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SOCIAL SECURITY BENEFITS: AN EMPIRICAL STUDY OF EXPECTATIONS AND REALIZATIONS

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ABSTRACT

I employ data drawn from the Retirement History Survey to study the accuracy of pre-retirement expectations concerning social security benefits. The major findings of this study are as follows. First, survey responses to questions about expected benefits are reasonably noisy. However, when one properly filters out the noise, reported forecasts appear to explain roughly 60% of the variance in realizations. Second, consumers do not form expectations on the basis of all available information. Proper adjustment of forecasts for information contained in concurrent social security entitlements could reduce the residual forecast error variance by roughly 15%. The potential gains from incorporating other information are minimal. Third, individuals do not ignore or forget information which they have used in the past, and they tend to form all expectations on the basis of the same information. Fourth, expectations are highly accurate, given the information that people do use. Extreme optimism is uncommon. Surprisingly, expectations were not abnormally inaccurate during periods of rapid legislative change. Fifth, of various population subgroups, widows and single women tend to make both the most conservative and most accurate forecasts. Married men are least conservative and least accurate. Accuracy and conservativism are not systematically related to wealth or education. Finally, individual behavior appears to conform more closely to the predictions of theory as retirement approaches.

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1. Introduction

Expectations play a key role in modern life cycle theory. This is something of an embarrassment to applied economists, since perceptions are not, in general, directly observable. Little if any existing evidence sheds light on the plausibility of central life cycle tennets, which hold that consumers think seriously and coherently about the relatively distant and uncertain future. The extent to which financial hardship among the elderly stems from myopia and inept financial planning therefore remains largely a matter of speculation. In addition, economists are frequently forced to invoke a variety of strong assumptions concerning the structure of expectations in order to identify behavioral models (e.g. many studies are based on the supposition that consumers understand the Social Security benefit formulae, and form their expectations "rationally"). Specific empirical results often depend heavily upon the nature of these assumptions. An excellent example of this appears in the literature on Social Secrity and personal saving: when employing macroeconomic data, one can obtain virtually any desired result by altering assumptions concerning expectations (see Leimer and Lesnoy's [1981] criticism of Feldstein [1974]). The study of expectations is therefore absolutely central to a comprehensive understanding of life cycle behavior.

Previous empirical work on household expectations has focused primarily on inflation (see Huizinga [1980], Curtain [1982], Gramlich [1983], and Papadia [1982]; Aiginger [1981] considers a somewhat broader range of variables). To my knowledge, there has been no previous systematic analysis of expectations and realizations among the elderly. Since the concerns and characteristics of the elderly differ from those of the non-elderly, it would be unwise to generalize from existing evidence when considering problems associated with aging.

In this paper, I employ data drawn from the Social Security Administration's Retirement History Survey (RHS) to study the accuracy of pre-retirement expectations concerning social security benefits. This emphasis on social security is appropriate, since program benefits are typically the most important single financial resource of retired individuals, comprising on average more than half of net wealth (see Bernheim [1987a]). In a separate piece (Bernheim [1987b]), I examine the accuracy of expectations concerning the timing of retirement.

The major findings of this study are as follows.

1. Survey responses to questions about expected social security benefits are reasonably "noisy". It is extremely important to bear this in mind when interpreting the data. When one filters out the noise appropriately, it appears that consumers do think seriously about future events, and report expectations which may well reflect, albeit imperfectly, their true beliefs. Indeed, respondents' forecasts explain roughly 60% of the variance in realizations.

2. Consumers do not form expectations on the basis of all available information. The data strongly suggest that individuals ignore a great deal of information contained in concurrent social security statutes. Proper adjustment for this information could reduce the residual forecast error variance by roughly 15%. There is also

somewhat weaker evidence that consumers at least partially ignore certain demographic factors which help to predict future events. However, the potential gains from more refined use of demographic information appear minimal--proper adjustment would reduce the residual forecast error variance by at most 5%.

3. The evidence is broadly consistent with the view that individuals use the same information to form expectations concerning a variety of different variables (social security benefits, other income, and date of retirement). When forming expectations concerning social seourity, individuals do not appear to ignore information upon which they base other expectations at the same point in time. In addition, consumers have good memories, in that they do not ignore information upon which they based expectations at previous points in time.

4. People seem to be reasonably competent at forming relatively accurate expectations conditional upon the information that they do chose to use. In addition, it is somewhat comforting to note that few individuals exhibit the kind of extreme optimism that might be responsible for catastrophic errors in financial planning; indeed, there is a general bias towards conservativism. Surprisingly, there is very little evidence to support the view that expectations were abnormally inaccurate during periods of significant statutory reform. Indeed, the data broadly suggest that consumers correctly anticipated the general effects of legislative action during the early 70's, contrary to the supposition of most previous authors (see e.g. Hurd and Boskin

[1981]). Data on retirement expectations bear this conclusion out (see Bernheim [1987b]).

5. Of various population subgroups, widows and single women tend to form both the most conservative (i.e. low relative to realizations), and most accurate (judged by correlations or mean squared errors) forecasts. The forecasts of married men are the least conservative, and least accurate. There is no evidence that the poor, or those with relatively little education have particular difficulties forming accurate expectations.

6. The properties of reported expectations conform more closely to theory as retirement grows imminent. This suggests that individuals may become more serious about forming expectations with the approach of retirement.

The paper is organized as follows. Section 2 describes a general conceptual framework for analyzing social security expectations. Section 3 contains a description of the data. Simple tabulations of the raw data appear in section 4. Section 5 contains regression results which permit formal testing of certain aspects of the conceptual framework. While the results are generally unfavorable, I attribute this to the noisiness of reported expectations. I take up the issue of measurement error in section 6, and present new results which motivate many of the conclusions described above. Section 7 summarizes my findings, and discusses directions for subsequent research.

2. A Conceptual Framework

It is plainly unreasonable to expect that an elderly person could predict without error his financial resources several years hence. Uncertainty is simply a fact of life. For purposes of conducting behavioral analyses and designing public policy, the relevant issue is whether individuals have learned to deal with this uncertainty as well as their circumstances allow. Economists frequently employ the assumption that households form their expectations "rationally," in the sense that they are not fooled systematically, and furthermore, that their forecasts are as precise as possible conditional upon available information. Given data on expectations, one can test this hypothesis in a variety of ways. One approach is to determine whether or not forecast errors are systematically related to information which the individual possesses (or has access to) at the time his forecast is made. If they are, then one can actually identify the kind of information which individuals either ignore, or use improperly. Another approach is to examine the accuracy of predictions, and to see whether they become more accurate as knowledge improves. In this section, I develop these ideas formally.

Suppose that at each point in time, $t = 0,1,\ldots, T-1$, an individual forms an expectation, X_t^e, about the value of same variable X, which is realized at time T. During period t, he has access to certain information, which I denote as Ω_t. Throughout, I assume that the individual's memory is perfect, so that all information available at time t is also available in period $\tau > t$.

In subsequent sections, I interpret X as social security benefits, and T as date of retirement.[1/] When an individual reports expected social security benefits, there is, of course, some ambiguity as to what this means. While he may have in mind something like a mathematical expectation, it is also possible that his report reflects his view of the most likely outcome (i.e., the mode). As long as the distribution of X is approximately symmetric and single-peaked, this ambiguity is probably of very little consequence. Throughout, I therefore focus on the hypothesis that individuals report expected values, i.e.

$$X_t^e = E(X|\Omega_t) \quad . \tag{1}$$

From equation (1), one can derive a number of simple testable implications, which I summarize below as properties I through 4.

<u>Property 1</u>: Realizations should exhibit more variability than forecasts.

<u>Property 2</u>: The variability of forecasts should increase as the date of realization approaches.

<u>Property 3</u>: The variance of the forecast error should decline as the date of realization approaches.

<u>Property 4</u>: The correlation between forecasts and realizations should rise as the date of realization approaches.

The intuition for these results is straightforward. Different individuals should make different forecasts only if their information differs. Thus, as individuals acquire more differentiated information, forecasts should become more heterogeneous. Since information improves over time, property 2 follows naturally. Note also that the improvement of information immediately suggests properties 3 and 4, which essentially state that forecasts become more accurate as the date of realization approaches. Finally, since a realization is equivalent to a forecast based upon perfect information, realizations should exhibit more heterogeneity than forecasts (property 1). I refer the reader to appendix A for formal demonstrations.

Tests of the four properties listed above can help to determine whether or not consumers efficiently process available information. If these tests should fail, further investigation would be warranted. In particular, one would want to identify the kinds of information that individuals tend to ignore or process incorrectly. It is possible to shed some light on this issue by adopting a somewhat different approach. Specifically, equation (1) suggests the following regression framework:

$$X_{it} = \alpha + \beta X^e_{it} + \omega_{it}\gamma + \varepsilon_{it} \quad , \tag{2}$$

where the ω_{it} are variables that are observable at time t (i.e. elements of Ω_{it}). Theory implies that $\alpha = 0$, $\beta = 1$, $\gamma = 0$, and that ε_{it} is orthogonal to X^e_{it} and ω_{it}. Thus, least squares estimation of (2) generates an additional set of tests.[2/] In addition, it allows us to isolate particular types of information which consumers fail to process correctly, and to determine the direction and magnitude of the resulting forecast bias. Note in addition that by omitting ω_t from the regression, one can test a weaker proposition--that individuals form unbiased (conditional upon the information that they do use), although possibly inefficient expectations $(\alpha = 0, \beta = 1)$.

3. Data

The data for this study are drawn from the Social Security Administration's Retirement History Survey (RHS), which followed a sample of retirement-aged households (58 to 63 years old in 1969) for a period of 10 years, beginning in 1969. Each household was surveyed once every two years (1969, 1971, 1973, 1975, 1977, and 1979). Although the initial wave included more than 11,000 households, there was substantial attrition over successive waves.

In 1969, 1971, and 1973, respondents reported the level of social security benefits that they expected to receive upon retirement. In subsequent sections, the variable ESS (expected social security) reflects answers to these questions, adjusted to an annual basis. Unfortunately, data on expected benefits were extremely poor in 1969. Casual inspection revealed a low resonse rate (due in part to survey skip patterns), as well as a high frequency of nonsensical values. I have therefore confined attention to responses given in 1971 and 1973.

Unfortunately, interpretation of expected benefits is somewhat problematic, in that the treatment of inflation is ambiguous.

Certainly, the survey instrument does not specify whether the individual is to report a real or nominal figure. Throughout, I simply assume that respondents report expected benefits in current (i.e. survey year) dollars. This seems the most natural choice, since respondents would otherwise have had to forecast future inflation rates before formulating an answer to the question. To the extent my assumption is incorrect, the scale of expectations may be somewhat off.

The primary advantage of the RHS is that it allows the analyst to identify realizations by employing data from subsequent survey waves. In the case of social security benefits, this process is somewhat involved. While respondents are asked to report social security income in each survey year, these data are of questionable reliability. For example, it is not uncommon to find households which first report the receipt of benefits in a particular year, only to report no social security income in one or more of the subsequent waves. Furthermore, reported benefits frequently vary by 50% or more between consecutive waves. Since most of this undoubtably reflects "noise", the use of such data would introduce spurious forecast error. I therefore opt to use calculated values instead. The calculation procedes in several steps.

First, I identify the year in which each repondent began to receive social security benefits. While it is safe to assume that individuals rarely report the receipt of benefits when they in fact receive none, failure to report positive benefits does not necessarily indicate that none have been received (see above). Accordingly, I use the minimum of the date at which each respondent first reported social security income, and the respondent's reported date of retirement. Unfortunately, respondents are never asked to report their dates of retirement directly. Instead, they indicate whether or not they are retired at two year intervals. I take the respondent's reported date of retirement to be the date at which he left his last job prior to first classifying himself as retired. When the respondent fails to report this date, I take it to be midway between successive survey years (i.e. in the year prior to the survey year when he first reports himself as retired).

Second, I calculate yearly social security income for each individual by compiling his earnings history, and applying the benefit formula in effect during the year when he first began receiving benefits. Fortunately, the social security administration has provided matching administrative records on official earnings histories through 1975--the SSA uses these same data to calculate benefits in practice. These records are, of course, incomplete for individuals who began to receive benefits after 1975. In these cases, I use survey data on reported earnings after 1975 to complete the records. While survey data are available only through 1979, this turned out to be immaterial--according to the criterion described above, no individual who reports an expected benefit in either 1971 or 1973 actually began to receive social security benefits after 1979.

As described in section 2, part of my objective is to relate forecast errors to available information, in order to identify the kinds of information that individuals either ignore or process incorrectly. I consider two dozen informational variables, which I group into three distinct categories.

The first category contains variables which measure other reported expectations. The inclusion of these variables allows me to determine whether or not individuals have internally consistent expectations, in the sense that they base all expectations on the same set of information. By including lagged expectations, I can test the hypothesis that individuals have good memories, in the sense that they never ignore information which they employed at some prior point in time. Definitions of specific variables follow.

ERET: expected data of retirement.

EOI: expected retirement income, other than social security

LESS: expected social security income, reported in the preceding survey wave.

LERET: expected date of retirement, reported in the preceding survey wave.

LEOI: expected income other than social security, reported in the preceding survey wave.

Data on expectations is, of course, incomplete--many individuals who report expected social security benefits do not, for example, report an expected date of retirement. Accordingly, I also use dummy variables, which equal 1 if the individual reports the associated expectation, and 0 otherwise. I refer to the dummies corresponding to the five expectational variables listed above as DRET, DOI, LDSS, LDRET, and LDOI, respectively.

The second category includes a single variable, which is the individual's current social security entitlement, CSS, defined as the level of benefits he would receive under current law if he retired immediately. CSS is, theoretically, part of each individual's information set, in that it depends only upon his own past earnings history, and upon current law (which is public information). By including CSS, it is possible to determine the extent to which individuals ignore information related to existing statutes.

The third and final category includes various demographic variables and other household characteristics which might be useful in predicting future social security benefits. The list of variables includes:

MAR: a dummy variable, indicating whether or not the respondent is married (1 = married, 0 = other).

DIV: a dummy variable, indicating whether or not the respondent is divorced (1 = divorced, 0 = other).

WID: a dummy variable, indicating whether or not the respondent is a widow or widower (1 = widow or widower, 0 = other).

AGE: the respondent's age.

SAGE: the respondent's spouse's age.

ED: the respondent's level of educational attainment (measured in number of years).

SED: the respondent's spouse's level of educational attainment.

W: the household's net wealth (including financial assets, businesses, and real property).

GH: a dummy variable, indicating whether or not the respondent reports his health as being better than average for his age (1 = better, 0 = other)

BH: a dummy variable, indicating whether or not the respondent reports his health as being worse than average for his age (1 = worse, 0 = other).

KIDS: number of children.

COMPRET: a dummy variable, indicating whether or not the respondent's employer maintains a compulsory retirement age (1 = compulsory retirement, 0 = no compulsory retirement).

MOVE: a dummy variable, indicating whether or not the respondent has moved within the past two years.

Before passing on to analysis of the data, it is important to discuss two potential problems. The first concerns sample selection biases. I drop observations from the analysis for four reasons: i) the respondent fails to report expected social security benefits, ii) reported expectations are obviously nonsensical, iii) data on net wealth are inadequate, or iv) the household disappeared from the RHS prior to receiving social security benefits. Note that the first three items all reflect household characteristics that are known when the respondent makes his forecast. According to theory, these factors should therefore be uncorrelated with the forecast error--dropping these observations should not bias the regression results. The fourth item (subsequent attrition) does reflect events occurring after the forecast was made, and therefore may well be correlated with the forecast error. Nevertheless, this seems relatively unlikely. Attrition occurs primarily because of death, or because the respondent has moved. Death is, of course, highly correlated with realized social security benefits, in the trivial sense that an individual who dies prior to retirement receives nothing. However, I strongly suspect that individuals report a conditional (upon survival) expectation (i.e. the respondent thinks, if I live until retirement, what will I get?) If so, no sample selection bias arises. When attrition occurs for other reasons, one cannot make the same argument. However, the RHS did successfully locate many respondents after they had moved. Consequently, the variable MOVE should give some indication as to whether the resulting sample selection bias is significant. As we shall see, the evidence suggests that it is not.

The second problem concerns the non-independence of realizations. In a short panel such as the RHS, forecast errors are probably correlated accross observations, due to "macro" events. Suppose, for example, that subsquent to the date at which forecasts are recorded, Congress unexpectedly raises social security benefits by 20%. Then one would presumably discover that, on average, forecast errors are significantly positive. One should not construe this as contradictory to theory, since forecasts may indeed be unbiased given the *ex ante* distribution of macro events.

Since the 1970's witnessed several large and potentially unexpected real increases in social security benefits, this problem is potentially severe. I am particularly concerned about the 20% increase in benefits enacted in September 1972, and the double indexing for inflation which caused real benefit levels to rise substantially between 1975 and 1977. However, these were, for the most part, across-the-board increases in benefit levels. As a result, they probably affected little more than scale. To put it another way, one would not be surprised to find $\beta > 1$ in estimates of equation (2), and one should not construe this as contrary to theory. Indeed, through estimates of β, one can hope to discern the extent to which these legislative changes were actually anticipated. However, one would still expect to find $\alpha = \gamma = 0$ under the hypothesis that the theory is accurate.

This last remark is somewhat debatable. Legislative changes during the 70's did alter individuals' budget constraints (see Hurd and Boskin [1981] for an example). Presumably, this had behavioral consequences. To the extent different types of individuals had systematically different behavioral response to changes in their budget constraints, then the corresponding characteristics would, *ex post*, be correlated with forecast errors, even if the theory was valid. In the absence of more extensive longitudinal data, little can be done about this problem. The reader should bear this qualification in mind when evaluating the evidence.

4. A Comparison of Forecasts and Realizations

It is possible to learn a great deal about the raw data by tabulating simple summary statistics. I devote the current section to this task; sections 5 and 6 contain regression results.

Tables 1 and 2 provide a general picture of expectations and realizations, broken down by several different respondent categories, including married men, widows, widowers, single men, single women, wealthy married men, and high educated married men.[3/] I report the total number of observations not yet receiving social security, the fraction of these observations reporting expected social security benefits, the average expectation along with its standard error, the average realization for those reporting an expectation, along with its standard error, the relative mean forecast error (= $(\overline{SSI} - \overline{ESS})/\overline{ESS}$, where bars denote means), the correlation between expectations and realizations, and the mean square forecast error.

Consider first the response rates to questions about expected benefits. Since respondents may fail to report expectations for a variety of reasons, one should not attach too much importance to any particular rate. However, since the quality of an individual's information almost certainly affects the likelihood that he will report an expectation, relative response rates may be informative. The overall rate was 42% in 1971, and 40% in 1973. Since the average individual is closer to his date of realization in 1973 than in 1971, this is somewhat surprising--one would expect information to improve, and hence reporting to rise, as individuals approach retirement.

A comparison of response rate across population subgroups reveals that in 1971, single women and widows were least likely to report expected benefits. Yet in 1973, these subgroups were among the most

Table 1: Social Security Forecasts and Realizations, 1971
Selected Subgroups

Population Subgroup	Total number of observations	Fraction reporting an expectation	Mean Expectation (standard error)	Mean Realization (standard error)	Relative mean forecast error	Correlation coefficient	$MSE/10^6$
Married Men	4749	0.43	2331 (981)	2529 (1035)	0.085	0.38	1.29
Widows	775	0.39	1425 (484)	1695 (698)	0.189	0.60	0.39
Widowers	282	0.44	1627 (501)	1849 (820)	0.136	0.47	0.59
Single Women	245	0.32	1583 (619)	1837 (671)	0.160	0.75	0.27
Single Men	156	0.47	1520 (510)	1717 (568)	0.130	0.50	0.33
High Wealth Married Men	2997	0.45	2429 (1032)	2656 (1047)	0.093	0.34	1.48
Highly Educated Married Men	2230	0.45	2468 (1044)	2700 (1057)	0.094	0.32	1.55
Total	**6207**	**0.42**	**2147 (963)**	**2356 (1025)**	**0.097**	**0.47**	**1.10**

Table 2: Social Security Forecasts and Realizations, 1973
Selected Subgroups

Population Subgroup	Total number of observations	Fraction reporting an expectation	Mean Expectation (standard error)	Mean Realization (standard error)	Relative mean forecast error	Correlation coefficient	$MSE/10^6$
Married men	2513	0.37	2355 (1227)	2513 (1035)	0.067	0.35	1.70
Widows	386	0.52	1669 (780)	1815 (613)	0.087	0.38	0.64
Widowers	222	0.45	1788 (787)	1814 (821)	0.015	0.25	0.98
Single Women	129	0.47	1917 (719)	2041 (604)	0.065	0.51	0.45
Single Men	85	0.48	1768 (738)	1754 (863)	-0.008	0.37	0.82
High Wealth Married Men	1604	0.36	2494 (1241)	2615 (1069)	0.049	0.37	1.72
Highly Educated Married Men	1225	0.38	2395 (1255)	2660 (1065)	0.111	0.34	1.88
Total	3335	0.40	**2169 (1143)**	**2309 (995)**	0.065	0.40	1.40

likely to respond. One might conclude that the evidence on response rates does not establish a consistent pattern of intergroup differences. On the other hand, it is also possible that women become substantially more serious about planning for retirement as it approaches. Single men and widowers have relatively high response rates, and these rates change very little (a slight increase) between 1971 and 1973. In contrast, response rates for married men decline substantially over the two year interval. This phenomenon--which is confined to married men (the aggregate response rate declines simply because married men dominate the sample)--is rather puzzling. In addition, neither the response rates themselves nor the decline in these rates for married men is systematically related to wealth or education. Poor, uneducated individuals are just as likely to report expectations as their wealthy, highly educated counterparts.

I turn next to the relative mean forecast errors. The data indicate that in 1971, the average forecast was about 10% lower than the average realization. In 1973, it was about 6% lower. At this level, the data are consistent with the view that at least some of the statutory benefit increases during this period were unanticipated. Note, however, that the mean error was less that the real increase in benefit levels, so these changes were apparently not fully unanticipated (Boskin [1987] reports that the real benefit increase in 1972 was 14.1%). Furthermore, we shall see that further disaggregation casts doubt on the view that the mean forecast error is attributable to unexpected statutory changes.

A further point about the overall average forecast error deserves mention. In conducting regression analysis (see sections 5 and 6), I also calculated averages for several other variables, including current social security entitlement (CSS). Astonishingly, in 1973 the mean value of expected social security benefits differed from the mean value of current social security entitlement by only 40¢. While this may be largely coincidence, it also raises the possibility that, once individuals have reached retirement age (recall that respondents are between 62 and 67 years old in 1973), they form expectations by observing the experiences of similarly situated acquaintances who, unlike the respondent, choose to retire and receive their current entitlements.

Differences between subgroups are apparent. In 1971, married men had the smallest relative mean forecast error. Widows and single women were, on average, furthest off--their expectations tended to be very conservative. In 1973, widows and single women were still among the most conservative, but were joined by married men. The average forecast for single men was almost right on the nose. Once again, there appears to be no clear relationship with either education or wealth; if anything, the data indicate that the forecasts of educated individuals tend to be further off than those of uneducated individuals.

In the second to last collumn of Tables 1 and 2, I report the correlation coefficient between expectations and realizations. Note that this correlation is by far the highest for single women and widows --it is lowest for married men. A similar pattern is evident in 1973, although married men improved their performance relative to other groups (note that the correlations were generally lower in 1973--more on this later). Mean squared errors (the final collumn of Tables 2 and 3) also suggest that, despite their conservatism, women tend to make the most accurate forecasts, and that married men tend to make the least accurate forecasts.

I can only speculate as to the causes of this pattern. Unmarried women (especially widows) may depend more heavily upon social security benefits than other groups, and may therefore have more of a stake in acquiring accurate information. In contrast, couples may have greater access to other resources, and may therefore spend less time thinking about social security benefits. While this explanation seems plausible, it is apparently contradicted by the fact that the expectations of relatively poor married men are not systematically better than those of the relatively wealthy, despite the fact that the poor undoubtably depend upon social security to a greater extent. Conceivably, income could be correlated with ability, and ability with accuracy; this might offset any correlation arising from a diminished stake in social security.

The data in Tables 1 and 2 also allow us to draw some tentative conclusions concerning properties 1 - 4. I will take them in order.

The data for 1971 are superficially consistent with property 1 (for each subgroup, the variance of expectations is smaller than the variance of realizations). However, there are two reasons to question this evidence. First, as mentioned above, the average realization exceeds the average expectation by 10%. Assuming that this is attributable to some macro event that increased benefits proportionally across the boards, one should adjust for scale by inflating the standard deviation of expectations by 10%, in which case the data appear inconsistent with property 1. Second, the rather small differences between the standard errors of expectations and realizations suggest that relatively little new information becomes available between 1971 and retirement. The opposite conclusion is suggested by the rather low correlations between expectations and realizations. Note finally that the data for 1973 directly contradict property 1.

While the evidence seems contradictory to theory, strong inferences may be premature. In view of the fact that actual income is reported with a high level of noise (see section 3), it seems likely that expectations are also measured with error. In particular, respondents may report "ballpark figures" in surveys, despite using a more precise forecast for planning purposes. Measurement error could easily account for the apparent failure of property 1. I will return to this issue in section 6.

Next, note that the standard deviations of reported expectations are substantially higher in 1973 than in 1971. This is strongly consistent with property 2, and supports the view that individuals remember information which they used to form expectations at previous points in time.[4/] If the theory is valid, one would expect to find this pattern even in the presence of measurement error.

Properties 3 and 4 indicate that the mean square forecast error should fall, and the correlation between forecasts and realizations should rise as individuals approach retirement. A comparison of the data from 1971 and 1973 reveals precisely the opposite pattern. The mean squared errors rise for every subgroup, and the correlation coefficient falls for 5 of 7 groups. This suggests either that individuals process information incorrectly, or, contrary to my assertion in the preceding paragraph, they ignore information which they have employed at previous points in time.

Tables 3 and 4 provide a more disaggregated tabulation of the data for married men (other subgroups simply did not contain enough observations to permit similar calculations). In particular, I report the same set of items broken down by date of expected retirement. Since retirement is for the most part equivalent to realization of social security benefits, this disaggregation facilitates a more explicit analysis of properties 2 through 4. I use expected date of retirement rather than the actual date because the actual date is presumably correlated with information that became available subsequent to the survey year, and which therefore may well be correlated with forecast error.

Note first that, in 1971, the fraction of individuals reporting an expectation declines monotonically with the expected date of retirement. The same pattern holds in 1973, expect for one aberration (i.e. those expecting to retire in 1974 had an unsually low response rate). This finding contrasts with the longitudinal result noted above, that

Table 3: Social Security Forecasts and Realizations, 1971
Married Men

Year Expect to Retire	Total number of observations	Fraction reporting an expectation	Mean Expectation (standard error)	Mean Realization (standard error)	Relative mean forecast error	Correlation coefficient	MSE/10^6
1971	236	0.58	2225 (805)	2651 (1068)	0.19	0.54	1.03
1972	323	0.51	2425 (910)	2620 (1051)	0.08	0.49	1.04
1973	261	0.48	2447 (987)	2644 (966)	0.08	0.47	1.07
1974	209	0.47	2385 (892)	2611 (905)	0.09	0.35	1.10
1975	230	0.45	2381 (814)	2750 (950)	0.15	0.36	1.14
>1975	145	0.42	2358 (806)	2746 (1074)	0.16	0.46	1.15
Never retire	1176	0.37	2388 (1097)	2507 (1049)	0.05	0.28	1.67
No date reported	2169	0.43	2274 (989)	2438 (1037)	0.07	0.39	1.28
Total	**4749**	**0.43**	**2331 (981)**	**2529 (1035)**	**0.09**	**0.38**	**1.29**

Table 4: Social Security Forecasts and Realizations, 1973
Married Men

Year Expect to Retire	Total number of observations	Fraction reporting an expectation	Mean Expectation (standard error)	Mean Realization (standard error)	Relative mean forecast error	Correlation coefficient	$MSE/10^6$
1973	157	0.45	2409 (1183)	2483 (906)	0.03	0.55	1.04
1974	180	0.36	2574 (1111)	2853 (937)	0.11	0.33	1.50
1975	212	0.42	2458 (1281)	2645 (1046)	0.08	0.30	1.98
>1975	140	0.41	2355 (1227)	2513 (1035)	0.07	0.38	1.82
Never retire	524	0.27	2364 (1226)	2478 (1067)	0.05	0.30	1.87
No date reported	1296	0.38	2277 (1228)	2400 (1024)	0.05	0.34	1.72
Total	**2513**	**0.37**	**2355 (1227)**	**2513 (1035)**	**0.07**	**0.35**	**1.70**

response rates were lower in 1973.

The relative mean forecast errors in Tables 3 and 4 merit particularly close scruitiny. Consider first the results for 1971. Recall that legislative action raised benefit levels by about 20% in September of 1972, and that most analysts have thought of this as an unanticipated change. I have already suggested that the overall mean forecast error is at least partially consistent with this view. However, the disaggregated results are not. Note that respondents who expected to retire in 1971, prior to the benefit increase, had the largest mean forecast error, in most cases by a wide margin. Those expecting to retire in 1972, 1973, and 1974, after the benefit increase, had much smaller mean forecast errors, and the magnitudes of these errors fell well short of the real benefit increase. Forecast errors were somewhat larger for those intending to retire after 1974, but smallest of all for those who planned to continue working indefinitely.

A qualitatively similar pattern holds for 1973. Those expecting to retire in the current year had the smallest mean forecast error. However, the magnitude of this error declined monotically with the date of expected retirement thereafter. Indeed, the mean forecast error was relatively low for those expecting to retire after 1975, despite the fact that 1975 through 1977 was the period of double indexing.

One might object that expected dates of retirement may differ substantially from actual realizations. If, for example, those expecting to retire in 1971 actually worked on average for several more years, one would not necessarily expect this group to exhibit a systematically lower mean forecast error, even if the 1972 legislation was unanticipated. In practice, the correspondence between expected and actual dates of retirement is quite close. Analysis of the data reveals that the expected date of retirement was always the modal realization. More specifically, in 1971 approximately 40% of those who expected to retire in the current year actually did so, while in contrast only 10% of those expecting to retire in 1972 actually retired in 1971 (see Bernheim [1987b] for more details). Accordingly, under the view that the 1972 legislation was indeed unanticipated, one would be hard pressed to account for the apparent differences between subgroups.

Overall, the evidence contradicts the hypothesis that the overall mean forecast errors in 1971 and 1973 were attributable to unanticipated reforms. Individuals do not appear to form systematically less accurate forecasts during periods of legislative change.

Consider next the pattern of standard deviations on reported expectations. Property 2 suggests that these should rise as individuals age. The evidence from Tables 3 and 4 is mixed--the standard deviation does not move monotonically with expected date of retirement. This contrasts with the rather strong evidence in favor of proposition 2 arising from a pure longitudinal comparison (see above).

Turn finally to correlations and mean squared errors. Note that in 1971, the correlation between forecasts and realizations declined almost monotonically with expected date of retirement (there is a significant departure from monotonicity for the group intending to retire after 1975), while the mean squared error rose monotonically.

These results are supportive of properties 3 and 4. The general pattern is basically the same, although perhaps somewhat weaker in 1973.

Tables 3 and 4 also jointly facilitate more refined longitudinal comparisons. For those who expected to retire in any given year (e.g. 1974), i) the standard error of forecasts rises between 1971 and 1973, ii) with only one exception, the mean squared forecast error rises, and iii) the correlation between forecasts and realizations rises for some groups, and falls for others. The first observation is consistent with property 2; the second is inconsistent with property 3; and the third is weakly inconsistent with property 4. Thus, disaggregation does not alter the apparent implications of longitudinal comparisons.

One final observation of interest is that the relationship between expected and realized social security benefits for those who fail to report an expected date of retirement seems very similar to the relationship for those who do report such a date. I find this result somewhat surprising, in that an accurate forecast of one's retirement date seems essential when one is formulating an expectation about future social security benefits.

I close this section by addressing a somewhat different issue. Part of the motivation for studying expectations is to determine whether faulty expectations could be accountable for financial hardship. In the case of social security benefits, hardship could arise if individuals tended to be overly optimistic--those anticipating large benefits may make inadequate private provisions. In Table 5, I compute the fraction of each subsample for which expected benefits exceeded actual benefits

Table 5: Overly Optimistic Households: Selected Subgroups

Population subgroup	Survey Year	Fraction of Sample with forecast > realization by more than				
		5%	10%	25%	50%	100%
Married Men	1971	0.28	0.24	0.18	0.09	0.04
	1973	0.40	0.33	0.18	0.11	0.03
Widows	1971	0.15	0.13	0.09	0.04	0.01
	1973	0.30	0.24	0.15	0.05	0.01
Widowers	1971	0.16	0.15	0.10	0.04	0.01
	1973	0.28	0.22	0.08	0.04	0.01
Single Women	1971	0.10	0.10	0.08	0.06	0.00
	1973	0.33	0.23	0.08	0.05	0.00
Single Men	1971	0.21	0.21	0.12	0.09	0.07
	1973	0.29	0.20	0.12	0.05	0.00
High Wealth Married Men	1971	0.26	0.23	0.17	0.10	0.04
	1973	0.41	0.33	0.17	0.10	0.03
Highly Educated Married Men	1971	0.27	0.23	0.16	0.09	0.04
	1973	0.37	0.33	0.18	0.09	0.03
Total	**1971**	**0.25**	**0.22**	**0.16**	**0.08**	**0.03**
	1973	**0.37**	**0.30**	**0.16**	**0.09**	**0.02**

by more than 5, 10, 25, 50, and 100%. According to these data, approximately one in six individuals believes that benefits will exceed their actual levels by more than 25%; approximately one in twelve individuals expects over 50% more than they receive; and 2%-3% of all individuals receive less than half of what they expected. Widows, widowers, and single women are the most conservative groups, although single men are not far behind. Married men are the least conservative, regardless of wealth or educational attainment.

In interpreting these numbers, one should bear in mind the possibility raised earlier, that individuals may report expectations with substantial noise. If so, Table 5 may substantially exagerate the extent of excessive optimism.

Since this section has touched upon a large number of detailed points, it is useful to summarize the major findings. Women's forecasts tend to be relatively conservative, but also the most accurate of any subgroup. Married men tend to form the least conservative and least accurate expectations. Education and wealth appear to have very little to do with the quality of forecasts. Surprisingly, expectations are not systematically less accurate during periods of significant legislative changes. While many individuals are overly optimistic, this does not appear to be an especially pernicious problem for the vast majority of households.

Evidence on the theory of expectations developed in section 2 is mixed. Property 1 is generally contradicted by the data, but this is consistent with the presence of measurement error. Property 2 is weakly contradicted by cross-sectional evidence, but supported by longitudinal evidence. The reverse is true of properties 3 and 4. Overall, the evidence suggests some incomplete degree of coherence with the theory.

5. Regression Analysis

In this section I present estimates of equation (2) based upon the data and variables described in section 3. I provide separate results for 1971 and 1973. The 1971 sample contained 1949 observations, while the 1973 sample included 942 observations.

I will begin with tests of the comparatively weak hypothesis that individuals form unbiased (conditional upon whatever information they do use), although possibly inefficient expectations. That is, I estimate equation (2), omitting all informational variables, ω_t. For 1971, I obtain:

$$SSI_i = \underset{(44.8)}{1212} + \underset{(0.020)}{0.560}{*}ESS_i + \varepsilon_i$$

$$\sigma_\varepsilon^2 = 7.05 \times 10^5$$

Analysis of data for 1973 yields:

$$SSI_i = \underset{(56.6)}{1369} + \underset{(0.024)}{0.426}{*}ESS_i + \varepsilon_i$$

$$\sigma_\varepsilon^2 = 7.20 \times 10^5$$

In both cases, the intercept is large and estimated very precisely, while the slope coefficient is significantly less than unity. The point estimates imply that, if an individual responds to information by raising his expected benefits \$1, his realization will, on average, rise by roughly 50¢. This qualitative pattern persists when other informational variables are added.

Table 6 contains estimates of equation (2) where ω_t includes the full complement of informational variables described in section 3. In 1971, a large number of informational variables have statistically significant coefficients. These include the respondent's expectation of other income (EOI), current social security entitlement (CSS), age (AGE and SAGE), education (ED and SED), poor health (PH), number of children (KIDS), and compulsory retirement (COMPRET). Marital status (MAR, DIV, WID) does not appear to matter, nor does mobility (MOVE). Wealth (W) is marginally significant.

In 1973, fewer informational variables have statistically significant coefficients. As before, CSS plays an important explanatory role. Note that the 1973 regressions also include lagged expectations (this was not possible in 1971 due to data quality). LESS, the lagged value of social security benefits, appears with a very significant coefficient, which suggests that individuals may have poor memories. Aside from CSS and LESS, only ED enters significantly.

These results strongly contradict the theory of expectations outlined in section 2. Unfortunately, interpretation of the coefficients is problemmatic. Since the coefficient of ESS is in general rather small, other variables are probably explaining the magnitude of actual benefits, rather than the forecast error.

Table 6: Regressions of Realizations on Forecasts

Variable	1971	1973	Variable	1971	1973
Intercept	8708 (767)	1374 (684)	DIV	5.26 (89.3)	41.7 (86.5)
ESS	0.286 (0.019)	0.040 (0.018)	WID	22.6 (74.1)	50.2 (71.3)
ERET	13.5 (11.1)	62.8 (14.2)	AGE	-133 (12.7)	-19.7 (11.2)
DRET	-930 (817)	-4670 (1067)	SAGE	11.9 (1.99)	0.476 (2.17)
EOI/100	1.25 (0.46)	0.763 (0.613)	ED	6.54 (2.14)	5.15 (2.24)
DOI	-11.4 (50.4)	21.1 (63.4)	SED	-4.57 (2.52)	2.29 (3.07)
LESS		0.129 (0.029)	$W/10^4$	4.03 (2.17)	1.12 (2.84)
LDSS		-331 (68.3)	GH	8.05 (33.2)	-10.2 (36.3)
LERET		18.2 (14.3)	PH	-199 (49.8)	2.46 (59.1)
LDRET		-1310 (1055)	KIDS	-18.6 (7.78)	-7.71 (7.93)
LEOI/100		0.571 (0.614)	COMPRET	203 (56.5)	71.1 (41.6)
LDOI		37.2 (50.4)	MOVE	-40.4 (49.0)	-47.4 (53.4)
CSS	0.495 (0.021)	0.774 (0.025)	$\sigma^2/10^5$	4.50	2.60
MAR	-148 (131)	242 (135)			

It would, however, be premature to reject the theory on the basis of this evidence alone. As mentioned in section 4, there is some indication that reported expectations are rather noisy. Measurement error could account for the positive intercept and small slope coefficient. Other informational variables (especially CSS and LESS) might then help to filter out the noise, in which case they would appear with spuriously significant coefficients. These observations motivate the analysis of section 6.

6. A Treatment of Measurement Error

In this section, I devote serious attention to the possibility that expected benefits are measured with error. I adopt two separate estimation strategies. The first is to regress forecast errors on information; the second is to reestimate the regressions of section 5, instrumenting for expected benefits. I devote a separate subsection to each of these approaches. The section closes with an analysis of "true" forecast errors.

A. Forecast Error Regressions

For motivation, I return to the analysis of section 2. Note that one can rewrite equation (1) as

$$X - X_t^e = \varepsilon_t \tag{3}$$

where ε_t is uncorrelated with X_t^e. Suppose we observe X_t^e with error. In particular, survey responses measure $\tilde{X}_t^e$, where

$$(4) \qquad \tilde{X}_t^e = X_t^e + \mu_t \quad ,$$

and where X_t^e and μ_t are uncorrelated. Substituting (4) into (3), we obtain

$$(5) \qquad X - \tilde{X}_t^e = \varepsilon_t - \mu_t \quad .$$

By hypothesis ε_t is uncorrelated with available information. It is also plausible to assume that μ_t is unrelated to other contemporaneous variables, including the measurement error on these variables. Accordingly, equation (5) suggests the following regression framework:

$$(6) \qquad X_i - \tilde{X}_{it}^e = \alpha + \omega_{it}\gamma + (\varepsilon_{it} - \mu_{it}) \quad .$$

Theory predicts that $\alpha = \gamma = 0$. Estimates of (6) are not only robust with respect to measurement error, but also easily interpretable: from the coefficients γ, one can infer the manner in which individuals misuse information when constructing forecasts.

Estimates of equation (6) are presented in Table 7. I begin with the results for 1971. Note first that the intercept is usually statistically significant, which, strictly speaking, is contrary to theory. However, neither expected date of retirement nor expected other income appears with a significant coefficient. This supports the hypothesis that individuals employ an internally consistent set of information when formulating expectations.

CSS continues to play an important explanatory role, which strongly suggests that individuals ignore much of the information

Table 7: Forecast Error Regressions

Variable	1971	1973	Variable	1971	1973
Intercept	3313 (1004)	-622 (1412)	WID	16.2 (98.6)	-2.71 (147)
ERET	3.68 (14.8)	58.0 (29.4)	AGE	-55.7 (16.6)	4.93 (23.2)
DRET	-240 (1087)	-4226 (2205)	SAGE	10.3 (2.65)	-1.54 (4.49)
EOI/100	-1.05 (0.612)	-1.40 (1.26)	ED	4.41 (2.85)	3.03 (4.63)
DOI	-46.1 (67.0)	53.7 (131)	SED	-9.34 (3.34)	-7.03 (6.32)
LESS		0.008 (0.061)	$W/10^4$	9.75 (3.18)	10.7 (5.86)
LDSS		-238 (141)	GH	-14.6 (44.2)	-63.7 (74.9)
LERET		-4.35 (29.4)	PH	-118 (66.2)	184 (122)
LDRET		193 (2179)	KIDS	-9.82 (10.3)	-22.0 (16.4)
LEOI/100		-0.509 (1.27)	COMPRET	113 (75.1)	81.2 (86.0)
LDOI		120 (104)	MOVE	-39.5 (65.1)	27.2 (110)
CSS	0.287 (0.027)	0.262 (0.047)	$\sigma^2/10^5$	7.96	11.01
MAR	-434 (174)	188 (280)			
DIV	22.5 (119)	-24.0 (179)			

enbodied in current statutes. The coefficient of CSS is, however, substantially smaller than in section 5, which is consistent with the view that CSS was, in part, filtering the noise in ESS.

Married individuals tend to make high forecasts relative to realizations--this conclusion is consistent with the simple tabulations of section 3. The other marital status dummies are insignificant.

AGE and SAGE both appear significantly. The negative coefficient on AGE implies that older individuals tend to make high forecasts relative to realizations. Since the overall mean of expected benefits is lower than the mean realization, this implies that individuals tend to make more accurate forecasts as they approach retirement. While this accords with intuition, note that SAGE has the opposite effect.

SED comes in significantly negative. This implies that men with highly educated spouses tend to make less conservative, and more accurate forecasts of benefits. In contrast, the coefficient of ED is statistically insignificant.

Wealth enters with a significantly positive coefficient, which implies that wealthier individuals tend to be more pessimistic relative to realizations--in this sample, they are on average further off the mark. This result is consistent with the view that poorer individuals have a greater stake in finding out about their social security benefits. Finally, neither GH, PH, COMPRET, nor MOVE enters with a significant coefficient.

Turn next to the results for 1973. Surprisingly, ERET appears with a significant coefficient, which suggests that individuals may not form expectations on the basis of an internally consistent set of information. However, note also that the coefficient of LESS falls to zero. This is consistent with the view that the coefficient of LESS was significant in section 5 only because ESS was measured with error. Furthermore, it supports the hypothesis that individuals do not ignore information which they have used in the past.

As in 1971, the coefficient of CSS is still very significant, although once again its magnitude has declined. Note also that none of the other demographic variables or other individual characteristics enter significantly. Only the coefficient of wealth appears to be even marginally significant.

In summary, these results suggest that although individuals ignore information embodied in current statutes, they do recall the bulk of information used in the past, and for the most part base all their expectations on the same set of information. There is mixed evidence concerning the roles of marital status, age, and education. The partial correlation between wealth and forecast errors is marginally significant. Individual characteristics seem less important in 1973 than in 1971, which is consistent with the view that individuals get serious about planning for retirement as the date of retirement becomes more imminent (the apparent role of age confirms this view). Overall, these results suggest at least a partial degree of coherence with the theoretical framework of section 2.

B. Instrumented Regressions

The classic remedy for measurement error is, of course, the use of instrumental variables. One requires an instrument that is uncorrelated with both ε_t and μ_t, but correlated with X_t^e. Accordingly, valid instruments must be related to information which the invididual actually uses to construct X_t^e. Thus, one necessarily tests the basic expectations hypothesis jointly with the assumption that individuals use certain information (i.e., that contained in the instruments) efficiently.

This approach confers two important advantages. First, it allows one to estimate β. This facilitates a more powerful test of the theory. In addition, one can also allow for the possibility that, due to the "macro" events problem discussed earlier, the scales of expectations and realizations differ slightly. Second, it allows one to separate true forecast error from measurement error. I persue this second point in the next subsection.

The choice of instruments is completely arbitrary: one can employ any informational variable, and perform the associated joint test. I present results based upon the plausible assumption that individuals' expectations are internally consistent (i.e., all expectations are based on the same information). Accordingly, I instrument with the concurrent expectational variables.

As in section 4, I begin with tests of the comparatively weak hypothesis that individuals form unbiased (conditional upon information contained in other forecasts, and whatever other information they use), although possibly inefficient expectations. That is, I estimate equation (2), omitting all informational variables, ω_t, and instrumenting with expectational variables. For 1971, I obtain:

$$SSI_i = \underset{(175)}{122} + \underset{(0.085)}{1.09}{*}ESS_i + \varepsilon_i$$

$$\sigma_\varepsilon^2 = 9.65 \times 10^5$$

Analysis of data for 1973 yields

$$SSI_i = \underset{(245)}{-57.1} + \underset{(0.118)}{1.12}{*}ESS_i + \varepsilon_i$$

$$\sigma_\varepsilon^2 = 13.58 \times 10^5$$

These results are quite striking. In both cases, the intercept becomes insignificant, as predicted by theory. The slope coefficient for 1971 is 1.09, which is consistent with the observation that forecasts are, on average, about 9% lower than realizations. The slope coefficient for 1973 is slightly larger. In both cases, the standard errors are not terribly large. These estimates strongly support the view that, after a small scale adjustment, reported expectations are unbiased estimates of realizations, conditional upon the information contained in other forecasts, and whatever other information individuals actually use. Results to the contrary (section 5) are apparently attributable to measurement error.

It is also possible to test jointly for the correct usage of other information. Accordingly, Table 8 presents regressions of realized benefits on expected benefits (instrumented), current social security

Table 8: Instrumented Regressions

Variable	1971	1973	Variable	1971	1973
Intercept	5938 (1305)	1470 (974)	COMPRET	184 (62.5)	66.1 (53.2)
ESS	0.676 (0.126)	0.489 (0.193)	MOVE	-41.5 (54.2)	-0.06 (71.0)
CSS	0.383 (0.043)	0.548 (0.116)	$\sigma^2/10^5$	5.53	4.51
MAR	-304 (155)	180 (182)			
DIV	13.6 (98.9)	-0.662 (115)			
WID	18.6 (82.1)	13.6 (95.8)			
AGE	-94.0 (19.9)	-25.7 (15.4)			
SAGE	11.1 (2.22)	-0.003 (2.85)			
ED	5.58 (2.45)	4.84 (3.06)			
SED	-7.27 (2.95)	-0.900 (4.58)			
$W/10^4$	6.81 (2.16)	4.75 (2.55)			
GH	-5.65 (37.4)	-20.6 (48.2)			
PH	-158 (57.3)	84.9 (87.5)			
KIDS	-13.7 (8.81)	-11.2 (10.7)			

entitlement, and various individual characteristics, for 1971 and 1973, respectively. In both equations, CSS still enters significantly (in fact, ESS and CSS roughly divide up the original coefficient on ESS), although, as expected, the coefficient of CSS is lower than in section 5. This result confirms the view that individuals ignore information embodied in current statutes. In 1971, AGE, SAGE, ED, SED, W, and PH all enter significantly, while MAR is marginal. The direction of each effect is essentially the same as in section 6A. In 1973, nothing besides ESS and CSS is statistically significant (AGE and W come closest). Once again, it appears as though individuals used information better in 1973, when they were closer to retirement, than in 1971.

As mentioned at the outset of this subsection, there are a variety of candidates for instrumental variables. The alternative employed above is not only intuitively appealing, but also yields results that are highly consistent with the basic theory. However, I have also estimated equation (2) with other instruments. One set of estimates tested the basic expectations hypothesis jointly with the assumption that respondents make proper use of available data on demographic characteristics when formulating expectations (i.e., I used variables in the third category as instruments). Once again, the results supported the view that, after a small scale adjustment, reported expectations are unbiased estimates of realizations, conditional upon demographic variables and whatever other information individuals actually use. The pattern of coefficients on the informational variables corroborated the findings of section 6B. I omit a complete tabulation of the results in order to conserve space.

One could also estimate equation (2) by using CSS as an instrument, thereby testing the basic expectations hypothesis jointly with the assumption that individuals efficiently use all of the information contained in CSS. Since the preceding evidence uniformly contradicts this assumption, it is hardly surprising that the associated results (omitted) are non-sensical.

To summarize, estimates with instrumental variables support the joint hypotheses that individuals form all of their expectations on the basis of the same information, and that expectations about social security benefits are unbiased (conditional upon whatever information is used to construct them) up to a small scale adjustment. Individuals do not, however, make efficient use of all available information. Most importantly, they tend to ignore information embodied in statutory entitlements. In addition, there is some evidence that forecast errors are correlated with age, education, wealth, and health.

C. Recovering True Forecast Errors

One of the central objectives of this study is to assess the accuracy of individuals' expectations. If expectational variables are contaminated by measurement error, then inferences based upon simple indeces of accuracy can be highly misleading. Specifically, the variance of the observed forecast error reflects both the variance of the true forecast error, and the variance of the measurement error (see equation (5)).

Fortunately, it is possible to recover the variance of the true forecast errors through IV estimates, such as those presented in section 6B. I provide a detailed description of the procedure in appendix B. In essence, one recovers the variance of the measurement error by comparing OLS estimates from a regression of SSI on ESS with IV estimates. One then computes the variance of the true forecast error as a residual from the variance of the IV regression error. One can also use this procedure to assess the net reduction in true forecast error that would result from incorporating new information into the forecast.

To emphasize the importance of correcting for measurement error, I begin by presenting the unadjusted variances of regression errors (Table 9). The first row of Table 9 simply provides, as a basis for comparison, the population variance of realized social security income for 1971 and 1973, respectively. The second row contains the variances of error terms from IV estimates (using expectational variables as instruments) of the regressions reported in the text of section 6B (i.e. SSI on an intercept and ESS). The next three rows contain the variances of error terms from IV estimates of regressions that also incorporate other informational variables. The regressions corresponding to the entries in the final row appear in Table 8; I omit a complete tabulation of the other regression results in order to conserve space.

If we ignore the fact that regression errors are contaminated with measurement error, then the following picture emerges. In 1971, private forecasts explained almost none of the population variance in realized benefits. In 1973, these forecasts were actually worse than simply

Table 9: Variance of Regression Errors

Independent Variables	Variance of Regression Error/10^5 1971	1973
Intercept Only	9.91	9.59
ESS	9.65	13.58
ESS and CSS	8.36	8.89
ESS and demographics	6.93	8.99
ESS, CSS, and demographics	5.53	4.51

naming the population mean--a finding that is clearly at odds with the hypothesis that individuals use information rationally. While a significant improvement results from augmenting the information contained in ESS with CSS (current entitlements), the proper use of demographic information seems, on the whole, more important.

When we adjust the numbers in Table 9 for the presence of measurement error in order to obtain the variance of true forecast error, a dramatically different picture emerges (see Table 10). Private forecasts for 1971 now explain 56% of the variance in realized benefits; 1973 forecasts explain 65% of the variance. Note in particular that, as predicted by theory, the explanatory power of these forecasts is clearly better in 1973 than in 1971. This finding contrasts sharply with the results of simple data tabulations (section 4), which in general produce longitudinal patterns that are unfavorable to the expectations hypothesis. We now see that these negative findings are largely attributable to measurement error.

Table 10 also suggests that individuals make excellent, although incomplete use of available information. Augmentation of forecasts with demographic information would achieve a minimal gain (less than a 5% reduction in residual forecast error variance) in 1971, and no gain at all in 1973. On the other hand, augmentation with information about statutory entitlements (CSS) could achieve a reduction in residual forecast error variance of between 14% and 17%. Thus, CSS emerges as the most important piece of information that individuals fail to incorporate fully into their forecasts.

Table 10: Variance of Forecast Errors

Variables used for forecast	Variance of Forecast Error/10^5	
	1971	1973
Intercept only	9.91	9.59
ESS	4.34	3.34
ESS and CSS	3.70	2.77
ESS and demographics	4.14	3.49
ESS, CSS, and demographics	3.50	2.56

I close this section with one final remark. While the existence of measurement error is fully consistent with the results of this section, there is another interpretation of the model described in equations (3) through (6). Specifically, individuals may not know the true empirical model, and may form expectations, $\tilde{X}_t^e$, that are related as in equation (5) to the objective expectation, X_t^e, by some randomly distributed term, μ_t, reflecting idiosynchracies of the individual's calculations. Under this view, one must adjust one's reading of my results slightly. Specifically, the IV estimates indicate that individuals on average form unbiased expectations. Furthermore, the calculations of this subsection apply to the variance of the forecast error for a particular individual (i.e., after adjusting the mean for the idiosynchratic component), rather than to the population variance.

7. Concluding Remarks

The evidence in this paper indicates partial coherence with the theory of expectations outlined in section 2. In addition, inspection of the data reveal several interesting patterns. I have already summarized these patterns in the introduction.

One pattern does, however, deserve further comment, in that it has an obvious policy implication. Specifically, the bulk of the evidence indicates that individuals are simply not completely familiar with their current statutory entitlements. Presumably, the government could improve individuals' forecasts, and hence financial planning, by providing this information. Indeed, there is a precedent in the private sector. TIAA-CREF provides participants with an annual statement, which specifies the level of annuity benefits available upon immediate retirement, and projections of benefits based on assumptions about continued employment. Presumably, the Social Security Administration could provide each participant with similar information. If necessary, the program could be restricted to individuals over a certain age. According to my findings, most individuals would find this quite useful.

This paper leaves many important questions unanswered. In subsequent work, I plan to focus on the evolution of expectations, testing the hypothesis that expectations follow a random walk, and examining the manner in which individuals revise forecasts when confronted with new information. In addition, I plan to explore the link between expectations and behavior.

Appendix A

Equation (1) can be rewritten as

$$X = X_t^e + \varepsilon_t \quad , \tag{A.1}$$

where

$$E(\varepsilon_t | \Omega_t) = 0 \quad . \tag{A.2}$$

From (A.1) and (A.2), it is evident that

$$\text{var}(X) = \text{var}(X_t^e) + \text{var}(\varepsilon_t) \tag{A.3}$$

Accordingly, we obtain

$$\text{var}(X) < \text{var}(X_t^e) \quad , \tag{A.4}$$

which is property 1.

Next, note that

$$\begin{aligned} E(X_{t+1}^e | \Omega_t) &= E(E(X|\Omega_{t+1})|\Omega_t) \\ &= E(X|\Omega_t) = X_t^e \quad , \end{aligned} \tag{A.5}$$

from which it follows that

$$X_{t+1}^e = X_t^e + \eta_t \tag{A.6}$$

where

$$E(\eta_t | \Omega_t) = 0 \quad . \tag{A.7}$$

From (A.6) and (A.7), it is clear that

(A.8) $$\text{var}(X^e_{t+1}) = \text{var}(X^e_t) + \text{var}(\eta_t) \quad ,$$

which gives us

(A.9) $$\text{var}(X^e_{t+1}) > \text{var}(X^e_t) \quad ,$$

which is property 2.

Further properties follow from combining equations (A.1) and (A.6). In particular, recursive substitution yields

(A.10) $$\varepsilon_t = \varepsilon_{T-1} + \sum_{\tau=1}^{T-2} \eta_\tau \quad .$$

since η_t is an element of the information set Ω_{t+1}, (A.2) and (A.7) then imply that

(A.11) $$\text{var}(\varepsilon_t) = \text{var}(\varepsilon_{T-1}) + \sum_{\tau=t}^{T-2} \text{var}(\eta_\tau)$$

Accordingly, we see that $\text{var}(X - X^e_t)$ is declining in t (property 3).

The final property of interest concerns the correlation between forecasts and realizations, $\rho(X,X^e_t)$. Note that

(A.12) $$\begin{aligned}\rho(X,X^e_t) &= \text{cov}(X,X^e_t)[\text{var}(X)\text{var}(X^e_t)]^{-1/2} \\ &= \text{var}(X^e_t)[\text{var}(X)\text{var}(X^e_t)]^{-1/2} \\ &= [\text{var}(X^e_t)/\text{var}(X)]^{1/2} \quad ,\end{aligned}$$

where the second equality follows from (A.1) and (A.2). Combining (A.12) with (A.9), we see that $\rho(X,X^e_t)$ is increasing in t (property 4).

Note that equation (A.6) suggests a regression much like equation (2), and could be used as the basis for additional tests. Although I do not exploit this relationship here, I do plan to examine the evolution of expectations in future work.

Appendix B

Consider the forecasting equation

$$Y_i = \alpha + \beta X_i^* + \varepsilon_i \quad . \tag{A.13}$$

Let

$$X_i = X_i^* + \eta_i \quad , \tag{A.14}$$

and suppose that $E(\varepsilon_i \eta_i) = E(X_i^* \eta_i) = E(X_i^* \varepsilon_i) = E(\varepsilon_i) = E(\eta_i) = 0$. Suppose further that we observe X_i, rather than X_i^*. Substitution of (A.14) into (A.13) yields

$$Y_i = \alpha + \beta X_i + (\varepsilon_i - \beta \eta_i) \tag{A.15}$$

Let $\xi \equiv \varepsilon - \beta\eta$, so that

$$\sigma_\xi^2 = \sigma_\varepsilon^2 + \beta^2 \sigma_\eta^2 \quad . \tag{A.16}$$

Now let $\hat{\beta}_{OLS}$ be the OLS estimate of β. As is well known,

$$\beta_{OLS} \equiv \text{plim } \hat{\beta}_{OLS} = \beta\left(\frac{\sigma_x^2 - \sigma_\eta^2}{\sigma_x^2}\right) \tag{A.17}$$

From this is follows that

$$\sigma_\eta^2 = \sigma_x^2 (1 - \beta_{OLS}/\beta) \tag{A.18}$$

One obtains a consistent estimate, $\hat{\sigma}_x^2$, of σ_x^2 simply by computing the population variance of X. $\hat{\beta}_{OLS}$ is a consistent estimate of

β_{OLS}. Finally, the IV estimator, $\hat{\beta}_{IV}$, is a consistent estimate of β. Thus,

(A.19) $$\hat{\sigma}_n^2 \equiv \hat{\sigma}_x^2(1 - \hat{\beta}_{OLS}/\hat{\beta})$$

is a consistent estimator for σ_η^2. One obtains a consistent estimate, $\hat{\sigma}_\xi^2$, of σ_ξ^2 from the IV regression. From (A.16), it is then clear that

(A.20) $$\hat{\sigma}_\varepsilon^2 = \hat{\sigma}_\xi^2 - \hat{\beta}_{IV}^2\sigma_\eta^2$$

is a consistent estimator for the true forecast error, σ_ε^2.

Next suppose that we augment the original forecast with some vector of informational variables, Z_i, so that

(A.21) $$Y_i = a + bX_i^* + Z_i c + e_i \quad ,$$

and

(A.22) $$Y_i = a + bX_i + Z_i c + (e - b\eta_i) \quad .$$

Let $s_i \equiv e_i - b\eta_i$, so that

(A.23) $$\sigma_s^2 = \sigma_e^2 + b^2\sigma_\eta^2$$

IV estimation of (A.22) yields consistent estimates, $\hat{\sigma}_s^2$ and $\hat{b}_{IV}$, of σ_s^2 and b. We have already derived a consistent estimator, $\hat{\sigma}_\eta^2$, of σ_η^2. Thus,

(A.24) $$\hat{\sigma}_e^2 \equiv \hat{\sigma}_s^2 - \hat{b}_{IV}^2\hat{\sigma}_\eta^2$$

is a consistent estimator for the variance of the error term from the augmented forecast.

Footnotes

1/ Here, I abstract from the possibly that T is itself uncertain. I take this issue up in Bernheim [1987b].

2/ Since the variance of ε_{it} should, according to theory, depend upon t, heterostedasticity is a potential problem. I have ignored this issue throughout. Calculated standard errors may therefore be somewhat inaccurate.

3/ The RHS does not include married women as a separate respondent category. When surveying couples, the RHS always classifies the husband as "respondent," and the wife as his spouse. In this study, data on social security benefits for married men include their spouse's benefits. For purposes of categorization, I take the dividing lines for high wealth and high education to be $20,000 and tenth grade, respectively--these figures correspond roughly to medians.

4/ Of course, the 1973 sample is not identical to the 1971 sample, so caution is warranted. However, the average respondent in 1973 is 1.6 years older than the average respondent in 1971, and accordingly more advanced in the life cycle. It is therefore appropriate to evaluate properties 2-4 by comparing data from 1971 and 1973.

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