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CAN PEOPLE COMPUTE? AN EXPERIMENTAL TEST OF THE LIFE CYCLE CONSUMPTION MODEL

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An Experimental Test of the Life Cycle Consumption Model

ABSTRACT

This paper presents the results of an experimental study of the life cycle model in which subjects were asked to make preferred consumption choices under hypothetical life cycle economic conditions. The questions in the experiment are designed to test the model's assumption of rational choice and to elicit information about preferences. The subjects' responses suggest a widespread inability to make coherent and consistent consumption decisions. Errors in consumption decision-making appear to be very substantial and, in many cases, systematic. In addition, the experiment's data strongly reject the standard homothetic, time-separable life cycle model.

The principal specific findings of the laboratory experiment are:

(1) Subjects displayed significant inconsistencies in their consumption decisions; each of the subjects, in at least two pairs of economically identical situations, chose consumption values that differed by 20 percent or more. From the perspective of the standard life cycle model, error in decision-making accounts, on average, for roughly half of the variation in consumption.

(2) A sizeable fraction of subjects undervalued future earnings relative to present assets; i.e., they systematically overdiscounted future earnings.

(3) Almost all subjects exhibited oversaving behavior, apparently because they underestimated the power of compound interest.

(4) The hypothesis that intertemporal consumption preferences are uniform across individuals is strongly rejected. Indeed, the demographic characteristics of subjects are significant determinants of consumption choice in the experiment.

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1. Introduction.

The assumption of rational choice is a cornerstone of modern economic theory. Rational choice requires that individuals correctly value their present and future resources, that they make consistent decisions, and that they obey the axiom of revealed preference. This paper presents the results of an experimental study of consumption in which subjects were asked to make consumption decisions under hypothetical economic conditions. The questions in the experiment are designed to test the assumption of rational choice and to elicit information about preferences. The subjects' responses suggest a widespread inability to make coherent and consistent consumption decisions. Errors in consumption decision-making appear to be substantial and, in many cases, systematic. In addition, the experiment's data strongly reject the standard life cycle model of consumption choice.

The principal specific findings of the laboratory experiment are as follows: i) Subjects displayed significant inconsistencies in their consumption decisions; each of the subjects, in at least two pairs of economically identical situations, chose consumption values that differed by 20 percent or more. From the perspective of the standard life cycle model, error in decision-making accounts, on average, for roughly half of the variation in individual consumption choices. (ii) A sizeable fraction of subjects valued discounted future earnings less than present assets. iii) Almost all subjects exhibited oversaving behavior, apparently because they underestimated the power of compound interest. iv) The hypotheses that intertemporal consumption preferences are either homothetic or uniform across individuals are strongly rejected. v) Consumption choice is only weakly correlated with subjects' stated intertemporal preferences.

In recent years an increasing body of research in experimental economics has sought to test many of the basic axioms of economic theory. Important

experimental studies of rational decision-making include those of Allais and Hagen (1979), Grether and Plott (1979), Kahneman and Tversky (1979), and Tversky and Kahneman (1974). Laboratory exeriments have been used to study market and non-market institutions including competitive markets (Smith, 1967), oligopolistic price setting (Plott, 1982), public goods mechanisms (Smith, 1982), auctions, (Cox, Smith, and Walker, 1985), and bargaining and negotiation procedures (Samuelson and Bazerman, 1985). To our knowledge, however, this is the first experiment of consumption behavior.

Our laboratory experiment tests directly the life cycle model of saving (Modigliani and Brumberg, 1954; Ando and Modigliani, 1963). A large body of theoretical and empirical research is based on the life cycle model. Its influence on research and macro economic policy notwithstanding, tests of the life cycle model with field data have proven inconclusive for reasons of data quality, inability to identify the consumer unit, incomplete knowledge of the consumer unit's information set, and lack of information about financial and other constraints confronting the consumer. It has proved particularly difficult to test directly the model's most basic assumption of intertemporal optimization by consumers. Recourse to experimental testing is, therefore, attractive because it alleviates a host of data and information problems.

The experiment was implemented by an interactive computer program in which subjects key in consumption choices in response to a series of questions. Forty-nine subjects (MBA students and undergraduates at Boston University) were paid to participate in the life-cycle simulation. Subjects were asked what consumption choices they would make if they were single, faced no uncertainty, had specified levels of future earnings and current assets, knew their ages of retirement and death, and could borrow and save at a specified interest rate.

The experiment presents subjects with two kinds of decision tasks. In Parts I, II, and VI of the experiment subjects are asked to make consumption and savings decisions year by year over their life cycle (from age 35 until death at age 75). In the other parts of the experiment subjects made single year consumption choices under varying economic conditions (asset levels, earnings, interest rates). With the experiment's data one can examine whether subjects tend to over- or under-save, whether subjects make identical consumption choices in economically equivalent (but different) situations, whether preferences are homothetic, and whether the present value of labor earnings and current assets, which together constitute the present value of resources, have an equal impact on consumption spending.

As experimental economists (see Vernon Smith, 1982) have forcefully argued, in certain respects experimental data permit more effective tests of theoretical models than does field data. The advantages of experimental analysis are those of control and measurement: the experimenter can control perfectly the exogenous economic environment and can measure all relevant economic variables without error. Since field data is subject to measurement errors and lack of controls, it may be difficult or impossible to determine from nonexperimental data whether changes in behavior are due to differences in preferences or economic circumstances as opposed to non-optimizing behavior.

The countervailing criticism of the experimental approach, of course, is that individual behavior in laboratory experiments may differ from real world decision-making. Vernon Smith (1982) uses the term "parallelism" to denote the extent to which the laboratory setting mimics the real world. In our view, the parallelism issue in our experimental setting is a matter of degree. Certainly our experimental setting is far simpler than the real

world setting. However, parallelism need not be diminished (indeed, it may be enhanced) by simplification as long as the main factors affecting behavior in actual practice are captured in the design of the experiment. Though simplified, the description of the life-cycle setting contained in the experiment certainly resembles the kind of consumption and saving choices faced by individuals in their own lives.

Granted that the settings are parallel, it is obvious that both the analytical resources available to the individual and his decision-making incentives may differ between the experiment and the real world. In making real world consumption and saving choices individuals have more time and incentive to consider their decisions and to revise them. They also have the option to avail themselves of expert advice and observe the behavior of their friends and relatives. On the other hand, real world intertemporal optimization problems are far more complex than those presented in our experiment. They involve a variety of uncertainties and financial constraints, problems of joint utility maximization in the case of families, and significant problems of information updating. Furthermore, our own casual empiricism suggests that individuals do not freely discuss their saving decisions, that the number who consult accountants and other professionals on these matters is relatively small, and that many individuals make their decisions without significant analysis. Thus, in providing responses to the experiment's questions, subjects may be acting quite similarly to the way they would act if actually faced with the comparable situation in the real world. Hence, experimental analysis may shed considerable light on actual consumption and saving decisions.

The paper is organized as follows. Section 2 provides a summary and review of the testable implications of the life cycle model of

consumption under certainty. Section 3 describes the design of the experiment and the subject population, and Section 4 presents the main results. Section 5 summarizes the findings and indicates our plans for additional experimental research on consumption.

2. Testable Implications of the Life Cycle Model Under Certainty.

The life cycle model under certainty posits that an individual chooses his consumption spending over his lifetime to maximize a concave utility function:

$$(1) \qquad U = U(C_1,\ldots,C_d) \quad \text{subject to}$$

$$(2) \qquad \sum_{j=1}^{d} C_j \prod_{s=2}^{j} R_s = A_1/R_1 + H_1$$

where C_j is consumption at age j, d is the age of death, $R_s = 1/(1+r_s)$ where r_s is the interest rate at time s, A_1 is initial assets, and H_1 is the present value of labor earnings (human wealth) as of age 1.

The fundamental presumption of this intertemporal optimization problem is that the individual's life-time consumption and savings decisions are made without error. Thus, in an experimental setting that imposes constraint (2), a subject should make consumption decisions in precise accordance with life-cycle predictions. Two implications, stated as hypotheses, follow immediately from the general model.

> Hypothesis i: The individual should exhaust his resources at the time of his death (there are no left-over assets).
>
> Hypothesis ii: An individual's consumption choice in a given year depends directly on the present value of resources and is independent of the mix of assets and the present value of life-time labor earnings.

In addition, if consumption at each age is a normal good we have:

> Hypothesis iii: An increase in the present value of resources leads to increases in consumption at each age.

If the utility function is homothetic and time separable, utility can be written as:

$$(3) \qquad U = v(C_1) + \beta v(C_2) + \ldots + \beta^{d-1} v(C_d)$$

where $\beta = 1/(1+\delta)$, and δ is the individual's time preference rate. In this case, the individual's optimal consumption expenditure at age j can be expressed as:

$$(4) \qquad C_j = PVR_j / \left[\sum_{s=j}^{d} \pi_{i=j+1}^{s} R_i h(R_i/\beta) \right]$$

where PVR_j is the present value of resources at age j, and where the function $h^{-1}(\ )$ is the marginal rate of substitution between consumption at different dates, i.e.,

$$(5) \qquad C_{s+1}/C_s = h(R_{s+1}/\beta)$$

From (4) and (5), one sees that the assumption of separable utility implies the following strengthening of hypothesis iii:

> Hypothesis iiib: With the time path of the interest rate held constant, consumption in a given year is proportional to the present value of resources as of that date. Equivalently, the average and marginal propensities to consume are equal and independent of the level of PVR_j.
>
> Hypothesis iiic: If the interest rate is constant an individual's average and marginal propensities to consume are increasing functions of age.

Hypothesis iiic holds since when the interest rate is constant the right-hand side divisor in (4) is a smaller sum the larger is the initial age j at which the summation begins.

Finally, in the case that the utility function is of the isoelastic form

$$(6) \qquad v(C_s) = C_s^{1-\lambda}/(1-\lambda)$$

expression (5) can be rewritten in logs as

$$(5') \qquad \log(C_{s+1}/C_s) = -1/\lambda \log\beta + 1/\lambda \log R_{s+1}.$$

In this instance, one can regress the log of the ratio of consumption in adjacent periods on a constant plus an the log of R_{s+1} and, thereby, estimate β and λ.

3. Description of the Experiment.

The life-cycle experiments were conducted at Boston University in three sessions using paid student volunteers as subjects. The majority of subjects were MBA students; the others were undergraduate business majors and graduate economic students. There was no time limit for completing the computerized questionnaire. Most subjects took about an hour and a half to finish; some finished within an hour, and some took as long as two hours. Collaboration of any kind and the use of calculators were prohibited. Sixty students completed the questionnaire. However, eleven questionnaires were excluded from the analysis either because they contained key punch errors or because the subject failed to complete one or more sections. Therefore, the results to be discussed are based, in most cases, upon 49 sets of responses.

It was strongly and repeatedly emphasized at the beginning of the experiment that subjects do their best to respond to all questions on the basis of what would make them most happy given the situation described. Furthermore, subjects were told that if they were conscientious in expressing their true preferences they would receive a bonus at the end of the experiment. In Parts I and II of the questionnaire, subjects were reminded that they should attempt to spend all of their earnings over their lifetimes. The Appendix reproduces the experimental questionnaire as well as the instructions.

The questionnaire's basic economic setting can be summarized as follows. The individual in the experiment has just turned 35 and will live to his 75th birthday on which day he dies (with certainty). In his job he earns an annual salary of $25,000 until he retires on his 65th birthday — that is, he works for thirty years and is retired for ten. The individual can save or borrow as much money as he wishes at 4 percent interest. Subjects were instructed that in the questionnaire setting there is no inflation, deflation, or taxes, no dependents to support, no current or potential health problems, and no uncertainty about the future. All durable goods are rented by the year. Finally, it was assumed that annual consumption expenditures occur and the labor earnings are received on January 1st of each year and that the individual's birthday is also January 1st.

The computer questionnaire consists of eight parts soliciting annual consumption spending choices for various combinations of age, assets, interest rates, future earnings, and retirement ages. In total, each subject makes 145 such choices. Part I asks the subject to specify his desired level of consumption spending for each year from age 35 to 75. In this section, the subject receives no feedback concerning the level of assets accumulating

(at 4% interest) in his savings account. Part II solicits the same information, but updates the subject's asset position before each annual consumption decision is made.

In Parts III through V subjects are asked to make consumption choices for four ages — 35, 46, 55, and 69 — under varying economic conditions. In Part III subjects report consumption choices at these ages at different levels of assets (with future earnings unchanged). Part IV varies the individual's retirement age (with the level of assets and annual earnings fixed). Part V varies the stream of earnings (with assets and the age of retirement fixed.) In Parts VI and VII subjects report consumption decisions under varying interest rates. Finally, Part VIII asks subjects to rank in order of preference five life-time consumption profiles.

In all parts, except Part I, subjects were prompted to make their consumption decisions sequentially, i.e. although they were allowed to modify a current response, they were not allowed to return to modify previously given answers. In addition, subjects were prohibited (and prevented by the computer program) from returning and changing any previously completed part of the experiment.

Several economic situations were repeated more than once to permit tests of consistency in the subjects' choices. For example, in Part III subjects were asked to choose consumption spending at ages 35, 46, 55, and 69 given the same amount of assets and same lifetime earnings they had at those ages in Part II. In this, as in other cases of exactly identical circumstances, subjects were not alerted to the fact that the circumstances were identical. Other pairs of situations, while not precisely the same, presented the subjects with the same present value of resources (assets plus the present value of future earnings) at the same age, but differed in the relative

contribution of assets and earnings to total resources. In addition, several pairs had the same level of assets and present value of labor earnings, but differed with respect to the life-time profile of earnings.

Subjects were asked to make nine consumption decisions at age 35, three pairs of which had the same present value of resources. For age forty-six, there were thirteen decisions, including four pairs with the same present value of resources. For age 55 there were nine decisions, including four pairs with the same resources, and for age 69 there were seven decisions, including one pair with the same resources.

Listed below is a brief summary of the eight parts of the consumption experiment.

Part I—Annual Consumption Choices Without Feedback

In this section the subject is asked to choose the level of annual consumption spending for each year from age 35 to age 74, inclusive (40 choices in all). The subject is allowed to modify his consumption choices until he is satisfied with them, but throughout he receives no information about his accumulated balance in his savings account.

Part II—Annual Consumption Choices With Savings Feedback

Again, the subject reports his annual consumption expenditure for each year from age 35 to age 74, inclusive. In contrast to Part I, however, the subject is informed of the accumulated balance in his savings account at the time he must make his next year's consumption choice. Consumption choices are made in chronological order — that is, the subject is not permitted to change an earlier consumption choice.

Part III—Consumption with Specified Assets at Selected Ages

Here the subject is presented with sixteen age/asset pairs and is asked to choose the level of consumption spending at that age given the specified balance in his savings account. The following are the age/asset pairs.

	Age			
	35	46	55	69
		Assets		
A.	43500	43500	43500	43500
B.	214000	214000	214000	214000
C.	130000	130000	130000	130000
D.	*	*	*	*

*Assets in D were set equal to accumulated assets at the same age in Part II.

Part IV—Consumption With Different Retirement Ages

This section varies the retirement age and assets. The subject is asked to choose his consumption spending at age 46 assuming the following retirement ages and asset levels.

	Assets	Retirement Age
A.	500000	72
B.	100000	56
C.	100000	61
D.	100000	68

Part V—Consumption With Different Lifetime Earnings

In this part subjects are presented with ten different earnings profile/asset/age combinations and asked to choose consumption expenditure in each case.

		Age			
		35	46	55	69
	Earnings Profile*	Assets			
A.	23200/47800/32500	65000	65000	65000	
B.	33000/33000/33000	65000	465000	65000	
C.	20700/31000/42500	65000	65000	65000	65000

*The three numbers are the annual earnings in the three decades of work: ages 35–44, 45–54, and 55–64, respectively.

Part VI—Consumption At Different Interest Rates

Here the subject chooses consumption at age 46 given assets of $90,000 at each of 5 interest rates (0%, 2%, 4%, 6%, and 8%).

Part VII—Consumption With Changing Interest Rate

The subject is asked to choose his consumption spending in each year between age 45 and age 75, with the annual interest rate varying according to the chart below. The subject initially has $50,000 in his savings account at age 45, and his asset balance is updated each year.

Age	Interest Rate	Age	Interest Rate
45–52	2%	61–67	6%
53–60	4%	68–74	3%

Part VIII—Ranking Different Lifetime Consumption Profiles

The participant is asked to rank, in order of preference, five different lifetime consumption profiles each of which is financially feasible, i.e. exactly exhausts his resources at age 75. The profiles assume that the individual begins his working life at age 35 with no initial assets and earns $25,000 of labor income each year until retirement at age 65.

1. $21,841 per year, every year.
2. $16,008 at age 35, growing by 2% per year thereafter.
3. $11,240 at age 35, growing by 4% per year thereafter.
4. $28,592 at age 35, falling by 2% per year thereafter.
5. $23,420 from age 35 until age 65, then $10,921 from 65 to 75.

4. Experimental Results.

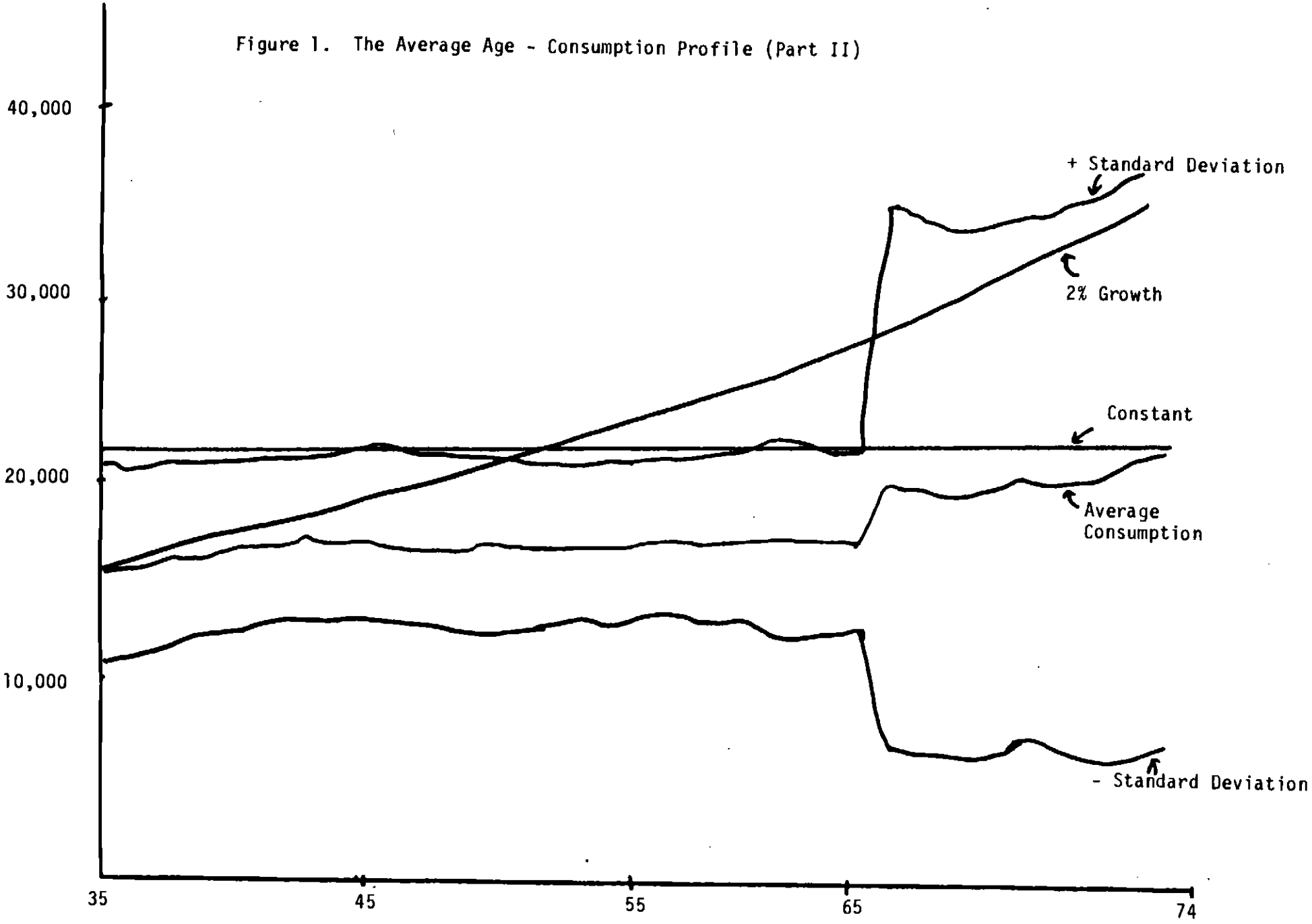
This section presents first some general features of the data, many of which accord with predictions of the life cycle model. One central feature of the data is the extent of heterogeneity in consumption choices. Next we discuss the extent of inconsistent choice and explore the degree to which consumption errors are systematic. Subsection c considers the evidence on normality and homotheticity and presents more formal tests of the standard life cycle model. Subsection d considers the extent of over-saving. Subsection e examines the correlation between actual consumption choices in Part II and Part Viii's preferred options among a group of alternative feasible consumption paths. The final subsection indicates what rates of time preference and intertemporal elasticities of substitution might be inferred from these data.

a. Summary of Consumption Behavior

Figure 1 displays the average level of consumption chosen by the 49 subjects at each age in Part II (with savings feedback). The dotted lines represent a band of one standard deviation in consumption responses at each age. The large size of these standard deviations indicates considerable diversity of consumption choices. Table 1 reports the data depicted in Figure 1. Listed is the average consumption profile as well as the coefficient of variation, the minimum and maximum responses, and the levels of consumption at the 25th and 75th percentiles of the consumption distribution.

The average consumption expenditure rises throughout the course of the life-cycle. Average consumption spending first exceeds $25,000, the amount of annual earnings, in the first year of retirement. The growth of

Figure 1. The Average Age - Consumption Profile (Part II)



average consumption is slow prior to retirement and very substantial after retirement; the ratio of average consumption at age 44 to average consumption at age 35 is 1.11. In contrast, the age 74 to age 65 ratio is 2.01. This end of life rapid growth of consumption appears to be the result of over-saving. Although their asset balance is updated year by year, subjects do not appear to appreciate fully the amount of assets they are accumulating. Thus, in the last years of their life, they play "catch up".

There are sizable differences in saving behavior across subjects. The coefficient of variation averages nearly 20 percent from age 35 to 57 and increases steadily and substantially thereafter. Another measure of dispersion is the ratio of the 75th percentile consumption choice to the 25th percentile consumption choice. This ratio is 1.33 at age 35, 1.16 at age 45, 1.16 at age 55, 1.75 at age 65, and 2.50 at age 74. A third measure is the ratio of the maximum to the minimum consumption choice. This ration is 2.60 at age 35, 1.67 at age 45, 2.00 at age 55, 5.56 at age 65, and 104.00 at age 74. This increase with age in the dispersion of the consumption distribution suggests that not all subjects over-saved; some may have under-saved and those that oversaved may have over-saved in different degrees.

Table 2 presents summary data on subject consumption choices for the representative ages 35, 46, 55, and 69 as reported in Parts III-V of the experiment. Recall that in these parts of the experiment each subject is asked for consumption choices at particular ages given an exogenously specified level of assets, a time path of future earnings, and a retirement age. The interest rate is 4 percent throughout these parts of the experiment. The Table lists

Table 1 Summary of Lifetime Consumption Behavior

Age	Average	Coefficient of Variation	25th Percentile	75th Percentile	Minimum	Maximum
35	17663	.248	15000	20000	9600	25000
36	17891	.223	15000	20000	10000	24000
37	18258	.198	15000	20000	10000	23000
38	18705	.187	16000	21000	10000	24500
39	18568	.192	15000	20000	10000	25000
40	19523	.214	17000	21000	10000	35600
41	19747	.155	18000	21000	14000	30000
42	19522	.171	18000	21000	12000	30000
43	19577	.196	17500	21963	8000	30000
44	19605	.169	18000	21963	10000	29000
45	19965	.141	19000	22000	15000	25000
46	20514	.233	18000	22000	15000	45000
47	19701	.160	18000	22000	10000	25000
48	20107	.171	18000	22000	10000	30000
49	20352	.238	18000	22000	15000	40000
50	21393	.217	18800	23000	15000	40000
51	21069	.265	18000	22000	11000	45000
52	20754	.217	19000	22000	15000	40000
53	20522	.186	19000	22000	14000	30000
54	20595	.188	19000	22000	15000	33000
55	20638	.172	19000	22000	15000	30000
56	21456	.163	19000	24000	15000	30000
57	21438	.193	19000	24000	12000	34000
58	21687	.261	19000	24000	13500	50000
59	21732	.260	20000	23000	13000	50000
60	22213	.287	19000	24000	14500	50000
61	22114	.267	20000	24000	15000	50000
62	22438	.299	19000	25000	10000	50000
63	22669	.350	19000	25000	10000	60000
64	24004	.491	19000	25000	10000	90000
65	27679	.343	20000	35000	9000	50000
66	27852	.295	22000	33000	10000	50000
67	30335	.366	22000	35000	17495	80000
68	31203	.341	23000	40000	8500	58000
69	34471	.461	24000	40000	10000	100000
70	36742	.419	25000	45000	8000	70000
71	37276	.477	25000	45000	8000	100000
72	37605	.503	25000	42000	4000	100000
73	35666	.449	23000	45000	4000	75000
74	55556	1.063	25631	64100	3000	311991

average APCs and MPCs as well as key percentiles of the APC and MPC distributions at the four ages. Table 2 also indicates APCs for benchmark cases corresponding to lifetime consumption paths with -2%, 0%, 2%, and 4% constant yearly growth.

As predicted by the Life Cycle Model, the average APCs increase with age (Hypothesis iiic). The dispersion of APCs, measured by the ratio of the 75th to the 25th percentile is largest at age 69, where it is 1.37. This is somewhat surprising; one might expect less difficulty and more similarity in consumption choice after retirement because the present value of future labor earnings need not be computed.

The average MPCs are similar in magnitude to the average APCs, however, the dispersion of MPCs is much greater. The median MPCs are smaller than the median APCs at each age; at ages 55 and 69 the differences are sizeable.

Table 2 APCs and MPCs by Age

	Age							
	35		46		55		69	
	APC	MPC	APC	MPC	APC	MPC	APC	MPC
Mean	.042	.049	.052	.048	.069	.072	.202	.187
Median	.041	.038	.049	.044	.064	.052	.185	.155
25% percentile	.036	.025	.045	.021	.058	.019	.166	.108
75% percentile	.045	.060	.054	.064	.071	.115	.227	.209
Benchmark Profiles								
2% decline	.064	.064	.070	.070	.083	.083	.192	.192
Constant	.049	.049	.057	.057	.071	.071	.183	.183
2% increase	.036	.036	.045	.045	.060	.060	.175	.175
4% increase	.025	.025	.034	.034	.050	.050	.167	.167

Prior to age 69 the median APC falls between the constant and 2 percent increase benchmark APCs. At age 69, however, the median APC is slightly larger than that of the constant growth rate path.

The variation across subjects in APCs appears to be systematic. A total of 17 of the 49 subjects recorded APC's above the Table 2 averages for all 4 ages; 14 other subjects exceeded the average in 3 of 4 cases. At the other extreme, 15 subjects recorded consumption below the average in three or more cases. In short, the population of subjects appears to be divided into two distinct groups of "big" and "small" savers.

b. Inconsistencies and Errors in Consumption Choice

Hypothesis ii states that individuals should make the same consumption choice when facing the same present value of resources and the same interest rate. We tested this hypothesis by constructing in Parts II-V 17 pairs of situations in which subjects faced identical economic resources (at a 4% interest rate). Table 3 lists the percentage difference between each subject's chosen consumption expenditure for each economically equivalent (EE) situation. Percentage differences are computed in this Table with the second minus the first case in the numerator and the first case in the denominator. To illustrate, the first column compares the subject's consumption choice in Part II at age 35 to his later choice made at the same age and given the same economic circumstances in Part III question d. The percentage errors of all subjects are listed in ascending order for each EE pair.

For all but three of the 17 EE cases in Table 3 the average absolute error exceeds 20%. Clearly, this constitutes stong evidence of widespread consumption inconsistency and strongly contradicts hypothesis ii. Moreover, consumption errors are widespread across the subjects. As documented in Table 4 each of the 49 subjects made at least two large consumption mistakes – an error in excess of 20% in absolute value. Thirty-seven of the 49 subjects made 5 or more large consumption errors in the 17 cases. Thirty-nine

Table 3 Consumption Errors

Age 35

II - IIId	IIIc- Vc	Va - Vb	Vb- IIIb	IIIb - Va
-.500	-.625	-.250	-.250	-.800
-.500	-.622	-.250	-.242	-.770
-.200	-.513	-.250	-.219	-.763
-.150	-.400	-.250	-.219	-.714
-.080	-.400	-.077	-.207	-.700
-.042	-.375	-.000	-.200	-.667
-.006	-.370	.000	-.200	-.600
.000	-.333	.000	-.179	-.600
.000	-.320	.000	-.175	-.514
.000	-.280	.000	-.120	-.500
.000	-.250	.000	-.120	-.460
.000	-.240	.018	-.107	-.438
.000	-.240	.100	-.107	-.389
.000	-.227	.111	-.107	-.370
.000	-.217	.136	-.100	-.333
.000	-.214	.136	-.083	-.304
.000	-.200	.143	-.074	-.300
.000	-.200	.154	-.074	-.280
.000	-.200	.167	-.074	-.250
.000	-.189	.183	-.069	-.249
.000	-.167	.190	-.048	-.242
.000	-.150	.207	-.028	-.229
.000	-.138	.227	-.011	-.212
.000	-.133	.250	.000	-.200
.000	-.119	.250	.000	-.200
.000	-.100	.250	.000	-.200
.000	-.074	.259	.000	-.170
.000	.000	.273	.000	-.167
.000	.167	.280	.042	-.130
.000	.200	.316	.056	-.120
.000		.333	.100	-.120
.000		.333	.125	-.098
.000		.350	.167	-.080
.000		.350	.320	-.072
.000		.353	.333	-.072
.020		.391	.333	-.053
.029		.400	.471	-.050
.050		.422	.500	-.045
.059		.462	.522	-.040
.067		.500	.600	-.007
.067		.500	.630	.000
.091		.500	.818	.000
.091		.579	.852	.000
.095		.600	1.000	.000
.105		.667	1.000	.040
.111		.739	1.500	.136
.133		.765	1.667	.143
.143		.813	2.333	.160
.200		.840	3.667	.667

Table 3 continued Consumption Errors

Age 46

II - IIId	IIIa - IVc	IIIc - IVd	IVa - Vb	IVa - IVb	IIIb - Vc
-.532	-.700	-.756	-.600	-.547	-.793
-.489	-.567	-.655	-.600	-.450	-.600
-.310	-.250	-.653	-.400	-.333	-.556
-.250	-.205	-.520	-.333	-.156	-.535
-.250	-.183	-.425	-.300	-.130	-.500
-.217	-.167	-.423	-.178	-.105	-.500
-.079	-.167	-.400	-.175	-.083	-.458
-.067	-.150	-.348	-.057	-.071	-.442
-.045	-.150	-.333	.000	.000	-.440
-.043	-.143	-.250	.000	.000	-.355
-.006	-.130	-.250	.000	.037	-.343
.000	-.100	-.222	.000	.080	-.333
.000	-.100	-.200	.000	.120	-.300
.000	-.091	-.200	.000	.143	-.243
.000	-.087	-.200	.000	.200	-.200
.000	-.053	-.191	.000	.250	-.200
.000	-.050	-.182	.086	.273	-.148
.000	-.050	-.167	.100	.450	-.133
.000	-.043	-.167	.111	.599	-.130
.000	-.024	-.143	.136		-.120
.000	.000	-.130	.167		-.120
.000	.000	-.100	.250		-.100
.000	.000	-.100	.277		-.100
.000	.000	-.091	.333		-.091
.000	.000	-.087	.500		-.065
.022	.000	-.087	.500		-.033
.050	.000	-.083	.600		.000
.050	.000	-.080	.600		.000
.050	.000	-.056	.714		.000
.056	.016	-.042	.750		.000
.071	.029	-.021			.000
.100	.059	.000			.000
.100	.087	.000			.000
.111	.097	.000			.039
.125	.100	.000			.040
.130	.111	.006			.043
.150	.132	.042			.064
.156	.133	.043			.080
.167	.136	.050			.081
.176	.143	.053			.120
.211	.211	.057			.130
.222	.286	.058			.150
.222	.294	.095			.160
.250	.333	.100			.200
.353	.389	.200			.250
.375	.400	.200			.250
1.500	.469	.333			.350
1.900	.933	.333			.364
2.636	1.000	.750			.417

Table 3 continued Consumption Errors

Age 55					Age 69
II - IIId	Va - IIIc	IIIc - Vb	Vb - Va	Vc - IIIb	I - IIId
-.480	-.400	-.750	-.375	-.612	-.450
-.130	-.385	-.583	-.333	-.423	-.350
-.120	-.354	-.483	-.231	-.400	-.333
-.120	-.321	-.333	-.200	-.383	-.193
-.111	-.320	-.267	-.200	-.375	-.167
-.091	-.308	-.222	-.200	-.375	-.143
-.091	-.280	-.200	-.185	-.371	-.143
-.087	-.276	-.167	-.167	-.353	-.126
-.041	-.259	-.167	-.130	-.333	-.113
-.019	-.250	-.167	-.120	-.286	-.100
-.006	-.250	-.167	-.107	-.286	-.091
.000	-.240	-.163	-.100	-.267	-.059
.000	-.233	-.150	-.091	-.265	-.050
.000	-.200	-.128	-.091	-.263	-.050
.000	-.200	-.107	-.071	-.233	-.040
.000	-.200	-.091	-.063	-.233	-.008
.000	-.167	.000	-.050	-.233	.000
.000	-.158	.000	-.012	-.200	.000
.000	-.143	.000	.000	-.194	.000
.000	-.063	.000	.000	-.167	.000
.000	-.045	.000	.000	-.148	.000
.024	-.040	.000	.000	-.132	.000
.042	-.022	.042	.000	-.118	.029
.043	.000	.043	.000	-.100	.040
.045	.000	.050	.000	-.042	.042
.045	.000	.050	.000	-.040	.080
.050	.000	.059	.000	.000	.117
.053	.000	.105	.000	.000	.167
.068	.000	.111	.000	.000	.178
.105	.000	.136	.024	.000	.200
.136	.013	.136	.071	.000	.200
.167	.022	.150	.075	.000	.220
.179	.034	.167	.080	.029	.250
.222	.037	.167	.080	.030	.250
.263	.100	.182	.100	.087	.300
.316	.100	.190	.121	.103	.308
.333	.100	.211	.130	.143	.333
.364	.111	.227	.143	.231	.364
.364	.119	.250	.176	.250	.366
.412	.200	.250	.190	.278	.389
.438	.200	.278	.190	.280	.500
.500	.200	.333	.217	.346	.500
.667	.200	.375	.250	.361	.550
.733	.433	.381	.286	.372	.786
.750	.500	.381	.318	.724	.818
.818	.600	.400	.333	.875	1.000
1.857	.933	.667	.389	1.000	1.074
2.161	1.233	.750	.500	1.581	1.083
3.091	1.667	.957	.500	4.435	1.955

Table 3a Summary Information for Table 3

	Average	Median	Absolute Average	Type	d(Erns/Res)
Age 35					
II - IIId	-.004	.000	.056	1	.000
IIIc - Vc	-.231	-.250	.255	2	.112
Va - Vb	.255	.250	.298	3	.000
Vb - IIIb	.286	.000	.409	2	-.223
IIIb - Va	-.232	-.200	.279	2	.223
Age 46					
II - IIId	.141	.000	.234	1	.000
IIIa - IVc	.040	.000	.179	2	-.144
IIIc - IVd	-.107	-.087	.202	2	.066
IVa - Vb	.083	.080	.259	3	.038
IVa - IVb	.015	.037	.212	2	.068
IIIb - Vc	-.104	-.065	.216	2	.268
Age 55					
II - IIId	.264	.045	.317	1	.185
Va - IIIc	.034	.000	.243	2	-.009
IIIc - Vb	.059	.050	.228	2	.056
Vb - Va	.030	.000	.141	3	.026
Vc - IIIb	.088	-.042	.366	2	-.015
Age 69					
II - IIId	.198	.042	.296	1	.165

Type 1 - Identical circumstances
Type 2 - Same resources, different earns/res.
Type 3 - Same resources, same earns/res, different earns pattern

subjects made 1 or more very large errors - errors in excess of 40% in absolute value and, of these subjects, 11 made 5 or more very large errors.

Table 4 The Distribution of Subjects by Number of Consistency Mistakes and Size of Mistake

Percentage Mistake	Number of Subjects with Specified Number of Mistakes										
	0	1	2	3	4	5	6	7	8	9	10+
20%+	0	0	3	3	6	6	11	5	6	3	6
40%+	10	13	5	5	5	3	2	3	0	1	2

A closer examination of Table 3 and the summary information in Table 3a indicates that many of the consumption errors are systematic. Consider, for example, the age 35 comparison of Part III-C with Part V-C. In III-C the asset level is $130,000, while it is $65,000 in V-C. Since total resources are equal in the two cases the ratio of the present value of earnings to total resources is greater in V-C. In addition, the timing of labor earnings differs. In III-C the earnings path is a constant $25,000 until retirement. In V-C it is $20,700 from age 35 to age 44, $31,000 from age 45 to age 54, and $42,500 from age 55 to age 64. Taking III-C as the base, the median percentage change in consumption between III-C and V-C is negative 25 percent. Of the 30 subjects who answered these two questions (V-C was added after some initial experiments were conducted), only 3 had nonnegative errors (i.e., they increased their consumption from III-C to V-C). Some of the errors are quite sizable; 3 subjects reduced their consumption choice by more than 50 percent although they were in exactly the same economic choice situation.

The age 35 comparison of III-B with V-A also involves an increase in the earnings-resource ratio. Again, the median percentage error is negative;

it is negative 20 percent. In this case 10 of the 49 subjects reduced their consumption by 50 percent or more in switching from the III-B circumstances to the V-A circumstances. The age 35 V-B and III-B comparison is quite similar; here the earnings to resource ratio falls, and while the median error is zero, the mean is .29, with 12 of 49 errors in excess of positive 50 percent. Overall, in 8 of 10 type 2 cases in which the earnings to resource ratio changes, the average error has the opposite sign of the change in the earnings to resource ratio.

In the age 35 comparison of V-A and V-B the earnings to resources ratio is unchanged. Compared with V-B, earnings in V-A occur earlier in the life cycle. Again, there seems to be an undervaluation of future earnings. In this case the median consumption error in switching to V-B is positive 25 percent, and 20 of 49 subjects increase their consumption by 30 percent or more.

c. Normality, Homotheticity, and Regression Tests of the Standard Life Cycle Model

The standard life cycle model assumes that preferences are homothetic and time separable implying that consumption at a given age is proportional to the present value of resources (hypothesis iiib). Thus, the elasticity of consumption at each age with respect to the present value of resources should equal unity. To test the standard model we calculated income elasticities for each subject between each pair of observations of consumption at specific ages. In this analysis we treated pairs of observations with identical resources as a single observation with the level of consumption equal to the average of the two choices.

For each subject there are 10 income elasticities at age 35, 28 at

age 46, 10 at age 55, and 15 at age 69. Table 5 indicates for each age the distribution of elasticities across all subjects by the size of the elasticities. The fraction of elasticities that are negative are .30 at age 35, .25 at age 46, .43 at age 55, and .25 at age 69. These fractions are sizeable and raise serious doubt about the validity of the normality assumption. It is particularly surprising that normality is violated so frequently at age 69; at this age the subjects are retired and need consider only their assets. A number of subjects repeatedly violated normality. For example in their age 55 responses 17 of the 49 subjects have negative income elasticities in a quarter or more of the possible cases; 7 of these 17 have negative income elasticities in half or more of the possible cases.

The negative income elasticities obviously contradict the homotheticity assumption. Moreover, the positive elasticities are also often far from unity. Indeed, at age 35 only 13 percent of the calculated elasticities fall between .75 and 1.25, and at age 46 it is also only 13 percent; it is only 9 percent at age 55; and it is only 19 percent at age 69.

Table 5 The Distribution of Income Elasticities of the Entire Sample by the Size of Income Elasticity

	Fraction of Elasticities of Size:							
Age	<-1	-1 to -.5	-.5 to -0	0 to .5	.5 - .75	.75-1.25	1.25-1.5	1.5+
35	.13	.05	.12	.15	.04	.13	.04	.33
46	.11	.05	.09	.11	.08	.13	.06	.36
55	.22	.07	.14	.13	.06	.09	.04	.27
69	.10	.05	.10	.19	.12	.19	.05	.20

Another test of the standard life cycle model is provided by estimating a regression equation at each age of the form:

$$C = \alpha + \gamma R + u, \tag{7}$$

where R denotes the present value of lifetime resources, and u is an error term. Finding a significant regression intercept leads to a rejection of the

homotheticity assumption. Separate regressions were estimated for each subject at each of the ages 35, 46, 55, and 69. The number of observations (i.e., resource and consumption pairs) for the regressions at these ages are 9, 13, 9, and 6 respectively.

The results of these regressions show that a significant minority of subjects displayed non-homothetic consumption behavior. At age 35, the hypothesis of a zero intercept was rejected at the 5 percent significance level in 10 cases (of 49), at age 46 in 24 cases, at 55 in 4 cases, and at age 69 in 8 cases. The age 46 regressions contained the largest number of observations (16 compared to the next largest number 10). Of the 196 estimated constants (49x4), 36 intercepts were significantly positive while only 10 were significantly negative. Thus, for the bulk of non-proportional subjects, the predicted APC falls with income.

An additional test of homotheticity was conducted by including a quadratic term in the value of resources as an independent variable in the regressions. Of a total of 196 regressions the coefficient on squared resources was significant (at the 5 percent level) in 24 cases. Thus, there appears to be evidence of some nonlinear consumption behavior.

Retaining the linear specification, a test that consumption is independent of the mix of resources (hypothesis ii) can be conducted by estimating regressions of the form

$$C = \alpha + \sigma_1 A + \sigma_2 E + u, \tag{8}$$

where A denotes the subject's accumulated savings to date, and E denotes the present value of his future earnings. Of course, the irrelevance of the mix of resources implies that σ_1 should equal σ_2. We estimated (8) separately for ages 35, 46, and 55 (at age 69 future earnings were zero). Table 6 presents a summary of the distribution of assets and earnings coefficients.

In 85 percent of the cases (124 of 147 regressions), the earnings and assets coefficients are both positive as predicted by the life-cycle model. The coefficient on assets exceeded that on earnings in slightly more than half of the 147 regressions. In total, 41 of 147 (or 28%) of the regressions displayed coefficients that are statistically different from one another at the 5 percent level. In these 41 cases the coefficient on assets exceed that on earnings 25 times. Finally, there is only a single, insignificant asset coefficient (which is negative), but 16 negative earnings coefficients 8 of which are significant. It appears from these results that a significant minority of subjects undervalue earnings relative to assets, while a somewhat smaller minority overvalue earnings. Table 6 summarizes these findings and presents the age-specific results.

Table 6 Tests of the Importance of the Resource Mix to Consumption

Number of Regressions (Fraction of Regressions)

Age	Total	$\sigma 1, \sigma 2$ Pos	$\sigma 1 > \sigma 2$	$\sigma 1, \sigma 2$ Signif Diff	$\sigma 1$ Signif $> \sigma 2$
35	49	35	36	14	14
46	49	44	24	11	6
55	49	45	17	16	5
Total	147	124	77	41	25

Tables 7a - 7d consider whether nonhomotheticity and the resource mix are significant in pooled regression analysis. The Table displays the coefficients of four regression models estimated for the four key ages with the data pooled across all subjects. Model A explains consumption only in terms of total resources. Model B differs from A by the addition of an intercept. Model C modifies B by entering assets and earnings separately.

Model D adds the squares of assets and earnings and the product of assets and earnings.

The model B intercepts in each of the four Tables, 7a through 7d, are highly significant. Thus these pooled regressions reject the homotheticity hypothesis. The model B coefficients on resources also contradict the Life Cycle Model's prediction that the marginal propensity to consume increases with age. Although all are insignificant, the coefficients at ages 35, 46, 55, and 69 display no strong positive correlation with age.

Given that an intercept belongs in the relation between consumption and resources, is it also the case that earnings and assets enter with the same coefficient? i.e., do subjects value equally a dollar in assets and a dollar in human wealth? According to F tests of model B vs. C, reported in Table 8, the assumption of equal valuation of assets and earnings is strongly rejected for the pooled age 35 data, but accepted for the pooled age 46 and pooled age 55 data. In the age 35 model C regression, the assets coefficient is over seven times greater than the earnings coefficient. These results may reflect an inability of subjects to discount properly far distant earnings streams; i.e., at ages 46 and 55 the future earnings streams extend for a shorter interval than at age 35.

The results on model G reinforce a view of undervaluation of future earnings. The APC is negatively related to the earnings to resources ratio at each of the three ages 35, 46, and 55. The earnings to resources coefficient is highly significant at ages 35 and 46. Hence, the larger the share of the present value of earnings in total resources, the smaller the average propensity to consume.

Table 7a Age 35 Pooled Regression Coefficients (Standard Errors)

Model	Res	Const	Earn	Assets	Earn*Assets	Squared Res	Squared Earn	Squared Assets	Earn/Res	$\bar{R}^2$
A	.042									.151
	(.001)									
B	.051	-4989								.156
	(.006)	(3461)								
C		11791	.012	.085						.249
		(4061)	(.008)	(.007)						
D		234167	-.851	-.431	.547	.821E-6	.683E-6			.263
		(88865)	(.340)	(1.101)	(1.173)	(.318E-6)	(.145E-5)			
(Dep Var is APC)										
G	.085								-.049	.088
	(.007									(.008)

Table 7b Age 46 Pooled Regression Coefficients (Standard Errors)

Model	Res	Const	Earn	Assets	Earn*Assets	Squared Res	Squared Earn	Squared Assets	Earn/Res	$\bar{R}^2$
A	.049									.185
	(.001)									
B	.038	6625								.207
	(.004)	(2033)								
C		7234	.036	.039						.207
		(2681)	(.007)	(.005)						
D		2075	.026	.128	-.024	.242E-7	-.146E-7			.224
		(10363)	(.058)	(.175)	(.252)	(.677E-7)	(.136E-6)			
(Dep Var is APC)										
G	.052								-.100	.000
	(.006)								(.008)	

Table 7c Age 55 Pooled Regression Coefficients (Standard Errors)

Model	Res	Const	Earn	Assets	Earn*Assets	Squared Res	Squared Earn	Squared Assets	Earn/Res	$\bar{R}^2$
A	.007									.066
	(.002)									
B	.056	-4367								.069
	(.010)	(3833)								
C		1961	.068	.053						.072
		(4362)	(.014)	(.011)						
D		-15173	-.165	-.440	.398	-.136E-6		-.828E-6		.085
		(29221)	(.233)	(.646)	(.923)	(.366E-6)		(.103E-5)		
(Dep Var is APC)										
G	.061								-.012	.003
	(.008)				(.011)					

Table 7d Age 69 Pooled Regression Coefficients (Standard Errors)

Model	Res	Const	R^2
A	.176		.40
	(.005)		
B	.034	8404	.15
	(.005)	(2575)	

One may also question whether higher order powers of assets and earnings help explain consumption. As indicated in Table 8 (in the C vs. D F test) these additional variables are jointly significant for the age 35 and the age 46 regressions. Table 8 also reports the results of a Chow test, assuming model B, indicating whether it is appropriate to pool the data. Pooling the data is very strongly rejected for each of the four ages; i.e., there is very significant heterogeneity in individual model B regression coefficients.

A final way to evaluate the performance of the standard life cycle model is in terms of R bar square. If the model is correct, the R bar squares in the regressions of consumption against resources (Model A) should be unity. This is far from the case. Table 9 reports the distribution of R bar squares from subject-specific regressions for several of the models of Tables 7a - 7d for each of the four reference ages. For a large percentage of subjects the standard time-separable homothetic model, model A, explains only a modest fraction of the total variance in consumption choice. For example, at age 46 one half of the R bar squares are below .5; 30 percent fall below .25. The R bar squares for models C and D are somewhat higher, but even for model D at least a third of the R bar squares at each age are less than .75.

d. Evidence of Over-Saving

Perhaps the most severe challenge to accurate choice is posed in the year-by-year consumption decisions of Parts I and II. Recall that in Part I, subjects make their year-by-year decisions without feedback (i.e. without any information concerning the accumulated balance in their savings account). In

Table 8 Significance Values of F Tests for Pooled Regressions

	Age			
Test	35	46	55	
B vs. C	.404E-7	.728	.249	
C vs. D	.024	.014	.075	
B Pooled vs. Unpooled	.955E-7	.111E-15	.001E-18	.115E-15

Table 9 Distribution of $\bar{R}^2$s from Alternative Regression Models

		Fraction of $\bar{R}^2$s of Size:					
Model	Age	<0	0 - .25	.25 - .5	.5 - .75	.75 - .85	.90 - 1
A							
	35	.22	.18	.29	.20	.08	.02
	46	.20	.12	.18	.31	.14	.04
	55	.27	.16	.24	.24	.06	.02
	69	.14	.02	.06	.22	.10	.45
C							
	35	.20	.06	.22	.27	.14	.10
	46	.12	.08	.14	.37	.14	.14
	55	.12	.10	.12	.39	.10	.16
D							
	35	.22	.08	.08	.24	.04	.33
	46	.04	.06	.06	.33	.12	.39
	55	.10	.06	.14	.10	.16	.43

Part II, subjects received this feedback year-by-year. Clearly, the information provided in Part II better conforms to the information available in "real world" consumption and saving decisions. Our objective in studying the non-feedback settings was to gain insight into subjects' abilities to discount and also to compare consumption choices with and without asset feedback.

In Part I the overwhelming majority of subjects left significant positive asset balances at the conclusion of their lives. While the average value of age 74 consumption chosen is $25,709, the average value of assets unspent at age 75 is an astounding $250,000. Overall, 36 of 46 subjects

(three subjects' responses to Part I were invalidated by key punch errors) left balances at age 75 in excess of $50,000; nearly two thirds of the subjects left assets in excess of $200,000, and over one third left assets in excess of $300,000.

Table 10 lists the amount of assets not spent by the end of life in Part I in ascending order in the first column. The second column considers the subjects in the same order as the first column and indicates the level of consumption at age 74 chosen by the subjects in Part I. The third column gives the ratio of the first to the second column. The forth column expresses the present value of the amount of end of life unspent resources as a percent of the initial age 35 present value of resources. The average ratio of unspent end of life assets to age 74 consumption is 13.97, and the median ratio is 13.26. In total, 28 of the 46 subjects who answered Part I failed to spend 10 percent or more of their lifetime resources; 9 of the 46 failed to spend 20 percent or more of their lifetime resources; and 2 of the 46 failed to spend 30 percent or more.

Further suggestion of oversaving comes from comparing the age consumption profiles of Part I with those of Part II. Figure 2 displays the two profiles of one of the subjects. Note that the Part I profile is generally below the Part II profile. In the initial working years the two profiles closely track one another. In later years, after observing a significant amount of accumulated assets in Part II, the subject rapidly readjusts his consumption spending upward.

Figure 2. Comparison of Part I and Part II Profiles

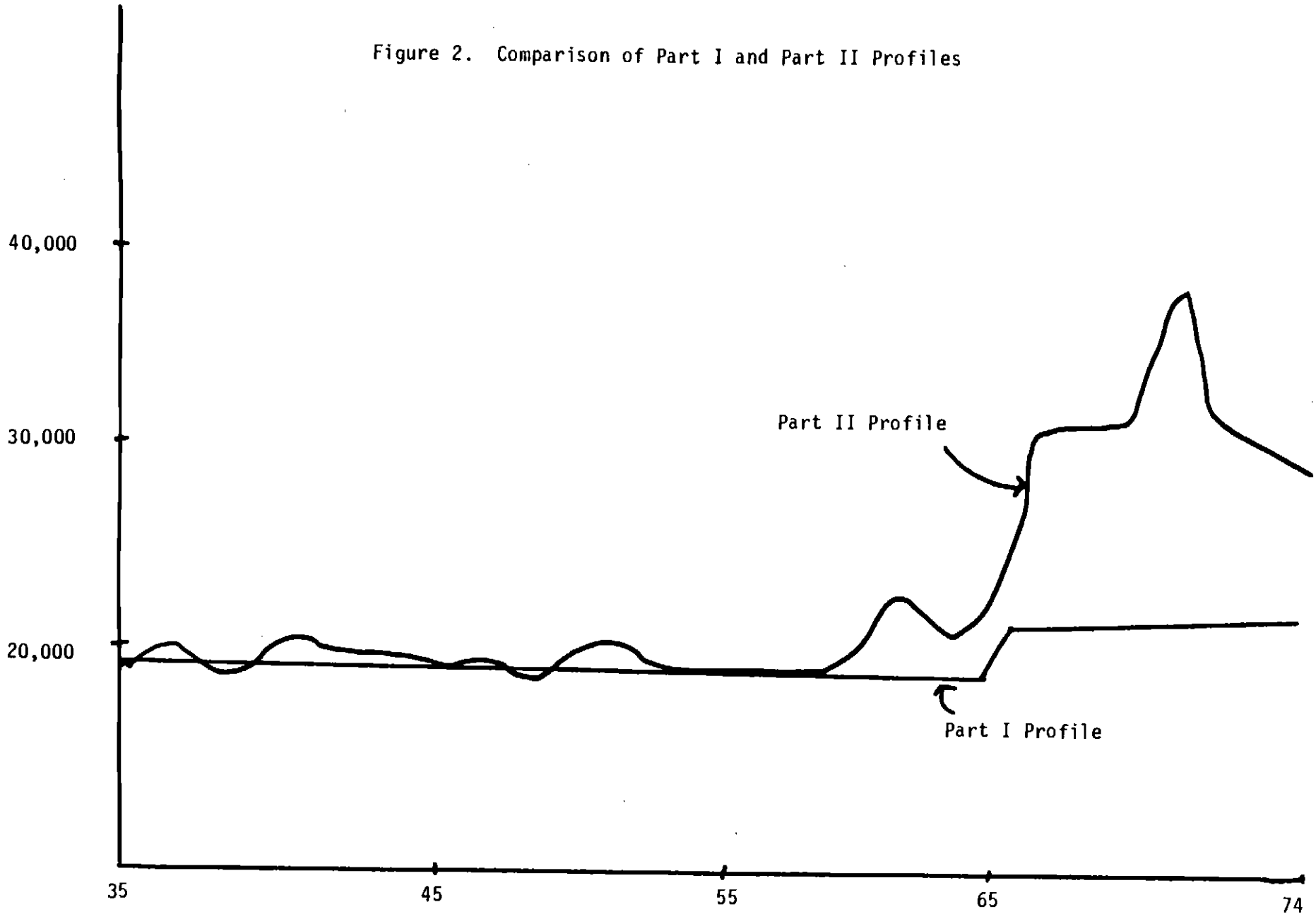


Table 10 Part I Oversaving Behavior

End of Life Assets	Age 74 Consumption	Ratio of Column 1 to Column 2	Ratio of the Present Value of End of Life Assets to the Present Value of Resources
-385233	100000	-3.85	-.178
-93992	50000	-1.88	-.044
-58329	24000	-2.43	-.027
-25614	40000	-.64	-.012
1	21000	.00	.000
6064	25000	.24	.003
9294	20000	.46	.004
17526	25000	.70	.008
35865	20000	1.79	.017
41740	100000	.42	.019
71726	15000	4.78	.033
98152	40000	2.45	.045
114038	15000	7.60	.053
126193	12000	10.52	.058
133541	16000	8.35	.062
181975	20000	9.10	.084
201976	15000	13.47	.094
209846	25000	8.39	.097
217359	20000	10.87	.101
243476	16000	15.22	.113
254577	15000	16.97	.118
257139	18000	14.29	.119
265955	22100	12.03	.123
280801	19000	14.78	.130
280844	25000	11.23	.130
293823	30000	9.79	.136
307669	18500	16.63	.143
308462	25000	12.34	.143
319849	22000	14.54	.148
333265	20000	16.66	.154
352145	26550	13.26	.163
354585	25000	14.18	.164
368681	25000	14.75	.171
378563	25000	15.14	.175
394742	17000	23.22	.183
401699	20000	20.08	.186
419154	18000	23.29	.194
439242	25000	17.57	.203
443701	25000	17.75	.206
482401	24000	20.10	.223
527973	35000	15.08	.245
529761	30000	17.66	.245
566066	18000	31.45	.262
605157	10000	60.52	.280
676817	16000	42.30	.314
765124	10000	76.51	.354

Though consumption behavior varies markedly across subjects, the general characteristics of Figure 2 are quite similar for many subjects. For 36 of 48 subjects, Part II consumption profiles exceed Part I profiles for all but a small number of years. A quantitative measure of the relative consumption behavior with and without feedback is provided by comparing accumulated savings at a given age. At age 69, 44 of 48 subjects had significantly smaller asset balances in Part II than in Part I. In Part II, the average level of age 69 assets was $250,000; in Part I it was $350,000.

With the benefit of asset feedback in Part II, subjects exhibited what might be termed "adaptive" consumption behavior. However, even in Part II it is clear that subjects did not succeed in choosing optimal consumption profiles. Rather they appear to oversave in the early stages of their working lives and then engage in rapid spending especially during their last 10 to 15 years. To illustrate this point, we calculated for Part II the number of years of age 64 consumption that could be financed by the subject's age 65 assets. If the individual's aim was to have constant consumption over the last decade of life, then his age 65 assets would be sufficient only to finance 10 years of the age 64 consumption level. In fact, for a significant minority of the subjects age 65 assets are sufficient to finance their age 64 level of consumption for many more than 10 years.

Table 11 presents the Part II consumption choices of subjects in the last 10 years of life. The Table's first column lists in ascending order the level of assets at age 65; the second column presents the corresponding age 64 level of consumption; the third column presents the largest level of consumption over the remaining ten years, age 65 through 74. The forth column gives the number of years of consumption at the age 64 level that could be financed with age 65 assets.

A total of 29 of the 49 subjects had assets at age 65 that could finance 10 or more years of their age 64 level of consumption; 9 had sufficient resources to finance 20 or more years of age 64 consumption; and 5 had enough assets at age 65 to finance 30 or more years of age 64 consumption. Those subjects who could finance 20 or more years of age 64 consumption realized at some point in their remaining 10 years of Part II that they had sizeable amounts of assets at which point they dramatically adjusted upward their consumption. A comparison of columns two and three of the Table indicates that the high savers (those for whom column 5 exceeds 20), for at least one of their remaining 10 years, chose a consumption level that, on average, equaled 6.5 times their age 64 consumption.

e. Comparisons of Actual Consumption Choices with Expressed Preferences

Recall that in Part VIII subjects were asked to rank in order of preference five feasible consumption profiles: a constant profile, profiles with 2%, 4%, and −2% annual growth, and a step function with $23,000 in annual consumption prior to retirement and $10,000 thereafter. A natural question is whether the life cycle consumption paths chosen by subjects in Part II are consistent with their preference rankings reported in Part VIII. In principal, one would like to have precise information about each subject's utility function. But the difficulty in eliciting such information makes that approach impractical. Instead, we compare a given subject's actual consumption choice with his preference ranking of the Part VIII alternatives.

Table 11 Part II Oversaving Behavior

Age 65 Assets	Age 64 Cons.	Largest Post 64 Cons.	Years of Age 64 Cons. Affordable from Age 65 Assets
35885	30000	20000	1
108895	90000	25000	1
109107	18000	32526	6
113478	20000	40000	6
114490	21963	21002	5
123102	22000	39546	6
126668	27500	39157	4
127440	22000	31199	6
140088	22000	30000	7
142006	40000	50000	3
145527	20000	31000	8
161457	28000	35000	6
171288	24000	40000	8
172429	30000	38000	6
173850	19000	70954	11
176054	25000	50000	8
176701	30000	45000	6
183500	18000	66199	12
192288	22000	60000	10
193384	15000	39529	17
194727	25000	50000	9
195945	18000	40000	13
197989	25000	50000	9
198271	20000	55830	12
203607	28000	45000	8
204173	24000	52615	10
205148	15900	56000	17
212663	20000	47000	13
213833	19000	127000	14
224233	41129	41130	6
233823	19000	55000	16
244782	25000	70000	12
256051	24000	70000	13
256887	30000	66925	10
260740	20000	51598	17
261302	28000	65754	11
267808	25000	90715	13
294322	20000	140000	21
296081	23000	60000	17
300673	10000	70000	∞
307186	10000	91936	∞
319143	19700	143000	24
321064	28000	100000	14
328270	19000	80000	27
335706	15000	100000	50
337159	20000	100000	26
343607	25000	70000	19
395443	15000	255798	∞
406827	20000	50000	38

∞ Resources can finance a perpetuity

Table 12 Ranking of Alternative Consumption Profiles

	Fraction of Subjects Choosing Alternative Profiles				
	0%	2%	4%	-2%	Step
First Choice	.23	.31	.25	.13	.08
Second Choice	.23	.44	.15	.11	.17

Table 12 indicates the fraction of subjects listing each profile as their first or second ranked alternative. Three quarters of all subjects listed the 2% growth path as their first or second choice. The constant path is next in popularity, followed by the 4% growth path. The great majority of subjects also displayed "single peaked" preferences, choosing as their second profile choice a profile close to their first choice.

It is interesting to compare the Part II profiles chosen by subjects with their consumption profile rankings. A useful measure of the closeness of these choices is the average annual absolute percentage difference between the Part II profile and the most preferred Part VIII. For those whose first choice in VIII is a constant profile the mean percentage deviation is 15 percent; for those with first choice profiles of 2%, 4%, -2%, and the step function the mean deviations are 21 percent, 25 percent, 37 percent, and 46 percent. These mean percentage differences are quite large.

A second comparison of consumption choice with Part VIII expressed preferences is summarized in Table 13. The second row of this Table lists the number of subjects whose actual Part II choices came closest in terms of mean percentage error to their top ranked choice in VIII. The third row lists the number of subjects whose consumption choice more closely resembles their second ranked profile in VIII, and so on. It is clear that many subjects failed to choose profiles that came closest to their ranking in VIII; only 19 of 48 subjects chose in II a profile that came closest to their

most preferred in VIII.

Table 13 Correlation of Part II Choices with Part VIII Rankings

	Profiles				
	0%	2%	4%	-2%	Step
# of Subjects	11	15	12	6	4
Closest	5	10	4	0	0
2nd Closest	4	5	3	0	0
3rd Closest	0	0	0	4	3
4th Closest	0	0	0	0	1
5th Closest	2	0	5	2	0

f. Estimates of Time Preference Rates and Intertemporal Elasticities of Substitution

The time preference rate and the intertemporal elasticity of substitution are key parameters in standard analyses of the supply of savings and the efficiency gains from tax reform (see, for example, Summers, 1981 and Auerbach and Kotlikoff, 1987). Estimates as large as 18 percent for the rate of time preference have been reported by Hausman (1979), but most estimates appear to center around 1.5 percent (Lawrence, 1986). In the case of the intertemporal elasticity of substitution, the majority of estimates range from .2 to .5 (Auerbach, Kotlikoff, and Skinner, 1983). These parameters have often been estimated assuming homothetic, time separable preferences. While our data reject such preferences, it is still useful to determine whether estimates of these parameters based on experimental data are in accord with those based on actual data. If they were substantially different one would presumably be more skeptical of the quality of these experimental data.

We can calculate these preference parameters using the data from Part

VII which asked subjects to choose a time path of consumption in the presence of time varying interest rates. Estimation of (5') based on the pooled data yields an estimate of .376 for the intertemporal elasticity of substitution and .018 for the time preference rate. The standard error of the elasticity of substitution is .578; given the estimate of the elasticity of substitution, a standard error in the intercept of (5') implies values of the time preference rate ranging from -.042 to .081.

The individual estimates of (5') are, however, significantly different from the pooled estimates. The F test determining whether individual coefficients in the regression of equation (5') equal the pooled coefficients is significant at the .003 percent level.

Estimating (5') separately for each subject yields only three significant estimates of the intertemporal substitution elasticity. A total of 24 of 49 substitution elasticities are negative; of the remaining 25 elasticities only 3 are less than .5; 15 exceed 1. Of the 49 estimates of the rate of time preference, 4 are negative; 18 are between zero and .03; and 5 exceed .10.

Section 5. Consumption Choices and Demographic Characteristics

One way to exhibit differences by demographic groups in consumption choices is to regress APCs against characteristics. Table 14 reports the coefficients from such regressions for ages 35, 46, 55, and 69 where all the data in Parts II through V which assume a 4 percent interest rate are pooled. The demographic variables include dummy variables for males, italian, jewish, catholic, asian, hispanic, and black and others. There are also dummies for the income position of the subject's parents. "Poor Parents" and "Rich Parent" are dummies for subjects with parents who they consider to be in

lower income and upper income groups, respectively. "Exp to be Rich" is a dummy for subjects who expect to be in high income groups later in life. The excluded group is female, white protestants, with middle income parents, who do not expect to be in the high income group. In addition to these dummy variables, "age" is the subject's age and "yrs col" is the subject's number of years of college.

The combined set of demographic variables are highly significant in all four regressions, thus adding further evidence about consumption heterogeneity. The specific results suggest that males consume significantly more than females, that asians, italians, and blacks consume less than white protestants, that jews consume more than white protestants, and that those with more years of college consume less than those with fewer years of college. The significant asian dummies are not surprising, but the coefficients on the dummies for italians, blacks, and jews are rather surprising.

The last three dummy variables in the regressions are also quite interesting. Subjects with poor parents consumed significantly more and those with rich parents significantly less than those with middle income parents. One may speculate that rich parents have imbued their children with stronger saving ethics than poor parents. The insignificance of the "Exp to be Rich" dummy suggests that subjects were able to abstract from their own personal circumstances in responding to the experiment. If such abstraction were quite difficult, one would expect this coefficient to be significantly positive.

A second interesting question is which subjects are more likely to make consumption mistakes. A pooled regression of the absolute percentage errors from Table 3 (but redefined with the smaller consumption value in the

denominator) on the explanatory variables of Table 14 produced significant positive male and jewish coefficients, and a significantly positive coefficient on "Poor Parents". In addition, the coefficient on "Yrs of Col" was significantly negative.

Table 14 Regressions of APCs on Demographic Characteristics

Coefficients (Standard Errors)

	Age 35	Age 46	Age 55	Age 69
Constant	.324E-1	.735E-1	.843E-1	.308
	(.632E-2)	(.828E-2)	(.113E-1)	(.447E-1)
Male	.488E-2	.340E-2	.152E-1	.182E-1
	(.215E-2)	(.275E-2)	(.383E-2)	(.152E-1)
Age	.913E-3	-.210E-3	.241E-3	-.266E-2
	(.294E-3)	(.424E-3)	(.524E-3)	(.298E-2)
Yrs Col	-.358E-2	-.372E-2	-.743E-2	-.123E-1
	(.800E-3)	(.144E-2)	(.143E-2)	(.566E-2)
Italian	-.109E-1	-.148E-1	-.181E-2	-.346E-1
	(.433E-2)	(.655E-2)	(.772E-2)	(.306E-1)
Jewish	.746E-2	.541E-2	.251E-1	.466E-2
	(.337E-2)	(.440E-2)	(.602E-2)	(.239E-1)
Catholic	-.438E-3	-.753E-2	.504E-2	-.282E-1
	(.268E-2)	(.379E-2)	(.478E-2)	(.189E-1)
Asian	-.908E-3	-.142E-1	-.118E-3	-.663E-1
	(.281E-2)	(.355E-2)	(.502E-2)	(.199E-1)
Hispanic	.380E-2	-.424E-2	-.438E-3	.620E-2
	(.312E-2)	(.366E-2)	(.556E-2)	(.220E-1)
Black, Ot.	-.613E-2	-.104E-1	-.569E-2	-.487E-1
	(.322E-2)	(.524E-2)	(.574E-2)	(.227E-1)
Poor Parents	.941E-2	.159E-1	.138E-1	.762E-1
	(.424E-2	(.617E-2)	(.756E-2)	(.300E-1)
Rich Parents	-.982E-2	-.119E-1	-.238E-1	-.536E-1
	(.201E-2)	(.271E-2)	(.358E-2)	(.142E-1)
Exp to be Rich	-.635E-3	.486E-2	-.556E-2)	.210E-1
	(.202E-2)	(.304E-2)	(.360E-2)	(.143E-1)

Section 7. Summary and Conclusion

A variety of findings in our life cycle consumption experiment raise serious questions about the life cycle model's ability to describe consumption choice. In their life cycle consumption choices many subjects repeatedly made substantial errors; they chose quite different levels of consumption in identical economic situations, and they over-saved, typically by very sizeable amounts. These errors are often systematic and appear to

reflect a widespread inability to discount properly future earnings streams. Many subjects clearly undervalue future earnings streams, while a smaller number overvalue future earnings. Given these errors it is not surprising that the standard life cycle model typically explains less than half the variance in consumption. In addition, the experiment's data significantly reject the hypotheses that intertemporal consumption preferences are either homothetic or uniform across individuals. Indeed, differences in preferences appear to be substantial and are correlated, in part, with demographic characteristics.

These findings have important policy implications. If large segments of the population undervalue future income streams, then policies, such as social security and tax cuts, will alter saving because they change the timing of income. Thus a fully funded, actuarially fair social security system that provides future benefits in exchange for current payroll taxes will depress consumption and increase saving if future benefits are undervalued. Alternatively, a cut in current income tax receipts coupled with an equal present value increase in future income tax receipts will stimulate consumption and lower saving.

The findings also suggest that Keynesian models which place greater emphasis on current relative to future income streams may better describe actual consumption choice. But the Keynesian model, while perhaps a better descriptive tool, is probably too naive, just as the life cycle model appears to be too sophisticated. What is needed is a better model of choice in the context of bounded rationality.

We believe that experimental research on consumption choice can provide a set of empirical regularities that will instruct the development of models of bounded rationality. In addition, experiments incorporating policy variables may prove a useful tool in policy formulation and analysis. In our future experimental research we intend to explore the responses to policy

variables. In addition, we hope to gain more insight into the nature of consumption mistakes by examining directly whether subjects can discount and correlating mistakes in discounting with mistakes in consumption choices. A third area of future experimental research is consumption choice under uncertainty.

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Appendix

CONSUMPTION EXPERIMENTER

Introduction

We are interested in learning how people make saving decisions. We are going to ask you how much you would choose to consume in the following hypothethical circumstances.

General Circumstances

You are age 35, unmarried, and about to start your first job. You will work on this job until you retire at age 65. Each year you must decide how much money to spend on consumption and how much money to save. When you retire your salary will cease. After you retire you will live for 10 more years and die at age 75.

Your Specific Circumstances

(1) You are single and will never get married. You have no children, parents, or other relatives to care for. You are going to spend all of your money over your lifetime on your own consumption.

(2) You face no uncertainty whatsoever about the future. You will live for certain until age 75. You will be in excellent health and never have to pay a cent for medical or dental care. You will work full time until age 65 when you retire.

(3) Any money you save is deposited in your savings account and earns 4 percent interest per year. You may borrow money at any time in which case you must pay 4 percent interest on your borrowings.

(4) There is never any inflation or deflation in your economy; i.e., prices never change.

(5) There are no taxes in your economy.

(6) All events in your life occur on January 1. You were born on January 1. You get paid--in advance--for the coming year's work on January 1. You will retire on January 1. You receive interest on savings or pay interest on horrowing on Jan. 1. In addition you make all your consumption expenditures for the year on January 1. You will die on December 31st, 2026, the day before you turn 75.

(7) Consumption expenditures include purchases of food and clothing, payment for vacations during the year, payment for utilities for the year, and rental of housing and durable goods.

(8) You always rent by the year housing as well as all durable goods like cars, refrigerators, furniture, stoves, televisions, air conditioners, etc. On January 1 of each year you pay all of the rent for the coming

year. There are no moving costs, hassle costs, or any other costs of your renting a bigger house or apartment or, for example, of renting a smaller car or bigger dishwasher.

CONSUMPTION EXPERIMENTER

Basic Fact Sheet

General

This questionnaire has eight parts and should take from one to one and a half hours to complete. We recognize the experiment is somewhat lengthy but ask that you try to be as conscientious as possible throughout. Please take your time and try to answer every question thoughtfully, on the basis of what would make you most happy given the situation described to you. We suggest that after you complete Part IV you take a five minute break. At that time, please help yourself to the refreshments we have provided.

If you have any questions whatsoever during the experiment, please stop and speak to one of the proctors. We strongly discourage guessing when at all in doubt.

Summary of Your Facts of Life

1. You begin working at age 35 with no savings.

2. You retire at the end of your 64th year, so 64 is the last year you work and earn a salary. (The only exception to this is Part IV, which varies the retirement age.)

3. You die, with certainty, at the end of your 74th year, so 74 is the last year in which you can consume.

4. With the exception of Part V, you always earn a $25,000 salary each year until you retire.

5. The interest rate is always 4% (except in Part VI and VII). Your savings account will earn interest at that rate; you may always borrow as much as you wish at that interest rate.

6. INTEREST COMPUTATION: Your assets on January 1 of any year are equal to 1.04 times the sum of your assets on January 1 of the previous year plus your earnings on January 1 of the previous year less your consumption on January 1 of the previous year. Thus, if assets last January 1 were $10,000, earnings were $25,000, and consumption was $23,000, then assets this January 1 would equal 1.04 times ($10,000 + $25,000 - $23,000) = 1.04 x $12,000 = $12,480.

Operating the Computer

- In responding to any question, type only numerals, no commas, dollar signs, decimals, etc.

- With the exception of Part I, Part VII, and Part VIII, entry of an answer requires two steps. First, you key the number you wish to enter and press the return key. Second, once you have looked at the number you have typed on the screen to make sure you've typed it correctly, type the ampersand (&--shift 7) to confirm the entry. The computer will then accept the answer and move on to the next question.

- If you wish to correct an entry after you have hit return, but before you have confirmed it with an ampersand, simply retype the number and hit return again.

- If you wish to correct an entry before you have hit return, use the backspace key (<--, upper right on the keyboard) to begin the number again or to rekey part of the number.

- After you have typed the ampersand to confirm an entry, there is no way to correct it--so CHECK EACH ENTRY CAREFULLY BEFORE YOU CONFIRM IT.

- If the word 'TEXT' lights up after you have hit the return key, but before you have confirmed with an ampersand, retype your entry.

- At the end of the Background and Introduction screens, and at the end of Parts I, VII, and VIII, you must type the ampersand to advance to the next screen. IMPORTANT: Sometimes it will be necessary to type the ampersand several times, so if you've typed it and, within a second or two, have not advanced to the next screen, type it again.

- IMPORTANT: On Part II, if you accidentally confirm a number that was typed incorrectly, stop immediately and tell a proctor.

- On Parts I and VII, you may change any entry you wish by moving to the entry with the up or down arrows (to the far right of the keyboard). To move all the way to the beginning of these screens to review all of your entries, press the HOME key (next to the up arrow). DO NOT PRESS THE HOME KEY ON ANY OTHER PART OF THE EXPERIMENT.

PART I--ANNUAL CONSUMPTION (Press down arrow to page down.)

Today is January 1, 1987 and you have just turned 35. This is your first day of work. You receive $25,000 today, payment in advance for working over the year. You will continue to work f the next 30 years earning $25,000 each year. On Jan. 1, 2016 y will be 64 and will start your last year of work and receive yo last paycheck. Your last day of work is December 31, 2016. After retiring you will live for 10 more years and die on Decem 31, 2026.

You have no initial savings. Below is a list of earnings you receive at each age over your lifetime. At each age please fill in the total amount of money you would choose to spend on consumption during that year.

Before you fill in your consumption choices, we want to make su you understand how interest on your savings or borrowings is co Since the interest rate is 4 percent, your assets on January 1 year are equal to 1.04 times the sum of your assets on January the previous year plus your earnings on January 1 of the pre- vious year less your consumption on January 1 of the previous y Thus, if assets last January 1 were $10,000, earnings were $25, and consumption was $23,000, then assets this January 1 would e 1.04 times ($10,000 + $25,000 - $23,000) = 1.04 x $12,000 = $12

Remember, at the end of your life YOU SHOULD NOT END UP IN DEBT the other hand, you do not want to leave behind any unspent mon In deciding your consumption at each age choose on the basis of what would make you most happy given what you can afford.

(Type '&' to begin Part I.)

PART I--ANNUAL CONSUMPTION

Please enter your desired consumption for each year.
Enter only numerals, no commas or other punctuation.

AGE	DATE	EARNINGS	CONSUMPTION
35	Jan. 1, 1987	25000	0
36	Jan. 1, 1988	25000	0
37	Jan. 1, 1989	25000	0
38	Jan. 1, 1990	25000	0
39	Jan. 1, 1991	25000	0
40	Jan. 1, 1992	25000	0
41	Jan. 1, 1993	25000	0
42	Jan. 1, 1994	25000	0
43	Jan. 1, 1995	25000	0
44	Jan. 1, 1996	25000	0

45	Jan. 1, 1997	25000	0
46	Jan. 1, 1998	25000	0
47	Jan. 1, 1999	25000	0
48	Jan. 1, 2000	25000	0
49	Jan. 1, 2001	25000	0
50	Jan. 1, 2002	25000	0
51	Jan. 1, 2003	25000	0
52	Jan. 1, 2004	25000	0
53	Jan. 1, 2005	25000	0
54	Jan. 1, 2006	25000	0
55	Jan. 1, 2007	25000	0
56	Jan. 1, 2008	25000	0
57	Jan. 1, 2009	25000	0
58	Jan. 1, 2010	25000	0
59	Jan. 1, 2011	25000	0
60	Jan. 1, 2012	25000	0
61	Jan. 1, 2013	25000	0
62	Jan. 1, 2014	25000	0
63	Jan. 1, 2015	25000	0
64	Jan. 1, 2016	25000	0
65	Jan. 1, 2017	0	0
66	Jan. 1, 2018	0	0
67	Jan. 1, 2019	0	0
68	Jan. 1, 2020	0	0
69	Jan. 1, 2021	0	0
70	Jan. 1, 2022	0	0
71	Jan. 1, 2023	0	0
72	Jan. 1, 2024	0	0
73	Jan. 1, 2025	0	0
74	Jan. 1, 2026	0	0
75	Jan. 1, 2027	YOU ARE NOW DEAD	

PART II--CONSUMPTION WITH KNOWLEDGE OF MONEY IN SAVINGS ACCOUNT

We are now going to repeat the previous question, but this time before you tell us how much you wish to consume in a given year we will tell you the amount of savings you have at the beginnin of that year. If you are in debt at the beginning of a particular year your savings will be negative. Keep in mind th while you are free to borrow money from the bank, you cannot en up in debt at the end of your life. Also recall that your year earnings are $25,000 per year until you retire at the beginning of your 65th year and that you will die when you reach age 75.

(After reading, type '&' to begin Part II.)

You are 35 years old. You will earn $ 25000 per year until age 65.
Your savings in your bank account is $ 0.
How much do you wish to spend on consumption this year?

AGE	MONEY IN SAVINGS ACCOUNT	CONSUMPTION	INTEREST INCOME	LABOR EARNINGS
35	0		0	25000

(Enter number. Then type '&' to confirm.)

PART III--CONSUMPTION WITH SPECIFIED SAVINGS AT SELECTED AGES

We are now going to ask you to imagine you are a particular age and have a certain amount of money in your savings account. Please tell us how much you would spend on consumption at that age, given the savings indicated. The questionnaire will ask y to respond to 16 different age/savings combinations. Be sure t read BOTH age and savings before responding. Remember, you wil continue to work until age 65 earning $25,000 per year.

(After reading, type '&' to begin Part III.)

You are 35 years old. You will earn $25000 per year until age 65.
Your savings in your bank account is $ 43500.
How much would you consume at this age?

AGE	MONEY IN SAVINGS ACCOUNT	CONSUMPTION	EARNINGS
35 <--	43500 <--		25000
		(Enter number. Then type '&' to confirm.)	

PART IV--CONSUMPTION WITH DIFFERENT RETIREMENT AGES

Next we want to find out how much you'd spend on consumption if your retirement age were different from 65. We will ask you wh would consume at age 46, with $100,000 in your savings account, are to retire at some specified retirement age. We will ask yo 4 different retirement ages.

As usual, your earnings will be $25,000 per year until you reac given retirement age.

(After reading, type '&' to begin Part IV.)

You are 46 years old. You earn $ 25000 per year until retirement.
Your savings account balance: $500,000.
How much would you consume at this age if you retire at age 72?

AGE	MONEY IN SAVINGS ACCOUNT	CONSUMPTION	RETIREMENT AGE
46	500000		72 <----
		(Enter number. Then type '&' to confirm.)	

PART V--CONSUMPTION WITH DIFFERENT LIFETIME EARNINGS

Now assume again that you will retire at 65 but that your earni
vary throughout your working life. We will hold your savings c
at $65,000. Then we will show you an earnings profile and ask
how much you would consume at 3 different ages, given those ear
We will repeat this 3 times, showing you a different earnings p
each time. You will be asked for a total of 9 responses.

(After reading, type '&' to begin Part V.)

You are 35 years old, and your savings account balance is $65000.
Your annual earnings are listed below--notice you retire at age 65.
How much would you consume at this age, given these earnings?

AGE	MONEY IN SAVINGS ACCOUNT	EARNINGS
35 <--	65000	23200 from age 35 through age 44
		47800 from age 45 through age 54
	CONSUMPTION	32500 from age 55 through age 64

(Enter number. Then
type '&' to confirm.)

PART VI--CONSUMPTION WITH DIFFERENT INTEREST RATES

Next we want to find out how much you'd spend on consumption if
the interest rate were different from 4%. We will ask you what
would consume at age 46, with $90,000 in your savings account,
the interest rate indicated. We will repeat this 5 times, chan
the interest rate each time. Your earnings will be $25,000 per
until age 65.

(After reading, type '&' to begin Part VI.)

You are 46 years old. You earn $ 25000 per year until age 65.
Your savings in your bank account is $ 90000.
How much would you consume at this age if the interest rate were 0%?

AGE	MONEY IN SAVINGS ACCOUNT	CONSUMPTION	INTEREST RATE
46	90000		0% <--

(Enter number. Then
type '&' to confirm.)

PART VII--CONSUMPTION WITH CHANGING INTEREST RATE

Next we want to see how your consumption and saving decisio
are influenced by changes in interest rates over the course
your lifetime. Imagine that you are age 45, that you work
65 earning $25,000 per year, and that you die at age 75.
interest rate you receive on your savings is not, however,
The following table summarizes the interest rate you will f
each age. (They will be repeated on the next screen.)

(After reading, type '&' to begin Part VII.)

PART VII--CONSUMPTION WITH CHANGING INTEREST RATE

Now assume you are age 45 and will earn $ 25000 per y
you retire at age 65, and that you will die at age 75

Please enter your desired consumption for each year,
interest rate in each case. Type '&' after completin
entire column.

AGE	DATE	EARNINGS	CONSUMPTION	INTEREST RATE
45	Jan. 1, 1997	25000	0	2%
46	Jan. 1, 1998	25000	0	2%
47	Jan. 1, 1999	25000	0	2%
48	Jan. 1, 2000	25000	0	2%
49	Jan. 1, 2001	25000	0	2%
50	Jan. 1, 2002	25000	0	2%
51	Jan. 1, 2003	25000	0	2%
52	Jan. 1, 2004	25000	0	2%
53	Jan. 1, 2005	25000	0	4%
54	Jan. 1, 2006	25000	0	4%
55	Jan. 1, 2007	25000	0	4%
56	Jan. 1, 2008	25000	0	4%
57	Jan. 1, 2009	25000	0	4%
58	Jan. 1, 2010	25000	0	4%
59	Jan. 1, 2011	25000	0	4%
60	Jan. 1, 2012	25000	0	4%
61	Jan. 1, 2013	25000	0	6%
62	Jan. 1, 2014	25000	0	6%
63	Jan. 1, 2015	25000	0	6%
64	Jan. 1, 2016	25000	0	6%
65	Jan. 1, 2017	0	0	6%
66	Jan. 1, 2018	0	0	6%
67	Jan. 1, 2019	0	0	6%
68	Jan. 1, 2020	0	0	3%
69	Jan. 1, 2021	0	0	3%
70	Jan. 1, 2022	0	0	3%
71	Jan. 1, 2023	0	0	3%
72	Jan. 1, 2024	0	0	3%
73	Jan. 1, 2025	0	0	3%
74	Jan. 1, 2026	0	0	
75	Jan. 1, 2027	YOU ARE NOW DEAD		

PART VIII—RANKING DIFFERENT LIFETIME CONSUMPTION PROFILES

Again assume you are age 35 and will earn $ 25000 per year until you retire at age 65, and that you will die at age 75. Each of the following consumption plans will leave you with exactly zero dollars on the day you die. Rank them from 1 to 5, giving 1 to your most preferred and 5 to your least preferred.

(When finished, type '&' to exit.)

RANK

A. $21841 per year, every year
B. $16008 at age 35, growing 2% per year thereafter
C. $11240 at age 35, growing 4% per year thereafter
D. $28592 at age 35, falling by 2% per year thereafter
E. $23420 from age 35 until age 65, then $10921 from 65 to 75.

	Consumption In Selected Years				
AGE	A	B	C	D	E
35	21841	16008	11240	28592	23420
46	21841	19905	17303	22895	23420
65	21841	28997	36455	15597	10921
74	21841	34654	51887	13004	10921

PART IX—BUILD YOUR OWN CONSUMPTION PATH

You have 20 "points" to distribute amongst the age ranges to show the relative amounts you'd like to consume at various times in your life. For example, if you wish to consume the same amount in every year, put '5' in each column. If you'd rather consume more while you're young, and less while you're old, enter larger numbers first, then smaller numbers. The program will translate the numbers you type into consumption in each age range. You can modif your numbers until you're satisfied with your lifetime consumption path. Remember, you can type any numbers you like provided they add up to twenty. (NOTE: You still earn $25,000 per year until retiring at age 65.)

(Type '&' to begin Part IX.)

Allot your twenty points to the four decades of your life. You still earn $25,000 per year until retirement at age 65. Below the numbers you type will appear a translation of your points into consumption for the decade. ONCE YOU'VE ENTERED YOUR POINTS, TYPE '!' FOR TRANSLATION. YOU MAY DO THIS AS MANY TIMES AS YOU WISH. WHEN YOU ARE FINALLY SATISFIED WITH THE CONSUMPTION PATHS YOU HAVE CONSTRUCTED, TYPE '&' TO FINISH THE EXPERIMENT.

INTEREST/ AGE	35–44	45–54	55–64	65–74
.04	20	0	0	0
	53299	0	0	0
.08	20	0	0	0
	41944	0	0	0