol. 2, 1973. All workers were assumed to live no longer than age ninety-five.

been institutionalized, disappeared, or refused to respond. This study is based on the male respondents for whom complete data are available from all waves. We look at a subsample of 1,782 married men who were working in 1969 but had retired by 1979 and whose spouse was present in the household.[8]

We calculated the realized and comprehensive income of each household in 1969 and repeated the calculation for the household ten years later. We use these measures to look at changes in income distributions across the transition from work to retirement and to determine how well income and wealth levels in 1969 predict subsequent income in 1979.

Tables 3.1 and 3.2 show the degree of movement across realized and comprehensive income quintiles as individuals move from working in 1969 to retirement in 1979. The diagonal cells contain those workers who remain in the same income quintile over the period. The off-diagonal cells show the degree of movement.

A comparison of the tables reveals that the two distributions are similar. In fact, a chi-square test does not reject the hypothesis of no difference ($\chi^2_{24} = 22.97$). However, this finding is not too surprising at this level of aggregation. For most respondents a relatively large change would be required to change quintiles. A test of diagonal versus off-diagonal cells is

Table 3.1 **Percentage Distribution of Workers by Realized Income Quintiles, 1969 and 1979**

Distribution of Workers by Realized Income Quintiles, 1979	Distribution of Workers by Realized Income Quintiles, 1969				
	0–20	21–40	41–60	61–80	81–100
0–20	56	21	14	5	3
21–40	20	35	23	15	7
41–60	14	26	28	22	10
61–80	6	13	24	33	24
81–100	4	5	11	23	56

Source: Data are from The Retirement History Study, a longitudinal survey developed by the Social Security Administration. The subsample used here contains 1,782 observations.

8. As a first use of our new methodology we choose to look at the most common group of recently retired workers, those in marriages that remained intact over the period. In choosing this group we avoided the complications related to measuring the well-being of households of different sizes. Our analysis does not look at the effect of death or divorce of a spouse, which may be unexpected and could have important effects on the well-being of surviving members of the family. However we believe the influence of the economic variables we do test does not differ substantially across marital status groups. In our RHS sample 87 percent of the male population was married in 1969. In our initial sample of married couples in which the husband was working in 1969, 25 percent of marriages ended in the death of one spouse over the ten-year period and 8 percent ended in divorce or separation. A more complete study of the effect of unexpected changes on well-being should incorporate changes in marital status into the analysis.

Table 3.2 **Percentage Distribution of Workers by Comprehensive Income Quintiles, 1969 and 1979**

Distribution of Workers by Comprehensive Income Quintiles, 1979	Distribution of Workers by Comprehensive Income Quintiles, 1969				
	0–21	21–40	41–60	61–80	81–100
0–20	60	24	12	3	1
21–40	23	34	24	16	4
41–60	10	23	33	25	9
61–80	5	15	22	36	23
81–100	2	5	9	20	63

Source: See table 3.1.

significant at 5 percent ($\chi_1^2 = 4.68$), indicating that there are significantly fewer people moving into a new quintile when a comprehensive income measure is used.

We next examine smaller changes in the relative position of workers in the income distribution with a rank-order test. The coefficient for the Spearman rank-correlation test between single-year realized income for men working in 1969 and realized income in 1979 when the men have all retired is .56. Those with a higher income when working tend to have higher income when retired. This relationship is significant at the 1 percent level. The correlation for the same sample of workers using comprehensive income in 1969 and 1979 is .70. Once again the rank correlation between the two years is positive and significant at the 1 percent level. Notice that when this fuller measure of income is used the correlation improves over 25 percent. The neglect of unrealized wealth indicates a much greater fluctuation of well-being in retirement than is the case using our more sensitive measure of comprehensive income.

Now we test whether the two measures yield different results when we look at the effect of initial income and wealth in 1969 on predicted well-being in 1979. The dependent variables in these equations are realized income and comprehensive income respectively. The independent variables used to predict income level in 1979 consist of 1969 income variables, 1969 wealth variables, and demographic variables that capture changes in the worker's life between 1969 and 1979. Income variables include earnings, transfer payments, and interest income. Wealth variables account for physical wealth, financial assets, Social Security, and pension wealth. We expect that the higher a respondent's income and wealth in 1969, the higher his predicted income in 1979. The demographic variables are the respondent's age, the number of years retired, and his health status. The older a person is and the longer he has been retired, the larger the constraints on his optimal consumption path should it have to be changed due to unforeseen expenditures. Health status is based on the respondent's

subjective belief about his health relative to his peers in each of the six interview years. Because we are interested in changes in health, this binary variable takes the value of one when health is good in 1969 and deteriorates in any of the later years. The exact definition of all variables can be found in the appendix.

Table 3.3 contains the summary statistics and coefficients for the two equations. In both equations all the income and wealth variables except Social Security wealth are significant at the 5 percent level or better and have the expected sign. But of special interest to us is whether these two equations are significantly different. To test this we estimated the two equations using ordinary least squares. The equations are seemingly unrelated (i.e., the equations appear to be independent but their residuals are correlated). We expect the residuals will be correlated because there are many factors such as ability, motivation, and luck that affect the level of future income that cannot be included in the equations. These factors will affect both comprehensive and realized income measures, yet their effect may not be picked up by the independent variables. To the extent their effects are captured by the residuals, the residuals will be correlated. In fact the correlation between the residuals is .532.

The covariance between the residuals should be taken into account because we wish to test hypotheses concerning the coefficients of the two equations, and when the residuals are correlated, the correct standard errors and t-values involve the covariance. Usually the equations would have to be estimated by generalized least squares (Zellner 1962), but the regressions have the same regressors, and it is well known that in such a case ordinary least squares is algebraically identical to generalized least squares except where the covariance between residuals is concerned. To estimate the covariance, the sample covariance between the residuals of the two equations was estimated separately. This information was then used in the calculation of t-statistics.

3.1.2 Tests of Model Differences

We want to see if these equations represent different models, i.e., do our comprehensive and realized income equations yield different results with regard to predictions about people's well-being. We test for model differences in two ways: first, we test for statistically significant differences between individual coefficients, and second, we use an F-test to look for significant differences between the models as a whole.

In the final column of table 3.3 we report the t-statistics for the null hypotheses that the individual regression coefficients are equal. The null hypothesis is rejected for all but two variables (Social Security wealth and age). The other coefficients are significantly different from each other. This strongly suggests that the models are different.

Table 3.3 **Regression Coefficients and Summary Statistics**

	Realized Income Regression		Comprehensive Income Regression		Test of Differences H_0: $\beta_{1i}-\beta_{2i}=0$
Variable	Coefficient	t-statistic	Coefficient	t-statistic	t-statistic[a]
Constant	9,934.444	1.90*	8,597.380	0.84	.154
Resp. income	.139	9.28*	.237	8.15*	−3.99*
Spouse income	.283	11.20*	.407	8.27*	−2.98*
Asset income	.452	15.57*	.783	13.83*	−6.89*
Asset wealth	.024	8.28*	.075	13.15*	−10.49*
Physical wealth	.015	11.59*	.046	18.09*	−14.31*
Soc. Sec. wealth	.008	1.36	.018	1.54	−0.99
Pension wealth	.050	14.76*	.062	9.36*	−2.11*
Age (in 1969)	−67.410	0.76	19.946	0.11	−0.59
Years retired	−364.140	5.83*	−600.279	4.93*	2.28*
Health	−123.197	0.43	−826.198	1.48	1.48
R^2	.578		.583		H_0: $[I_1-I_2]\begin{bmatrix}\beta_1\\ \beta_2\end{bmatrix}=\underline{0}$[b]
$F_{11,1771}$	242.87*		248.11*		$F_{11,1770}=214.20$*

Source: See table 3.1

*Indicates significant at 5 percent level or smaller.

[a]Test of differences between individual coefficients.

[b]Joint test of coefficient differences.

The second test of model differences jointly tests for differences between coefficients. The null hypothesis is

$$[I_1 - I_2] \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} = \underline{0}.$$

The actual F with 11 and 1,770 degrees of freedom is 214.2. The F-test confirms that the null hypothesis of no differences is rejected. These two tests provide convincing evidence that the two measures of income provide different information about an individual's level of well-being.[9]

3.2 The Influence of Unexpected Events on Future Well-Being

Table 3.4 shows the realized income distribution and the composition of income sources by decile of our sample in 1969. It then shows the mean and income composition of these same deciles in 1979. Table 3.5 does the same using a comprehensive income measure. Observe that the income of men in our sample, measured in either realized or comprehensive terms, fell in real terms over the period. Given that the men in our sample retired and that the average age increased from fifty-nine to sixty-nine over the period, this result is not surprising. However, what is not clear is how the distribution of income changed over the period and to what degree unexpected changes in that distribution are related to the initial level of income.

In order to estimate that dependence while avoiding biases related to the time-series nature of the data, we develop here a theory of the determination of the percentage change in income, consistent with the usual theory of human capital. Further, we develop a test of the responsiveness of the percentage change in income over the period 1969–79 to the initial level of comprehensive income to answer the question: Does the inclusion of the omitted (unrealized) asset income that differentiates comprehensive income from realized income affect the stability of measured income?

The following subsections briefly sketch the model of the determination of income and the stochastic process that determines unexpected changes in income. Our final specification is then presented, and its hypotheses are tested.

3.2.1 Human Capital Model

We assume a model of income as follows:

$$\ln y_t = \underline{X}_t'\underline{\beta} + \epsilon_t, \tag{5}$$

where t indexes time, and $\underline{X}_t$ is the current value of the explanatory variables at t. They include the usual variables used to represent sources of human capital, such as education, experience, health, etc., and variables

9. Burkhauser and Wilkinson 1983 establishes a poverty line in comprehensive income terms and shows that the use of official poverty statistics will overestimate the dangers of falling into poverty in old age.

Table 3.4 **Composition of Realized Income for 1969 and 1979 by 1969 Income Deciles**

	Income Shares in 1969					Income Shares in 1979					
1969 Income Decile	Average[a] Income 1969	Social[b] Security	Private[c] Pension	Wages[d]	Other[e]	Average[a] Income 1979	Social[b] Security	Private[c] Pension	Wage[d]	Other[f]	*n*
0–10	4,504	3	1	94	2	5,442	60	5	15	20	181
11–20	9,555	1	1	96	2	7,570	56	8	23	13	176
21–30	12,228	*	2	94	3	7,877	59	22	9	10	178
31–40	14,466	*	2	95	2	8,925	55	20	14	11	178
41–50	16,637	*	2	94	4	9,592	51	22	13	14	182
51–60	19,008	*	1	96	3	9,718	53	26	10	10	178
61–70	21,649	*	1	95	3	11,486	46	28	12	14	176
71–80	25,003	*	1	94	5	12,634	42	25	13	19	176
81–90	31,152	*	1	92	7	15,341	37	32	10	21	180
91–100	53,353	*	2	84	14	23,614	24	27	11	39	177
TOTAL	20,719	*	1	92	7	11,207	43	24	14	21	1,782

Source: See table 3.1.

Note: Due to rounding, shares may not add up to 100.

*Indicates share of less than 1 percent.

[a]Realized income is equal to the sum of Social Security income, private pension income, wage income, and other income. All income figures are in 1979 dollars.

[b]Social Security income consists of Old-Age, Survivors, and Disability Health Insurance (OASDHI) payments.

[c]Pension income includes payments from railroad, military, government, and private pensions in 1969.

[d]Wage income includes respondent's and spouse's wage and self-employed earnings, paid sick leave, unemployment benefits, and workman's compensation payments.

[e]Other income in 1969 includes income from assets (stocks, bonds, savings accounts, and rental property), insurance payments, and annuity income.

[f]Other income in 1979 includes the same sources of income as in 1969 plus Social Security Income (SSI).

Table 3.5 **Composition of Comprehensive Income for 1969 and 1979 by 1969 Income Deciles**

	Income Shares in 1969					Income Shares in 1979					
1969 Income Decile	Average[a] Income 1969	Social[b] Security	Private[c] Pension	Wages[d]	Other[e]	Average[a] Income 1979	Social[f] Security	Private[g] Pension	Wage[d]	Other[e]	*n*
0–10	10,174	34	2	50	14	8,325	37	3	11	49	178
11–20	17,532	28	5	56	11	10,078	38	11	12	39	178
21–30	20,053	30	7	59	14	13,323	35	10	10	44	178
31–40	25,755	25	7	54	14	15,115	32	11	7	50	178
41–50	29,031	22	9	56	13	16,528	30	13	7	50	178
51–60	32,567	21	8	55	16	17,662	29	13	5	52	178
61–70	36,014	19	9	56	16	19,985	26	14	8	51	178
71–80	40,801	17	10	56	17	21,492	26	16	7	50	178
81–90	49,562	14	11	57	18	27,627	20	16	7	58	178
91–100	86,690	8	10	49	33	47,302	12	14	5	69	178
TOTAL	35,076	17	9	54	20	19,875	25	13	7	55	1,780

Source: See table 3.1.

Note: Due to rounding, shares may not add up to 100.

[a]Comprehensive income is equal to the sum of Social Security income, private pension income, wage income, and other income. All income figures are in 1979 dollars.

[b]Social Security income in 1969 is the annuitized value of Social Security wealth. Social Security wealth was calculated from Social Security Administration data by Quinn 1981.

[c]Private pension income in 1969 is the annuitized value of private pension income estimated by Quinn 1981.

[d]Wage income consists of respondent's and spouse's wage and self-employed earnings, paid sick leave, unemployment benefits, and Worker's Compensation payments.

[e]Other income includes the annuitized value of asset wealth (stock value of stocks, bonds, savings and checking accounts, and net loans) and physical wealth (net value of home, farm, business, and real estate, minus auto and medical debts).

[f]Social Security income in 1979 includes actual payments from OASDHI.

[g]Private pension income in 1979 includes payments from railroad, military, government, and private pensions.

used to represent tastes or discrimination, such as race, but not sex, because the sample contains only men. The logarithmic form of income is justified primarily by the facts that income tends to be distributed lognormally and that the logarithm tends to stabilize the variance. That is, persons with more human capital tend to show more variation in income, while showing more homogeneous levels of variation in log income. The log form is standard in labor economics.

3.2.2 Percentage Changes

By differentiating each side of equation (5), we get

$$d(\ln y_t) = dy_t/y_t = (d\underline{X}_t')\underline{\beta} + d\epsilon_t, \tag{6}$$

where the disturbance can change over time. We consider equation (6) in some detail here, but first let us consider the problems caused by t's not being observed in an infinitesimal change, but rather in a finite change. Then we should integrate equation (6) from t_0 to t_1 to obtain:

$$\int_{t_0}^{t_1} d(\ln y_t) = \sum_{k=1}^{K} \beta_k \int_{t_0}^{t_1} X_{tk}dt + \int_{t_0}^{t_1} \epsilon_t\, dt. \tag{7}$$

The left side of equation (7) can be expressed as

$$\ln(y_{t_1}) - \ln(y_{t_2}) = \ln(y_{t_1}/y_{t_2}).$$

The right side is still a function of the changes in the values of the explanatory variables and the disturbance, so the only important effect of the integral form of the problem is to change the dependent variable.

If we wanted to estimate the coefficients of the human capital model, we could do so in a conventional regression. That would not, however, permit a discussion of whether the percentage change in income over the period 1969–79 is related to the initial distribution of income, and it is this change, which is coincident with retirement, that is of interest here. Another alternative would be to use the sort of equation specified in the first part of this chapter, with base-year income among the regressors. Such an equation is perfectly adequate, indeed, may be preferable, for purposes of predicting end-year income, because as we have shown, base-year income is highly correlated with end-year income. However, for purposes of estimating coefficients, such as a coefficient relating base-year income to percentage changes in income, such an equation is seriously flawed. This must be the case since base-year income is almost certainly correlated with the disturbance in end-year income. We exploit such a relationship in the next section to construct a model that avoids the bias caused by the correlation of disturbance and regressor (usually characterized as simultaneous equations or measurement error bias), and therefore estimate unbiased coefficient estimates. Thus neither the basic equation (5) nor the type of

equation found in the first part of the paper is suitable for our purposes, and we require a different model, which is presented next.

3.2.3 The Stochastic Process

The first term on the right side of equation (6) or (7) is $\Sigma\, \beta_k\, \Delta X_k$, that is, the changes in the explanatory variables over the period 1969–79 weighted by the regression coefficients from a model of income. The changes in the Xs are directly measurable.

The second term is $\Delta\epsilon_t$, which requires some explanation. We assume that ϵ_t basically follows a white noise process, but not necessarily with a mean of zero, because of unexpected but nonrandom drift in the macroeconomic or policy variables affecting the income of the men in our sample. Therefore, it may have a drift component α^*. However, all the persons in the RHS sample are observed for ten years, so all have a drift of $10\alpha^*$, which is replaced with a single parameter α.

Our model is formally similar to models of stock prices, which are also assumed to be distributed lognormally and to have a time-dependent error term. Note, however, that those models usually assume $\Delta\epsilon_t$ to be pure white noise. That is, it has no systematic motion up or down over time but drifts randomly. The modification here is that, with regard to income, systematic drifting is possible.

Over the period 1969–79 unexpected changes occurred in the levels of benefits under the Social Security program and in the real returns to private pensions as well as to other assets such as houses or stocks.[10] Certainly different rates of increase in the various sources of income were observed over this period. Consequently, we hypothesize that the level of income may be correlated with the unexpected change in income, because persons at different levels of income may have had systematically different portfolios of income sources. As can be seen in table 3.5 the portfolio of upper comprehensive income decile varies substantially from those of lower decile with respect to Social Security and private pensions. If the unexpected drift in income is positively correlated with income in 1969, then the rich became relatively richer. Conversely if the unexpected drift is negatively correlated with 1969 income, then the reverse is true. Note that in absolute terms an increase equal to a constant percentage gives the rich more income, while a decrease equal to a constant percentage takes more away from the rich. Thus, we parameterize the disturbance as:

$$d\epsilon_t = \alpha + \delta \ln y_t + \eta_t, \tag{8}$$

where α is the effect of macroeconomic policy on the drift in individuals' incomes; δ links individuals' initial levels of comprehensive income to the

10. For a discussion of the unexpected nature of the change in Social Security benefits in the 1970s see Anderson, Burkhauser, and Quinn 1983.

unexpected changes in income; and η is a random, pure-white-noise error term.[11]

The point is that ϵ_t, the unexpected change in income, is correlated through time because slowly changing unobservable variables, such as motivation, are presumably correlated through time, and because of systematic but unexpected factors related to the level of income.

3.2.4 The Final Specification

The equation to be estimated is:

$$\ln (y_{t_1}/y_{t_0}) = (d\underline{X}_i)\underline{\beta} + \alpha + \delta \ln y_{t_0} + \eta_t. \tag{9}$$

Our only changing explanatory variable is health. As in the previous section, health is a binary variable equaling one if self-reported health goes from good to bad over the period. The other two regressors are time (the constant) and initial income.

For a regression to be free of bias, the explanatory variables must be uncorrelated with the disturbance. We assume that the Xs and the changes in the Xs are uncorrelated with the disturbance. The dependent variable is, however, correlated with the disturbance at and before time t. But most important for our analysis, the dependent variable at t is uncorrelated with future additions to the disturbance. In that case our regressions are appropriate, since the 1969 level of income is one of the regressors, but the disturbance includes only the addition over the period 1969 to 1979. This assumption is seriously flawed if future changes were expected and taken into account in 1969. If this were the case the dependent variable, log income at time t, would be correlated with future disturbances as well. However, in that event, all attempts to model income without variables representing expectations of the future would be misspecified. We argue that the changes were unexpected, so our modeling is appropriate. It represents an intermediate position between the conventional ignoring of expectations and a full-blown attempt to respecify human capital models with endogenous expectational variables.

3.2.5 Expected Signs of Coefficients

We have three independent variables in our equation. The first is the time trend. Because real income tended to fall during the period, α is ex-

11. That the changes were unexpected implies that they should be in the disturbance. Alternatively, one could postulate a rational expectations model in which these changes are anticipated. In such a case, expectations are present in the model determining income, since future conditions help to determine present decisions. All conventional human capital models are misspecified in that case, since they omit expectations. Even in a rational expectation model, unexpected changes will still not affect present decisions. The importance of this matter to the question of whether regressors and disturbance are uncorrelated is discussed later.

pected to be negative. This need not be the case since α represents the trend in *unexpected* income changes, not actual income changes.

Our second coefficient is most important with regard to measured inequality. If the unexpected changes during the period had a greater proportionate effect on upper-income workers, then δ should be negative. Conversely a positive sign would indicate unexpected changes had a greater effect on lower-income groups. We have no a priori judgment on the direction this term will take. The 1970s saw a major increase in Social Security retirement and health benefits which make up a larger share of the comprehensive income portfolio of lower-income workers. But the ability of higher-income workers to protect against uncertainties by adjusting their portfolios may offset that change. Our only other variable measures health deterioration over the period, and we expect that such a fall in health should decrease income.[12]

We have argued that comprehensive income is a theoretically superior measure of well-being. In measuring the effect of unexpected changes on well-being we use this measure. Nevertheless, it is still useful to compare these results with those using other income measures. Comprehensive income is divisible into two components—realized and unrealized income. It is the omitted income from unrealized assets that is the difference between our comprehensive and realized measures.

Comprehensive income and its unrealized component should be more stable than realized income, in the sense that the percentage change in unrealized income should be less responsive to the prior level of comprehensive income than the percentage change in realized income is. Complete stability would be present in an income distribution in which all changes were equal percentage increases or decreases. As to the time trend α, we do not have strong prior convictions about which components should rise or fall more, but we can compare them. Finally, with regard to health, we expect that serious medical problems would eat into wealth and substantially affect unrealized income.

3.2.6 Results

Table 3.6 displays the results of the estimation. We find that income tended to decline over the period at an annual rate of 5.0 percent for comprehensive income, 3.8 percent for realized income, and 9.2 percent for unrealized (omitted) income.[13] Thus, the sources of income not normally included in flow income fell more rapidly as far as the trend in the disturbance is concerned. However, they fell more if the initial level of income

12. Because we are considering a group of men who are retired over most of the period of analysis, we do not expect income to be reduced because of lost work. Rather we expect the loss to come because of increased consumption of wealth. This loss should be offset to the degree that these men have medical insurance.

13. The annual rate of change is $\exp(-\alpha/10) - 1.0$.

Table 3.6 **Regressions on Changes in Income, 1969–79**

Independent Variables	Comprehensive Income[a]		Realized Income[b]		Unrealized Income[c]	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Constant	−.517	−22.25*	−.375	−12.45*	−.853	−18.74*
Comprehensive income, 1969[d]	−.301	−6.29*	−.572	−9.15*	.287	3.06*
Health change	−.038	−1.58	.016	0.51	−.108	−2.03*
R^2	.022		.046		.009	
$F_{2,\ 1979}$	20.15*		43.16*		8.30*	

Source: See table 3.1.

*Indicates significance at 5 percent level.

[a] $\log\left(\frac{\text{comprehensive income 1979}}{\text{comprehensive income1969}}\right)$, comprehensive income in both periods is the sum of realized and unrealized income.

[b] $\log\left(\frac{\text{realized income 1979}}{\text{realized income 1969}}\right)$, realized income in both periods includes wages and salary, income received from assets, and any pension and Social Security received.

[c] $\log\left(\frac{\text{unrealized income 1979}}{\text{unrealized income 1969}}\right)$, unrealized income in 1969 includes annuitized values of Social Security wealth, pension wealth, asset wealth and physical wealth minus asset income, Social Security and pension income received. Unrealized income in 1979 includes annuitized values of physical and asset wealth minus asset income received.

[d] Income is measured in units of $1,000s.

were higher, so they tended to move in an equalizing manner. Realized income moved strongly in an equalizing direction, and strongly enough that the same was true for comprehensive income. For each increase of $1,000 in 1969 comprehensive income, there is an estimated decrease of 0.003 in the change of log income, or a decrease of about 0.3 percent. Loosely speaking, 0.3 percent of one's income was "given back" for each increase in the base level of $1,000. This is not a large effect in absolute terms (average comprehensive income was $35,000 in 1969), and one can regard it as not important in terms of redistribution, but the direction of effect is clearly established for these data.

With reference to the comparison between realized and unrealized income, we observe that, in fact, the unrealized component was absolutely less responsive to the prior level of income, and the net result is that comprehensive income is only about half as responsive as realized income is to the prior level of income (0.572 versus 0.301). The effect is quite significant, since the signs are opposite, and each is significantly different from zero.

Health has a strong negative effect on the omitted or unrealized portion of income, a slight positive effect on realized income, and on net a negative effect on comprehensive income. The coefficient is comparable to the effect of a $13,000 rise in income. Thus, the effect is quite large relative to that of comprehensive income; a change in health for the worse has an effect equivalent to that of 37 percent of the average level of comprehensive income. However, the t-statistic is only signficant at the 85 percent level. A change of this magnitude is somewhat surprising given that the great majority of these workers were eligible for medicare or medicaid.

Two inferences can be drawn from the regressions. First, they are statistically significant; second, they explain very little of the variation. We interpret this to indicate that the disturbance in the equation for log income is primarily a standard error term, unrelated to any systematic factors. Nevertheless, the significant relationships indicate a slight but meaningful effect of the prior level of income via unexpected changes in policies and returns on assets, and of health via systematic changes in health. We consider the low R^2 as positive support for our underlying assumptions. A higher R^2 might suggest that the relationships were too strong to be "unexpected." This point is best brought out by comparing our results with those of stock price models since it is from them that our model springs. Because stocks tend to follow a random walk, a regression of the type used here to estimate their future prices would be expected to have an R^2 close to 0.0. Any systematic factors would be ferreted out by profit seekers. Thus, all systematic factors should be incorporated into expectations. In the RHS sample, however, the men could not profit much from a better prediction of the future, would have had difficulty obtaining better information, and might not have been able to change their portfolios in any

case. Thus, a small but significant effect such as that found here is unlikely to have been fully anticipated.

3.3 Conclusion

Comprehensive income offers a theoretically superior method of measuring well-being and of asking questions with regard to how and why it changes over time. Those using traditional realized measures of income are likely to overstate the fall in well-being associated with retirement and to predict future income incorrectly. Finally our measure of comprehensive income was useful in showing that unexpected events appear to be "income equalizing" at least over the last decade. It also appears that a deterioration in health, even in the face of substantial government insurance protection, has an important unexpected negative effect on well-being.

Appendix

Variable	*Definition*
Respondent income	All wages and salary earned by respondent in 1969 in 1979 dollars.
Spouse income	All wages and salary earned by respondent's spouse in 1969 in 1979 dollars.
Asset income	Income from interest, dividends, rent, and pension payments in 1969 in 1979 dollars.
Physical wealth	Net value of house, farm, business, and real estate in 1969 in 1979 dollars.
Asset wealth	Net wealth of bonds, stock certificates, savings and checking accounts, and stock value of annuities in 1969 in 1979 dollars.
Social Security wealth	Net present value of Social Security benefit stream at 5 percent in 1969 in 1979 dollars.
Pension wealth	Net present value of pension benefit stream at 5 percent in 1969 in 1979 dollars.
Age	Respondent's age in 1969 in years.
Years retired	Number of years respondent has been retired as of 1979.
Health	Health binary that equals 1 if the respondent was in good health relative to his peers in 1969 and his health subsequently deteriorated over the period. Otherwise health equals 0.

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Comment Lee A. Lillard

Burkhauser, Butler, and Wilkinson provide us with new evidence on the consequences of retirement for financial well-being. In particular they compare estimates of changes and of stability based on realized income and on their concept of comprehensive income. Realized income includes wage and salary income, income from financial assets, and government transfers. Comprehensive income is essentially the sustainable annuity income flow from the stock value of current assets. Current assets include real assets less debts, financial assets, and Social Security wealth.

Using data from the Retirement History Survey (RHS) for men working in 1969 but retired in 1979, they find that comprehensive income is more stable than realized income, in terms of position in each distribution over time or rank correlation between periods a decade apart, that the two measures of well-being are related in significantly different ways to the composition of assets, income, age, time retired, and health, and that both measures decline in real terms over the period. These results provide us with a better understanding of the effect of retirement on financial well-being by acknowledging the presence of assets available to finance consumption, whether the potential is realized or not.

In the remainder of this discussion I will suggest some areas where improvements in the current study might be realized and some areas for further study.

Some additional calculations would improve our understanding of the current study. Are the current results sensitive to assumed parameters in the calculation of the stock value of assets and the sustainable annuity flow value, in particular the discount rate and the pattern of survival probabilities? These assumptions may interact with the composition of wealth holdings, e.g., current financial assets relative to Social Security wealth, which depends crucially on survival. In addition, it would be informative to learn more about the composition of assets between relatively liquid forms such as real and financial assets that may be used (or borrowed against) to finance realized consumption and relatively illiquid assets such as the expected stream of Social Security benefits. Are the observed relationships due more to liquid or illiquid assets? To the extent these assets are liquid, and potentially available to finance current consumption, the comprehensive income measure is more relevant.

More complete use could be made of the data. First, rather than using a simple comparison of two periods a decade apart, the full panel of data on interviewing periods could be introduced to study the path of events leading to the 1969–79 comparisons and to assess the degree of period-to-peri-

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od variability in these measures at the individual level. That is, to what extent are the decade differences due to systematic developments of the financial position versus more transitory variation and errors of measurement of assets and income. These notions may be formalized and their effects estimated using more periods of observation. Use of the full panel would necessitate the fuller use of the time of retirement and age of retirement, which may influence the income measures in ways not considered in this study.

Second, selection of the sample used for this study may be systematically related to the behavior under study. The sample includes men who worked in 1969 and were retired in 1979, who were married with spouse present in both years and who were not institutionalized in either period. This is a nontrivial selection criteria, even though it makes analysis simpler. The selected individuals survived a decade, their spouses survived a decade, and their financial and health status was such that they need not be institutionalized. Since survival and health, and particularly being placed in a nursing home, are major concerns of the elderly, this selection is potentially an important one. Comparisons of the survivors with those less fortunate may provide substantial additional information about the behavioral interpretation of their findings.

The stock of assets at preretirement is endogenous in that it is the result of prior labor supply and consumption choices. The change in assets over the next decade is similarly endogenous in that it results in part from the consumption (and time-of-retirement) choices of the individuals. Individuals differ in their rate of time preference, in their probability of survival over time, and in their expected health status and need for institutionalization over time. Differences in the time path of assets or comprehensive income available from it, as well as realized income, may depend crucially on these individual differences. Individuals may anticipate events that the researcher cannot. A reduction in assets or reduced comprehensive income over time may not be "bad" in the sense that it may be optimal behavior given the expected situation, time preference, and attitudes toward risk.

Burkhauser, Butler, and Wilkinson begin their paper with an interesting and relevant declaration: "Fear of living too long is paradoxically one of the major concerns of old age." This proposition is central to the issues surrounding the well-being of the elderly and changes in well-being over time. If individuals anticipate their own future—their mortality, health, and institutionalization—better than the assumed aggregate probabilities used in the analysis, then we may learn more by comparing the behavior of the healthy survivors (the sample) with the "less healthy" survivors (institutionalized) and with those not surviving (including length of survival). If individuals have informed expectations, their behavior with respect to financial matters should be systematically different. Changes in finan-

cial position occurring in the first few years of the panel (for survivors of a shorter period) may be considered in relation to forthcoming changes in health or survival status. While this is clearly beyond the scope of the current study, it may provide further insights into the relevant issues.

This chapter is suggestive of the substantial gain to be realized by analysis going beyond current realized income measures. I look forward to their further work.