Zeitschrift für Wirtschafts- u. Sozialwissenschaften (ZWS) 111 (1991), S. 169 - 185
Duncker & Humblot, Berlin 41

Risk Averse, Time Optimizing Behavior of Households: Comparison with German Microcensus Data

By Franz Gehrels*

The by-now generally accepted life-cycle hypothesis of Modigliani and Brumberg states that young earners save for their retirement years, during which they compensate for low retirement income by dissaving, leaving at the end some amount for their heirs. An alternative hypothesis is offered here, which takes account of risk aversion, and also of the fact that expected average income should have a rising path quite apart from the age factor. This is compared with German microsensus data for the year 1983. Data on age of household head, occupation, income, and size of family are arrayed against consumption and generally are consistent with the view that the life-cycle view needs significant modification.

This paper offers some further evidence on the Modigliani-Brumberg life-cycle hypothesis. The summary data are largely from the microcensus conducted by the German Central Statistical Office for the year 1983, covering 44 000 households. These provide information on consumption, saving, non-durable and durable expenditures, by six age groups and by five occupational classes. It was also possible to adjust these data for family size. Not available were the individual questionaire results, so that it was not possible to run regression experiments. Given the size of the sample, the averages for each cell have a high degree of reliability. Supplementary data on wealth accumulation are taken from a report of the Bavarian Bureau of Statistics for the year 1978.

The point of departure is a time-optimizing model with explicit treatment of risk aversion. While time-optimizing over a finite or infinite time-span is commonplace in the literature, formal treatments of response to uncertainty in this context are harder to find. Two examples which I am aware of are rather different from the aversion-to-variance model given in Section A below. So, for example, *Flavin* (1982) treats expectations of future income as subject to revision in response to unexpected changes in present income, but there is no explicit definition of a utility function with risk as an argument. This can be interpreted to mean that households revise expectations in a risk-neutral way; the path of expected income can of course be taken as rising or

* I wish to acknowledge the help received in obtaining data from W. Naggl and K. Uelses of Munich, and the comments from them and from R. Stout of Knox College, Galesburg Ill., and R. Britto of SUNY, Binghamton, N.Y.

falling or constant. One pair of authors who model a household-utility function with risk aversion are *Hansen / Singleton* (1983). They use the Neumann-Morgenstern notion of risk aversion, namely concavity of the utility function[1].

A further study, which uses panel data on food consumption, and distinguishes between temporary and longer-term income deviations is that of *Hall / Mishkin* (1982) who conclude that income changes thought to be "permanent" account for most of their observed changes in consumption. There is some harmony between what they find and the observations made below, except that their households are formally taken to act in a risk-neutral way. By contrast, in our model below households do indeed have a fair idea about their expectations, but are conscious of the variance around these.

One line not pursued in this paper is the effect of liquidity constraints on household spending, especially that of younger households. There are studies using U.S. data which find that liquidity has some effect. So, for example, *Hayashi* (1985), using the Federal Reserve study for 1962 - 63, divides his sample into low-saver and high-saver groups and finds that the liquidity constraint is operative for the former group. *Dolde* (1978) comes to a similar conclusion in a simulation study. *Flavin* (1985), using aggregated time-series data, explains the apparent reaction of consumption to income deviations by liquidity constraints, but uses the unemployment rate as a proxy for these.

Aside from the lack of German data to test this point, some justification for this neglect can be found in the high propensity to save of German households generally, compared with those in the United States. If average saving out of disposable income is between 15 and 20 percent for households in all age groups, even adjusting for contractual saving (as Hayashi does) would not bring many households to a position where they can not use their own assets or borrowing to enhance consumption. It may be added that the proportion of households below the poverty line is much smaller than that in the U.S.. For this reason, too, zero savers are likely to be few.

A second topic not receiving much attention in what follows is the subject of intergenerational transfers of wealth, recently reviewed both by *Modigliani* (1988) and *Kotlikoff* (1988). This I regard, in light of the evidence and argument below, as a complementary, rather than as a competing, explanation to the one offered below. That is, savers have residual wealth at the end

---

[1] *Hansen / Singleton* (1983) regress different measures of returns on financial assets on a consumption variable. Their risk-aversion parameter is the exponent in a utility function of the Form c^{τ}, where $\tau < 1$ indicates risk-aversion in the Neumann-Morgenstern sense. But this exponent did not turn out to be significantly different from one (see their Table 1, p. 258). Their underlying model was one of expected utility-maximization over an infinite time horizon.

of their lives because their dates of death are not known in advance, and because some of them have heirs. But this alone would not explain why time-series studies commonly show consumption varying with *current* income (exception: *Hall* 1978, who finds that past consumption best explains present consumption).

The evidence below suggests to this writer that time-optimization is strongly modified by, if not dominated by, a risk-avoiding response to changes of income. This is favored over either a simple life-cycle-permanent-income model or a habit-persistence model. These latter two, as *Muellbauer* (1986) points out, are difficult to distinguish empirically from one another, as expectations of income are heavily influenced by the experience of past income (see for example *Sargent's* (1978) modelling of expected income). Receiving more attention in the main discussion are the country studies appearing in a volume edited by *Modigliani / Hemmings* (1983). Here it is seen that countries of similar economic development and often with similar social-security systems have substantially different saving patterns. This leads to a discussion of how changes in social-security taxes and benefits affects aggregate saving (a topic in which Feldstein figures large).

A single-year cross-section examination by age-groups and by occupations assumes that under a given social framework and given cultural patterns households now young would one day act like presently older households, were society to stay unchanged. This contrasts with panel studies, which follow particular year-of-birth cohorts over time. These have the merit of giving evidence on households' responses to changes, either anticipated or surprise (as Hall and Mishkin do), but they can not be purified of changes in folkways and institutions during the same time span. But one particular consequence of the passage of time should not be omitted in evaluating the behavior of age cohorts, and that is the rate of increase in average income per head over time. If young households behaved as in the simple life-cycle model – and this means with good foresight – they should save much less than they do, because their future incomes on average will be much higher than those of the presently older, higher-earning age groups. The fact that they do not we take as a telling point against the simple levelling-of-consumption hypothesis.

A. A Risk-Averse Time-Optimizing Model

The purpose here is to provide a model of household behavior which takes account of the uncertainties of the real world. Households are taken to behave sensibly, rationally, given their knowledge of the future. There is no way, even with access to all present information, to make a certain forecast of the future. Some degree of risk aversion is therefore normal for house-

holds; but we do not attempt to state what degree of aversion to risk a household ought to have. In general there is no way to avoid risk completely.

The following dynamic-programming representation is intended to provide an intuitively direct way to the optimal behaviour of households[2]. The utility function of the representative household which is to be maximized is written as

$$\max U = \max \left[\sum_{t=0}^{T+1} U_t (C_t, K_t, V_t) R_t^{-1} \right] \tag{1}$$

C_t is consumption in period t; K_t is the expected value of capital owned by the household; V_t is the variance of expected income around its forecast, Y_t. R_t is defined as $(1 + r)^t$, r being the rate of interest available to the household, and R_t^{-1}, the discount factor applied to all future values. The maximand U is subject to

$$K_{t+1} = s_t Y_t + K_t \tag{2}$$

This states that the expected capital sum at time $t + 1$ depends on saving out of expected income and the expected capital sum at date t. Actual income at time t is defined by

$$Y_t = \tilde{K}_t G_t + \tilde{w}_t + \varepsilon_t = \tilde{Y}_t + \varepsilon_t \tag{3}$$

G_t is the expected growth factor of capital, being the sum of value increments (market-value increases, interest and dividends). w_t is earned income in period t from wages and self-employment. We make here the restrictive assumption that the amount of effort going into "earned" income is fixed; that is, there is no adjustment between leisure and income in response to, say, a change in the wage rate. ε_t is the random error term in forecast income, and V_t, the variance, is defined as

$$V_t = E(\varepsilon_t^2) \tag{4}$$

In order to solve this we first write the following Bellman equation

$$W_t = \max [U_t (C_t, \tilde{K}_t, V_0) R_t^{-1} + W_{t+1}] \quad \text{for } t = 0, 1, \ldots, T \tag{5}$$

This states that consumption and capital are to be allocated among periods so as to maximize the sum of their discounted utilities over all future

[2] It follows, with modifications, the style of argument of *Sargent* (1987) Ch. 1, which in turn has its roots in *Bellman / Dreyfus* (1962). The attention to expected variance but not to the third order or higher moments in expression (1) below implies either a symmetric density function (not necessarily normal) or a willingness to neglect these higher moments even if they exist.

periods. We assume a strictly concave utility function, and financial constraints on the household broad enough that an interior solution is attainable. We now differentiate W_t totally with respect to $\bar{K}_t$ for all t (supposing that (5) has already been solved by the dynamic programming algorithm) to obtain.

$$(6)\quad W'_{t+1}(\bar{K}_{T+1}) = (\delta U_{t+1} / \delta \bar{K}_{T+1}) \cdot R^{-1}_{T+1}$$

$$W'_T(\bar{K}_T) = [\delta U_T / \delta \bar{K}_T + (\delta U_T / \delta V_T)(\delta V_T / \delta \bar{K}_T)] R^{-1}_T + W'_{T+1}(\bar{K}_{T+1}) \cdot (\delta \bar{K}_{T+1} / \delta \bar{K}_T)$$

$$W'_t(\bar{K}_t) = [(\delta U_t / \delta \bar{K}_t) + (\delta U_t / \delta V_t)(\delta V_t / \delta \bar{K}_t)] R^{-1}_t + W'_{t+1}(\bar{K}_{t+1})(\delta \bar{K}_{t+1}) / (\delta \bar{K}_t)$$

$$W'_o(\bar{K}_o) = \delta U_o / \delta \bar{K}_o + (\delta U_o / \delta V_o)(\delta V_o / \delta \bar{K}_o) + W'_1(K_1)(\delta \bar{K}_1 / (\delta \bar{K}_o)^3$$

By successive substitution we eliminate the W'_{t+1}'s on the right-hand side of each expression and obtain an expression only in the marginal utilities (positive for the K_t's, and negative for the V_t's). And so W_o becomes

$$(7)\quad W'_o(\bar{K}_o) = (\delta U_o / \delta V_o)(\delta V_o / \delta \bar{K}_o) + \delta U_o / \delta \bar{K}_o +$$

$$+ [(\delta U_1 / \delta V_1)(\delta V_1 / \delta \bar{K}_1) + \delta U_1 / \delta \bar{K}_1](\delta \bar{K}_1 / \delta \bar{K}_o) R^{-1} +$$

$$+ [(\delta U_\tau / \delta V_\tau)(\delta V_\tau / \delta \bar{K}_\tau) + (\delta U_\tau / \delta \bar{K}_\tau)] \prod_{k=0}^{T-1} (\delta \bar{K}_{k+1}) / (\delta \bar{K}_k) \cdot R^{-1}_T +$$

$$+ (\delta U_{\tau+1} / \delta \bar{K}_{\tau+1}) \prod_{k=0}^{T} (\delta \bar{K}_{k+1} / \delta \bar{K}_k) \cdot R^{-1}{}_{T+1}$$

It is clear that for a maximal W'_o with respect to $\bar{K}'_o$ each successive $W'_t(\bar{K}_t)$ must also be maximal. Since both terms in each square bracket are positive (the disutility of risk is diminished by increasing $\bar{K}$), and each bracket is diminishing in $\bar{K}$ a maximum is reached when these brackets each weighted

---

[3] Of interest is also that the $W't(\bar{K}_t)$ are equivalent to the multipliers in the Lagrangean form corresponding to (1):

$$L = \sum_{t=0}^{T} U_t(C_t, \bar{K}_t, V_t) R^{-1}t + \sum_{t=0}^{T} \mu_t(\bar{K}_{t+1} - sY_t - \bar{K}_t)$$

$$\delta L / \delta \bar{K}_t = [\delta U_t / \delta \bar{K}_t + (\delta U_t / \delta V_t)(\delta V_t / \delta \bar{K}_t)] R^{-1}t + \mu_t(\delta \bar{K}_{t+1} / \delta \bar{K}_t - 1) + \mu_{t-1}$$

But at an optimum the present values μ_t are all equal, so that one has

$$\delta L / \delta \bar{K}_t = [\delta U_t / \delta \bar{K}_t + \delta U_t / \delta V_t \cdot \delta V_t / \delta \bar{K}_t] R^{-1}t + \mu(\delta \bar{K}_{t+1} / \delta \bar{K}_t)$$

$$t = 0, 1, \ldots, T$$

See the similar argument of *Sargent* (1987), 18 in a certainty context.

by the product of discount factor and capitalization factor are all equal. If the capital market is such that households get the same return on investment as they pay when borrowing the weights all become unity, and the household simply balances *undiscounted* marginal utilities.

It was not necessary to include in (6) or (7) the marginal utility of consumption, although consumption adjustments are the means for reallocating capital between different dates of the future. For each point in time we can write

$$(8) \qquad (\delta U_t / \delta C_t) R_t^{-1} + W'_{t+1}(\tilde{K}_{t+1})(\delta \tilde{K}_{t+1} / \delta C_t) = 0 \qquad t = 0, 1, \ldots, T$$

This states that consumption is adjusted so as to balance present satisfaction against that over the entire future. Had we included the utility changes of consumption in (6) (which means multiplying the expression above by $dC_t / d\tilde{K}_t$) these would have cancelled out.

But (8) does give information about the effect of risk aversion on the time-allocation of consumption, and so of the household's capital, over its lifespan. Consumption at time t affects the capital stock and the degree of risk at time $t+1$. K_t and V_t are measured at a point in time while C_t is a flow occuring in the short interval between t and $t+1$. With diminishing marginal utility, present consumption must be reduced in order to match additional loss of utility from diminishing $\tilde{K}_{t+1}$ ($\delta \tilde{K}_{t+1} / \delta C_t$ is negative) given that this has an effect on the degree of risk [$(\delta U_{t+k} / \delta V_{t+k})(\delta V_{t+k} / \delta \tilde{K}_{t+k})$ is positive] for all k in $W'_{t+1}(\tilde{K}_{t+1})$. This is true for all t up through $T-1$. At T, the terminal date, we assume that the household is interested only in the capital sum at $T + 1$ and no longer in the stability of income from it.

We wish still to compare the terms $\delta \tilde{K}_{t+1} / \delta \tilde{K}_t$ (appearing first in (6)) and $\delta \tilde{K}_{t+1} / \delta C_t$. The first is the contribution to capital owned at $t+1$ from increasing the capital stock at t by one unit, and is positive. The latter term is the consequence for the amount of capital at $t+1$ of increasing consumption at t by one unit (or reducing the capital stock at t), and is therefore negative. Formally,

$$(12) \qquad \delta \tilde{K}_{t+1} / \delta \tilde{K}_t = -(\delta \tilde{K}_{t+1} / \delta C_t) = G = 1 + g$$

In other words, G, the growth factor, is one plus the marginal return of capital, g, to the household. In addition we have the interest factor R, which should have a relation to G. Some authors (*Hall* 1978, *Sargent* 1978, 1987, *Becker* 1980, 1987, inter alia) have seen no need for the growth factor G to equal the interest factor R, even under certainty. The contention here is that under certainty the two must match because all investors, borrowers and lenders have full information and there can be no failures and no limits to

borrowing and lending and no discrimination to access. With *uncertainty,* here explicitly assumed, and with it incomplete knowledge and access, different debtor households can face different borrowing conditions, and saver households can have different investing opportunities. Moreover, borrowers can be rationed, and so their discount rate can be higher than the interest saved by reducing debt by one unit ($R > G$). On the other hand, saver households are not rationed – they can always change their capital by saving positively or negatively, at the same return – and for them the two rates should be the same ($R = G$)[4].

As the household ages, and assuming that its expectations are fulfilled, more or less, the second term of (8) may change. On the one hand the effect of additional saving on variance becomes smaller because the ratio of stable to unstable income becomes larger – earned income drops and capital income plus pension income rises. That is to say, $\delta V_t / \delta K_t$ becomes smaller. On the other hand, the aversion to risk on the part of aging households probably becomes greater, so that $\delta U_t / \delta V_t$ increases absolutely.

A third element which changes in time is the size of the household. The typical household has its greatest membership and greatest needs in its first quarter-century and declining needs thereafter, as children are educated and leave the household. These three elements – declining variance, increasing risk aversion, and shrinking household membership – can be weighted differently to give different results for the time path of household consumption.

What predictions about real world data can be generated by the model analysed above?

(a) In a world of relative certainty consumption of a household would still change as it ages, because of altering membership and changing tastes. With stable income it could well decide to continue saving during the retirement phase of life, in order to provide an estate of some predetermined size. With much less income in the retirement phase, saving should however be negative. But in a world of rising per capita income younger age cohorts should have low or negative rates of saving because their lifetime incomes will be

---

[4] This is in harmony with Böhm-Bawerk and Irving Fisher. In the optimal-growth literature it is common to define a discount factor for economic planners (e.g., for consumption per head) which is generally not the same as the rate of return on capital. Some authors, e.g., *Becker* (1980), and *Becker / Folas* (1987) define a discount factor for *consumers*, which differs from one individual to another. This can of course be done but may obscure the fact that the *marginal* rate of discount must in a perfect market be the same for all individuals and firms. Different time perspectives among individuals can of course lead to different accumulations of wealth among them, but this is only *one* reason, as we show here. *Tobin* (1967) deserves credit for reminding us that Fisher was the first to formulate the life-cycle hypothesis. However, Fisher's conclusion that saving is an upward sloping function of the interest rate is a *non sequitur*.

much higher than those of their seniors. This would be consistent with the time-leveling of consumption and with dissaving during retirement.

(b) In a world of uncertainty where predictions on the average are nevertheless fulfilled, expression (7) would predict less consumption and more saving in the early, active phase of a household's life, and an upward revision of consumption later, as the threats during the early phase are successfully met. This would only be modified by the increasing caution of the elderly. In other words, in such a world risk aversion properly interpreted should lead to a rising tendency for consumption. The reward for early caution is the possibility of consuming more in later life, and dissaving correspondingly. Life-cycle behavior on the part of households (saving in the early, earning phase, dissaving in the late, non-earning phase) is reinforced by risk-aversion.

(c) If, on the other hand, awareness of unfavorable events is given too little weight, the observed behavior of households should be consumption too high and saving too low in the first phase, and positive saving despite low income in the second phase. It may be that the great disasters – World War II, the great depression of the 1930's, political upheavals – are especially difficult to think of in advance. And the possibility of providing against them are, for most households, nonexistent.

B. Comparison with Some Evidence

If indeed households had a high degree of foresight one would expect to observe a marginal propensity to consume for variations of income from trend close to zero. One would also expect a high degree of substitutability between social security tax (with corresponding deferred income) and current saving, both in time comparisons for individual countries, and for comparisons between countries of similar economic development. For intergenerational comparisons one would expect drops of consumption per head for the retired parts of the population (because their lifetime incomes are less than those of younger cohorts), but with low or negative saving. From the conclusion above, the flow of household saving would not respond positively to the rate of interest, whereas the rate of consumption would, through the effect of the interest rate on future wealth – but only if the rate-of-interest change is viewed as permanent[5].

---

[5] Empirical evidence on the effect of the interest rate on saving is sparse and inconclusive. So, for example, *Carlino* (1982) takes interest income as part of lifetime income (which suggests that consumption should be an increasing function of the interest rate). But his regressions with time series data gave inconclusive results. *Boskin* (1978) also used aggregate time-series data and found that the rate of interest was one of the variables with a significant (negative) effect on consumption.

On the first point, time-series studies generally yield marginal propensities to consume considerably greater than zero, in contradiction to the hypothesis of (almost) perfect foresight. It will be seen below that German cross-section data tend to strengthen this picture.

With respect to the social-security-tax-hypothesis, *Feldstein* (1983 and earlier), offers evidence from U.S. data in support of the view that the saving goal is partly met by the compulsory saving implicit in the social security tax[6]. However, this conclusion is not confirmed by the cross-country study of *Modigliani/Sterling* (1983). Moreover, it is not confirmed by at least one particular-country study, that of *Bentzel/Berg* (1983) on Sweden; and only weakly supported by that of *Shinohara* (1983) on Japan. Generally there are countries with high social-security benefits and high savings ratios (Germany, Netherlands, France); others with high benefits and low savings (Scandinavia); and still others with only moderate benefits but low savings (the United States and Great Britain).

Another piece of evidence from intercountry comparisons is an apparent positive relation between rate of saving and rate of growth of the national product. Modigliani/Sterling (1983), 25 take growth as the cause and saving as the consequence. Rising household income, they argue, causes imbalance between wealth and income, and leads to more saving in order to restore the desired relation. This explanation (which implies surprise) is not quite consistent with their apparent advocacy of the simple life-cycle thesis. If the household has good foresight, it should consider financial assets and tangible wealth in relation to the sum of life time income, and not relatively to terminal income. A steeper (but foreseen) time-path of income should involve a different time-path of saving (early dissaving, later stronger positive saving) but not a greater aggregate when properly discounted.

More persuasive is the argument that a higher rate of aggregate saving (of which one part is household) leads through conditions on financial markets to higher investment. This is turn leads to an increasing capital-labor ratio and a younger physical capital stock – innovations come to fruition faster – and observer growth is also faster.

Some additional evidence on life-cycle behavior is provided by cross-sectional age-group microcensus data for West Germany, from the German Central Statistical Office (Statistisches Bundesamt) made for the year 1983.

---

[6] The Feldstein evidence in his 1983 paper is that the social security tax does reduce current saving but possibly by less than one-for-one. He views his findings as generally supporting the life-cycle hypothesis, in that retirement may be extended but private dissaving also diminishes because of social-security income. His earlier view, as I understand it, was that the social security system had a negative effect on aggregated net saving over all age groups. Somewhat unsatisfactory to this reader was that his regression coefficients β_1, relating life-time income to net worth, were negative rather than positive (see both tables 1 and 2).

Table 1 summarizes a part of these and calculates some significant ratios. Lines 1 und 2 show that household consumption expenditure rises and falls with income, the peak for both being in the age groups 35 - 45 and 45 - 55. The consumption propensity is highest for the age group 25 - 35, falls to its lowest value for the age group 45 - 55, then rises with another high in the age group 65 - 70; but the changes are not dramatic. Tending to even out the time path of consumption a little is the separation of durables, the purchase of which falls markedly for the age groups 65 - 70; and over 70. Nevertheless, the picture is one of consumption varying strongly with income and evened out only a little by the age factor. And the calculated propensity to save out of disposable income is near 20% for the two highest age groups. "Observed" saving as defined here includes recorded changes of assets and liabilities: retained earnings, savings accounts, home savings contracts, purchase of securities, real estate purchases and sales, house improvements, etc. This is about half the magnitude of saving in the sense of non-consumption. But its variation is in the same direction. Again, *all* age groups are net accumulators of assets, with the two oldest groups diminishing their accumulation ratios, as well as their absolute rates[7].

The microcensus for 1983 consisted of 44 000 households who responsed by printed questionaire. The individual cells generally had a sufficiently large number of responses (seldom less than 100) that even a large sample standard deviation would have led to a very small standard deviation of the mean. Because of some non-responses the possibility of sampling bias can not be excluded. See Fachserie M, Reihe 18, No. 6 (Statistisches Bundesamt), Aufgabe, Methode und Durchführung der Einkommens- und Verbrauchsstichprobe, 1969.

Further evidence on the behavior of assets is provided by a study of the Bavarian Bureau of Statistic for the year 1978. A part of these data is summarized in Table 2. This shows that ownership of securities increases with each age jump; that indebtedness disappears in the highest category; and that other categories decline only slightly in the upper age brackets. This, too, is consistent with the picture that positive saving continues to the end and is matched by asset accumulation.

[7] The picture given in Table 1 differs from that offered by *Hayashi* (1985) from the 1962 - 63 cross-section data in the U.S. Federal Reserve's *Survey of Financial Characteristic of Consumers*. His Table III takes only four age groups, with the two youngest saving little, and the two oldest saving much (the minimal age being 64). He does not state how much contractual saving accounts for. By far the highest saving occurs in the oldest age group.

Table 1

Net Income, Expenditure and Saving of Households by Age of Head, West Germany, 1983

	25 - 35	35 - 45	45 - 55	55 - 65	65 - 70	≥ 70
1. Net income (monthly)	3,183	4,370	4,397	3,472	2,800	2,115
2. Consumption expenditure	2,617	3,356	3,358	2,678	2,283	1,666
a) Durables	393,3	484,7	492,7	350,1	234,6	114,5
b) Nondurables	2,224	2,871	2,865	2,328	2,084	1,551
3. Saving* (observed)	1.378,9	600,7	594,4	452,2	288,5	226,4
4. Consumption propensity	.8222	.7703	.7637	.7713	.8154	.7877
5. Observed saving share (3 ⁄ 1)	.1190	.1375	.1352	.1302	.1030	.1070
6. Durables as share of income	.1236	.1109	.1121	.1008	.0838	.0541
7. Nondurables as share of income	.6987	.6570	.6516	.6705	.7314	.7333

Sources of data in rows 1 to 3: Statistisches Bundesamt, Fachserie 15, Einkommens- und Verbrauchsstichprobe 1983, Heft 4, Einnahmen und Ausgaben privater Haushalte.

Table 2

Households with Selected Assets and Liabilities by Age Group in Bavaria, Dec. 31, 1978 (values in DM)

	Age Group under 25	25 - 35	35 - 45	45 - 55	55 - 65	65 and over	% of Households
Asset							
Saving accounts	7,680	8,730	11,200	14,500	15,170	14,410	92.3
Home savings contracts	–	13,200	12,530	10,960	9,590	9,490	42.7
Securities	–	10,410	13,440	20,700	21,540	28,620	32.2
Property	–	36,250	40,320	42,640	36,210	37,620	51.4
Indebtedness	–	8,790	8,690	8,340	5,320	–	11.3

Note: The last column indicates the percentage of households in all age groups who hold the particular asset or have debt.

Source: Bavarian Bureau of Statistics, Income and Consumption Sample, 1978, Vol. 379a, Beiträge zur Statistik Bayerns, pp. 160 - 162.

A further partial answer to the apparently paradoxical inter-country results cited above is provided by still a third piece of evidence, again from the Statistisches Bundesamt study for 1983. This is shown in Table 3, where income, consumption and saving are shown for samples from five occupational groups: farmers, self-employed, government officials, salaried workers, and blue-collar workers. The striking difference is between the self employed and all other groups – these have a markedly lower consumption propensity that the others. At the same time government officials have a higher consumption propensity than salaried workers. Both observations are consistent with the fact that the self-employed must provide more of their retirement consumption out of their own savings, and that government officials enjoy better pension benefits than other salaried workers (approximately three-fourths of highest income compared to two-thirds). Here is some support for the Feldstein position – that more social security benefits with supporting current net income reductions, reduce the propensity to save.

Table 3

Net Income, Expenditure and Saving of Households, Age Group 45 - 55 by Occupation, West Germany, 1983

	Farmers	Self-Employed	Government Officials	Salaried Employees	Blue-Collar Workers
1. Net income (monthly)	4,457	6,586	5,322	4,826	3,777
2. Consumption expenditure	3,537	4,096	4,182	3,690	3,022
a) Durables	457,0	587,7	570,2	556,6	467,1
b) Non-durables	3,080	3,508	3,612	3,033	2,555
3. Saving (observed)	517.1	1,504	648.7	652.3	412.7
4. Consumption propensity	.7936	.6219	.7859	.7646	.8001
5. Observed saving share (3 ÷ 1)	.1160	.2284	.1219	.1352	.1093

Source of data: See Table 1.

What is not so clear is what happens to the rate of saving of the households *plus* that of the pension- or social-security fund. The salary reduction, explicit or implicit, provides more saving on the part of the fund. If the private saving reduction is less than the reduction of disposable income, as seems to be the case, then there is an initial net gain of saving. But the story

does not end there: If the fund makes current outpayments just equal to the accruals, and pension recipients save the same proportions as wage and salary earners, then there is no effect on total saving. Saving from all sources neither increases nor decreases. The German evidence just cited is that pensioners save almost the same proportion of income as the active population. In this case the effect of the entire operation is to leave saving unchanged; upward or downward changes in the social-security tax and benefits have no net effect. The Feldstein conclusion requires for its validity that pensioners have low or zero marginal saving propensities out of their changed pension incomes – in any case lower than the active population. In the particular case of the United States the Social Security Fund enjoys growing surpluses, owing to the more rapid growth of the active population compared to the retired part. Hence in that particular case the net consequence of any change in the tax is to change saving in the same direction. At some time in the intermediate-term future the opposite may occur in Germany – the number of pensioners outgrowing the active population. In that event the net effect of the fund could indeed be to reduce saving and increase consumption relatively to GNP. But this last result depends on the fund running a deficit, and *not* on a changed aggregate propensity to save out of disposable income.

Two last pieces of evidence are provided by Tables 4 and 5. Both use an adjustment for household size by age group to calculate income and consumption *per member* of the household. The former pertains to all households, and the latter, to self-employed and independent professionals. Table 4 taken alone gives the impression that there is so far little basis for discrimination between two hypotheses: One is that consumption per capita remains stable over the life-cycle because of good foresight, and the other is that consumption remains stable because income over the life-cycle remains stable. The latter says that people do not have a clear view about their lifetime average income, other than that these will be about the same as present incomes. Either they do not think far ahead, or they lack solid information for a more complex calculation than to project present income.

However, an observer armed with the knowledge that per capita national product has been rising at better than 2% in West Germany in past decades would expect households on the average to project their incomes on this basis, so that younger households would have higher per capita consumption than older households, even with lower incomes per member. A 2% growth rate implies that a young household should have a lifetime income roughly 50% higher than an old household, and consumption should under certainty (or under risk neutrality) be correspondingly higher. The actual picture is consistent with either risk aversion, with correspondingly reduced spending or possibly with interdependence of consumption behavior (each

adjusts to the consumption pattern he observes around him); or possibly institutional limits on the borrowing power of young households. But the last hypothesis is weakened by the fact that young households are still strongly positive savers.

The impression of risk averse behavior is strengthened by the data on independent households in Table 5. In this group the level of income and of consumption per head rises strongly with the age groups over 55. Here the degree of uncertainty about future income should be especially high in the younger age groups, and the favorable outcomes of later years (on the average) cause an upward adjustment of spending. Again, the simple life-cycle hypothesis, with its implicit assumption of good foresight, suffers serious damage.

Table 4

Consumption per Member of German Households, 1983

Age Group	Size of Household	Income per Member (DM/month)	Total Consumption per Member (DM/month)	Nondurable Consumption per Head (DM/month)
25 - 35	2.322	1,371	1,127	958
35 - 45	2.985	1,464	1,128	962
45 - 55	2.889	1,522	1,162	992
55 - 65	2.194	1,582	1,221	1,088
65 - 70	1.630	1,718	1,401	1,256
over 70	1.399	1,512	1,191	1,086

Note: Data for calculation of Col. 1 were supplied on request by the Statistisches Bundesamt.

Table 5

Net Income and Expenditures, Adjusted for Size of Household, for Self-Employed and Independent Professionals, 1983 (DM per month)

Age Group	Net Income	Consumption	Income per Head	Consumption per Head
25 - 35	4,515	3,269	1,944	1,408
35 - 45	4,504	3,967	1,509	1,329
45 - 55	6,589	4,096	2,280	1,418
55 - 65	6,480	3,768	2,954	1,717
65 - 70	6,694	3,928	4,107	2,410
over 70	5,446	3,369	3,893	2,408

C. Concluding Remarks

The picture which may best fit the evidence given above is one of households with strong subjective uncertainty about their own futures. Even those with steadily rising income – and this applies to most young households – adopt a cautious attitude and save positively. Higher future income is not spent in advance but spent when realized. This seems most clearly the case for the self-employed and the independent professionals. Households of all ages are from the German data positive savers; but at the same time they adjust consumption roughly in proportion to current income.

An almost self-evident by-product of these cross-sectional findings is their implication for the Keynesian multiplier. The life-cycle hypothesis implies a multiplier close to one for deviations from trend of autonomous spending such as investment, government spending, or exports – that is, consumption would not respond to variations of income (rightly) viewed as temporary. The view that foresight is imperfect and often revised (which is consistent with the evidence given here) implies that surprise-changes of income do alter expectations in the same direction. Consumption adjusts to the change in expected income, and the multiplier implied by this is considerable greater than one.

A last point to be made refers to the supply of saving in response to the return on personal investment. In a world of relative certainty it follows from the model above that households equate undiscounted marginal utilities of consumption for different dates. But higher returns on saving imply greater wealth over the life of the household, and therefore greater consumption. If one now takes two societies which are alike in every way except in their stocks of real capital, households in the capital-poor country would have a low propensity to save out of current income, compared to those in the capital-rich country.

To be sure, business saving can respond positively to the return on new investment (which we take to be proportional to that on the existing capital stock). It seems plausible that business saving in the form of retained earnings would be higher in the capital-poor country. But the household propensity to save (and so the absolute level) tends to be less.

In a world of uncertainty the ability of households to provide against contingencies is similarly improved with a high return on saving. And so the need to accumulate reserves is correspondingly reduced. The introduction of uncertainty does not change the conclusion that a higher permanent rate of interest elicits less saving rather than more, from households.

Summary

This paper uses a discrete finite-time, risk-averse, expected-utility model of households to explain their lifecycle behavior. Its theoretical predictions, namely, early high saving despite expectations of rising income, and later rising consumption, as expectations are realized, are consistent with German microcensus data for the year 1983. Important is the expectation of rising productivity and real income per head for the economy as a whole. Adjusting both income and consumption for family size had a strong smoothing effect over time on both variables. Saving remains strongly positive for all age groups, consistently with risk aversion.

Zusammenfassung

Der Aufsatz benutzt ein risikoaverses Modell des erwarteten Nutzens der Haushalte, mit diskreter, endlicher Zeit, um deren Verhalten über den Lebenszyklus zu erklären. Die theoretischen Prognosen daraus, nämlich frühes hohes Sparen trotz Erwartung des steigenden Einkommens und später steigendem Konsum, wenn Erwartungen in Erfüllung gehen, stimmen mit den deutschen Mikrozensusdaten des Jahres 1983 überein. Wichtig hierbei ist die Erwartung der steigenden Produktivität und des Realeinkommens pro Kopf, für die gesamte Wirtschaft. Die Korrektur des Einkommens und des Konsums für die Zahl der Familienmitglieder hat einen starken, zeitglättenden Effekt auf beide Variablen. Die Sparquote bleibt hierbei für alle Altersgruppen stark positiv, im Einklang mit der Risikoaversion.

Literature

Becker, R. A. (1980), On the Long-Run Steady State in a Simple Dynamic Model of Equilibrium with Heterogeneous Households. Quarterly Journal of Economics 95, 375 - 388.

Becker, R. A. / *Folas,* C. (1987), A Characterization of Ramsey Equilibrium. Journal of Economic Theory 41, 173 - 184.

Bellman, R. / *Dreyfus,* S. (1962), Applied Dynamic Programming. Princeton.

Bentzel, R. / *Berg,* L. (1983), The Role of Demographic Factors as a Determinant of Savings in Sweden, in: F. Modigliani / R. Hemming (ed.) The Determinants of National Saving and Wealth, London.

Boskin, M. J. (1978), Taxing, Saving and the Rate of Interest, Journal of Political Economy 89, 3 - 27.

Carlino, G. A. (1982), Interest Rates and Intertemporal Consumption, Journal of Monetary Economics 9, 223 - 234.

Dolde, W. (1978), Capital Markets and the Short-Run Behavior of Life-Cycle Savers. Journal of Finance 33, 413 - 424.

Feldstein, M. (1983), Social Security Benefits and the Accumulation of Preretirement Wealth, in: F. Modigliani / R. Hemming, loc. cit., 3 - 23.

Flavin, M. (1985), Excess Sensitivity of Consumption to Current Income: Liquidity Constraints or Myopia. Canadian Journal of Economics 18, 117 - 136.

Hall, R. E. (1978), Stochastic Implications of the Life-Cycle Permanent Income Hypothesis: Theory and Evidence. Journal of Political Economy 89, 971 - 988.

Hall, R. E. / *Mishkin,* F. S. (1982), The Sensitivity of Consumption to Transitory Income: Estimates from Panel Data on Households. Econometrica 50, 461 - 481.

Hansen, L. P. / *Sargent,* T. (1982), Instrumental Variables Procedures for Estimating Linear Rational Expectation Models. Journal of Monetary Economics 9, 263 - 296.

Hansen, L. P. / *Singleton,* K. J. (1983), Stochastic Consumption Risk Aversion and the Temporal Behavior of Asset Returns. Journal of Political Economy 92, 249 - 65.

Hayashi, F. (1985), The Effect of Liquidity Constraints on Consumption: A Cross-Sectional Analysis. Quarterly Journal of Economics 1, 183 - 205.

Kotlikoff, L. J. (1988), Intergenerational Transfers and Savings. Journal of Economic Perspectives 2, 41 - 58.

Modigliani, F. (1988), The Role of Intergenerational Transfers and Life Cycle Saving in the Accumulation of Wealth. Journal of Economic Perspectives 2.

Modigliani, F. / *Sterling,* A. (1983), Determinants of Private Saving with Special Reference to the Role of Social Security Cross-country Tests, in: F. Modigliani / R. Hemming, loc. cit., 24 - 55.

Muellbauer, J. (1986), Habits, Rationality and Myopia in the Life-Cycle Consumption Function. Centre for Economic Policy Research, Discussion Paper Series 112.

Sargent, T. J. (1978), Rational Expectations, Econometric Exogeneity, and Consumption. Journal of Political Economy 86, 673 - 700.

— (1987), Dynamic Macroeconomic Theory. Cambridge/Mass.

Shinohara, M. (1983), The Determinants of Post-war Savings Behavior in Japan, in: F. Modigliani / R. Hemming, loc. cit., 201 - 218.

Tobin, J. (1967), Life-cycle Saving and Balanced Growth, in: W. Fellner (ed.), Ten Economic Studies in the Tradition of Irving Fisher. New York.