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THE DISSAVING OF ANNUITY WEALTH AND MARKETABLE WEALTH IN RETIREMENT

BY THAD W. MIRER

State University of New York at Albany

This paper compares the automatic dissaving of annuity wealth with the discretionary dissaving of marketable wealth that would result from life-cycle consumption behavior by retired persons. In simulations of a life-cycle model based on the isoelastic utility function and realistic parameter values, we find that marketable wealth normally would be dissaved more rapidly than annuity wealth. This suggests that empirical findings that show the opposite relation—slow dissaving of marketable wealth being accompanied by faster dissaving of annuity wealth (or total wealth)—should not be interpreted as evidence that supports the life-cycle theory.

1. INTRODUCTION

At the time of retirement the present discounted value of future pension and Social Security benefits, which we call "annuity wealth," can be quite substantial. Indeed, for many persons and families holdings of annuity wealth are larger than those of marketable wealth (Quinn, 1985). Taking this form of wealth into account is important in a number of research areas, and it can be especially important in the study of wealth-age profiles and saving behavior.

In his 1985 Nobel Prize lecture, Modigliani (1986, p. 306) comments on a number of empirical studies that look at the wealth of the aged. Some of these show dissaving in old age to be quite modest, in apparent contradiction to the life-cycle hypothesis, but others show dissaving to be more rapid. He notes that the dissaving appears weak or even absent if the wealth measure includes only marketable wealth, but that it becomes quite pronounced if estimates of Social Security and pension benefits are included. That is, taking annuity wealth into account seems to make the evidence more supportive of life-cycle theory.

How does this apply to looking at empirical wealth-age profiles and trying to assess what they say about saving behavior? The age profile of marketable wealth is determined by discretionary behavior. According to life-cycle theory, discretionary dissaving by retired persons eventually results in marketable wealth decreasing over time. (Life-cycle dissaving can be negative in the early years of retirement, causing marketable wealth to increase with age.) The age profile of annuity wealth, by contrast, is determined by actuarial definition. The consequent automatic "dissaving" normally results in annuity wealth decreasing over time, but (as noted below) annuity wealth can increase with age under unusual circumstances.

Now, suppose that some data show that slow or modest dissaving of marketable wealth is accompanied by more rapid dissaving of annuity wealth, so that

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total wealth also is dissaved more rapidly than marketable wealth.[1] One might reason, then, that the evidence on total wealth is more supportive of life-cycle theory than is the evidence regarding just marketable wealth alone. For example, in a study of pension wealth and wealth-age profiles, McDermed, Clark, and Allen (1989, p. 730) state that "the inclusion of pension wealth into a measure of net worth will bring the life-cycle pattern of net worth more in conformity with the predictions of the life-cycle savings hypothesis. . . . [D]uring the retirement years, the inclusion of pension wealth will accelerate the decline in net worth."

This logic would make sense only if life-cycle theory predicts that it is normal for marketable wealth to be dissaved less rapidly than annuity wealth. Otherwise, data showing this relation between the two forms of dissaving should be considered evidence against the theory. Moreover, such evidence would be consistent with alternative theories, including those that emphasize a bequest motive.

What does life-cycle theory predict in this regard? The theory, of course, does not directly address the dissaving of annuity wealth. However, since an individual's discretionary dissaving of marketable wealth and automatic dissaving of annuity wealth both depend on the same interest rate and mortality factors, it seems plausible that life-cycle theory would imply some linkage between the rates of dissaving of the two forms of wealth.

In this paper we explore this linkage by examining the age profiles for marketable wealth that arise in a life-cycle model and comparing them with the corresponding age profiles for annuity wealth. These comparisons are made in a set of simulations that are based on the isoelastic utility function, using a variety of values of the main economic parameters and a realistic set of mortality rates. The aim of all this is to provide some guidance to researchers who are trying to interpret wealth data in terms of the life-cycle theory of consumption. Although most of our attention is devoted to what occurs at the individual level, we also look at the linkage at the aggregate level.

In what follows, section 2 presents a life-cycle model that is designed to reflect the essential realities of retirement. Section 3 contains the main results, which are comparisons of the wealth-age profiles. Section 4 extends our considerations to aggregate wealth holding. Section 5 contains a brief conclusion.

2. A LIFE-CYCLE MODEL OF CONSUMPTION IN RETIREMENT

The life-cycle model we work with is fairly standard, and it is the same as that underlying Mirer (1992). The key features that distinguish it as a model for behavior in retirement are the absence of labor income, the presence of Social Security or pension income, the holding of some marketable wealth at the time of retirement, and uncertainty regarding the length of life. As Yaari (1962) has shown, under life-cycle theory retired persons would prefer to convert all their marketable wealth into annuity income, which would be inconsistent with the main question of interest here. To reconcile the theory with the fact that people do

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[1] The rate of dissaving of total wealth is a weighted average of the rates of dissaving of its two components. Hence total wealth will decline more rapidly than marketable wealth when annuity wealth declines more rapidly than marketable wealth.

hold marketable wealth, we assume that there is no market to purchase additional annuities.[2]

In the model, a person's predetermined financial resources consist of a fixed annuity income (Y) plus an initial stock of marketable wealth (W_1) that is on hand at the eve of retirement and is carried over to period 1. This marketable wealth is invested in one-period notes that yield a fixed real rate of interest r. We consider three alternative values for this rate: 1, 3, and 5 percent. The annuity income Y corresponds to Social Security and pension benefits. Based on an analysis of the 1983 Survey of Consumer Finances, we take 0.12 as a realistic value for Y/W_1 in the calculations.[3] With the mortality rates discussed below, this results in annuity wealth being 64, 60, or 55 percent of initial total wealth when $r=1$, 3, or 5 percent, respectively.

In any period the resources available for consumption include the holdings of marketable wealth, the interest earned from that wealth, and the annuity income. Hence, the amount of marketable wealth that is planned to be carried over to the next period is

$$W_{t+1}=(1+r)W_t+Y-C_t, \tag{1}$$

where C_t is planned consumption in period t. We assume that net borrowing is not permitted, because without unrealistic forms of insurance there would be a default risk due to death. This assumption is embodied in the liquidity constraints

$$W_t \geq 0 \qquad t=2,3,\ldots,M+1, \tag{2}$$

where M is the maximum possible length of life. With W_1 and Y given, the age profile of marketable wealth is determined from equation (1) by the lifetime pattern of consumption.

To explain the pattern of consumption, we begin by assuming that a person's perceptions regarding the uncertainty of the length of life reflect the actual demographic experience of the economy. Viewed from the eve of retirement (near the end of period 0), the probability of surviving at least to the end of year t is given by S_t, with $S_0=1$ and $S_{M+1}=0$. The probability of dying at the end of period t, if one was alive at the beginning, is given by q_t, where $q_t=1-(S_{t+1}/S_t)$. It is an important demographic fact that q_t increases with age during the retirement years, and we adopt this as an assumption.

In our calculations these mortality rates are based on the U.S. Decennial Life Tables for 1979-81 for the total population. (We also carried out the calculations for men and women separately, and these results are noted below.) We let age 65 be the first year of retirement, and we let the maximum possible length of retirement (M) be 50 years.[4]

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[2] Instead of making this assumption, one might add a bequest motive. Friedman and Warshawsky (1990) show that this would be sufficient to explain the fact that retired persons hold substantial amounts of marketable wealth. However, adding a bequest motive is tantamount to assuming a different theory. Our interest is in clarifying some implications of pure life-cycle theory.

[3] In a sample of recently retired families, the median value of Y/W_1 was 0.12 (see Mirer, 1992). Calculations were also made for the values 0.05 and 0.20, which correspond closely to the lower and upper quartiles; the findings for these cases are similar to those reported here.

[4] The life table data are from the National Center for Health Statistics (1985), Table 1. We smoothed the mortality rates after age 94.

Utility within any period is assumed to be given by the isoelastic utility function $U(C)=C^{1-\gamma}/(1-\gamma)$, where γ is the coefficient of relative risk aversion, with $\gamma>0$. When $\gamma=1$, $U(C)=\ln(C)$. We explore five values for γ: 0.75, 1, 2, 4, and 6, a range that encompasses the most commonly considered values. In data that seem to conform with life-cycle behavior, Hurd (1989) estimates γ to be about 1.0, which (he notes) is lower than others have assumed.

We assume that a person makes a complete financial plan on the eve of retirement. Expected lifetime utility is given by

$$EU=\sum_{t=1}^{M} S_t(1+\rho)^{-t}\frac{C_t^{1-\gamma}}{1-\gamma}, \tag{3}$$

where ρ is the rate of time preference. In our calculations we consider cases with $\rho=0$, 2, and 4 percent.

Following Mariger (1987), it is possible to show that if the liquidity constraint in equation (2) ever is binding during the M possible years of retirement, then the optimal plan consists of two sequential phases. During the T years of the first phase wealth is positive, but it becomes exhausted by year $T+1$ so that $W_t=0$ all during the second phase.

In the first phase, the necessary condition for interior solutions leads to

$$\begin{aligned} C_t &= C_{t-1}\left[\frac{(1+r)(1-q_{t-1})}{(1+\rho)}\right]^{1/\gamma} \\ &\equiv C_{t-1}F_t = C_1\prod_{j=2}^{t}F_j \qquad 2\leq t\leq T. \end{aligned} \tag{4}$$

Since $W_{T+1}=0$, the discounted sum of consumption in the first T periods must equal W_1 plus the discounted sum of annuity income in those periods, so initial consumption is given by

$$C_1=\frac{W_1+\sum_{t=1}^{T} Y(1+r)^{-t}}{\sum_{t=1}^{T}\left(\prod_{j=1}^{t}F_j\right)(1+r)^{-t}}, \tag{5}$$

where $F_1=1$ for notational convenience. Consumption in later periods is determined from equation (4).

In the second phase, the liquidity constraint is binding, so that

$$C_t=Y \qquad T<t\leq M. \tag{6}$$

If the liquidity constraint is binding only for period $M+1$ (which means that some wealth would be on hand during every possible period of retirement, but none would be left after M periods), the necessary condition for interior solutions leads to equation (4), with $T=M$. That is, all of retirement would be like the first phase described above.

To find the complete optimal consumption plan for any given set of parameter values, we first apply a computational algorithm that searches for the longest possible interior phase. Mariger's Propositions 1 and 2 imply that this algorithm correctly finds the end of the first phase (T). In all the calculations within our selected parameter range the liquidity constraint becomes binding before the maximum length of life, so that $T<M$. After finding T, consumption in the two phases is determined by the preceeding equations. In some calculations not reported here, for cases with a low value for Y/W_1 and a high interest rate, the liquidity constraint is binding only for period $M+1$ so that $T=M$.

After finding the complete consumption plan, the age profile of marketable wealth is determined by equation (1). In all the cases in our parameter range, marketable wealth is used up sooner than annuity wealth in the optimal plan (because $T<M$). In an overall sense, then, marketable wealth is used up faster. However, as shown below, even in these cases marketable wealth may be dissaved less rapidly than annuity wealth at some ages.

This model has a number of limitations. Importantly, it deals only with a single individual, and thus it does not capture some of the features of decision making by married couples. Also, although the isoelastic utility function is commonly used in life-cycle studies, it does not represent all life-cycle behavior. Other forms for the utility function could lead to different findings, even with the same economic parameters. In addition, although the age-specific probability of dying (q_t) increases with age, the capacity to derive utility from consumption (a capacity that might be related to health) is assumed to be constant.

3. INDIVIDUAL WEALTH-AGE PROFILES

Our main task is to determine and compare the age profiles of marketable wealth and annuity wealth. The former are determined by the life-cycle behavior just discussed, and the latter are determined by an actuarial formula.

The age profile for marketable wealth is determined as part of optimal life-cycle planning. As explained in the previous section, this profile has two phases in our reported calculations, with $W_t>0$ in the first phase and $W_t=0$ in the second. The shape of the wealth-age profile during the first phase of retirement varies among the cases. In most cases with $r=0.01$ and in some with $r=0.03$, the wealth-age profile is fully convex. Such a profile is illustrated, for example, by the sequence of filled circles in Figure 1 (this is the case with $r=0.01$, $\rho=0.02$, and $\gamma=1$). In the majority of cases with $r=0.03$ and all the cases with $r=0.05$, the wealth-age profile is initially concave and then becomes convex. Such a profile is illustrated by the sequence of filled circles in Figure 2, for the case with $r=0.05$, $\rho=0.00$, and $\gamma=4$. We note that in all cases the rate of dissaving $[-(W_{t+1}-W_t)/W_t]$ increases with age until wealth is exhausted.[5]

Marketable wealth is exhausted in period T, which occurs well before the maximum possible length of life in our reported calculations. The first entry in each cell of Table 1 shows the age ($T+64$) at which this occurs for each of the cases. For comparison, the expected age of death (calculated on the eve of retirement) is about 81. Among these cases, and all others we computed with $T<M$, the age at which marketable wealth is exhausted varies consistently with the

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[5] For some cases outside of our parameter range, marketable wealth increases with age in the early years of retirement.

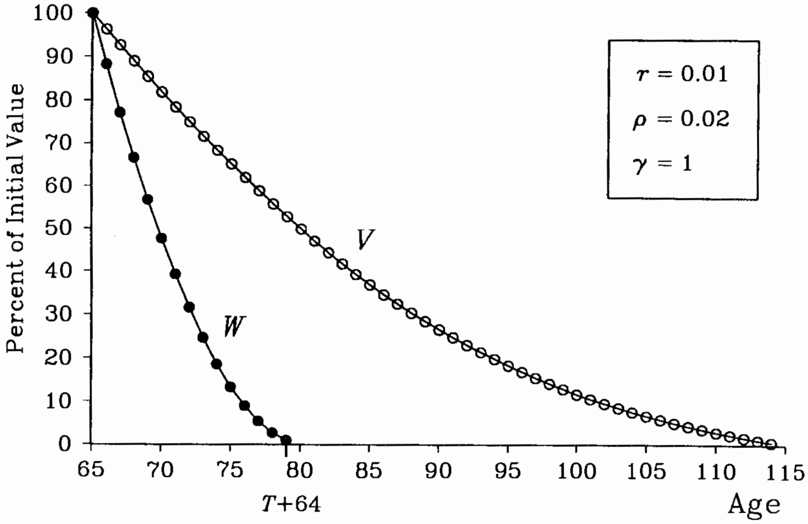

Figure 1. Wealth-Age Profiles: Annuity Wealth (V) and Marketable Wealth (W)

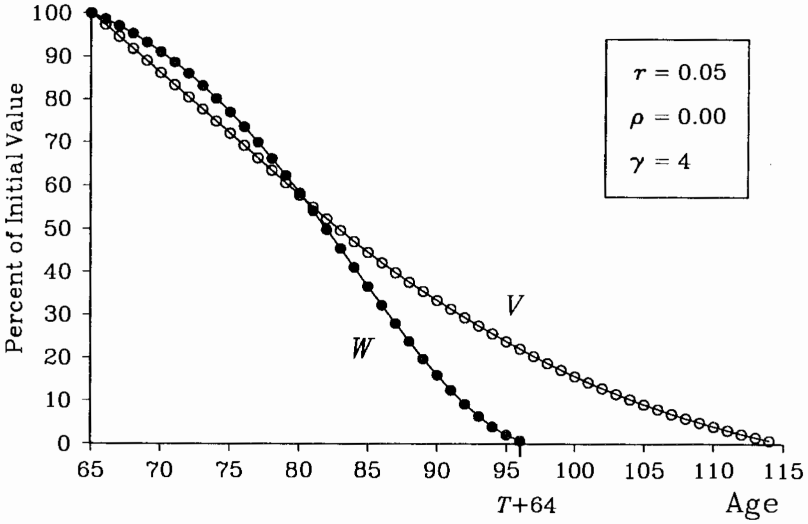

Figure 2. Wealth-Age Profiles: Annuity Wealth (V) and Marketable Wealth (W)

parameters as follows: $\partial T/\partial r > 0$, $\partial T/\partial \gamma > 0$, and $\partial T/\partial \rho < 0$. In calculations not reported here we find that $\partial T/\partial (Y/W_1) < 0$.

Each year, annuity wealth is defined as the expected discounted value of the remaining annuity income, taking survival probabilities into account.[6] In conformity with our accounting of marketable wealth, the value of annuity wealth in

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[6] This is the standard approach, but it may not be appropriate for some purposes (Mirer, 1992).

TABLE 1

Age at Which Marketable Wealth is Exhausted and (in Parentheses) Age Range When Marketable Wealth is Dissaved Less Rapidly Than Annuity Wealth

ρ	γ	$r=0.01$	$r=0.03$	$r=0.05$
0.00	0.75	80 (–)	84 (–)	87 (65–69)
0.00	1.00	82 (–)	85 (–)	89 (65–69)
0.00	2.00	86 (–)	89 (–)	92 (65–70)
0.00	4.00	91 (–)	94 (65–65)	96 (65–73)
0.00	6.00	94 (–)	97 (65–68)	99 (65–76)
0.02	0.75	78 (–)	81 (–)	84 (–)
0.02	1.00	79 (–)	82 (–)	86 (–)
0.02	2.00	84 (–)	87 (–)	90 (–)
0.02	4.00	89 (–)	92 (–)	95 (65–67)
0.02	6.00	92 (–)	95 (–)	98 (65–71)
0.04	0.75	76 (–)	78 (–)	81 (–)
0.04	1.00	77 (–)	80 (–)	83 (–)
0.04	2.00	82 (–)	85 (–)	88 (–)
0.04	4.00	88 (–)	90 (–)	93 (–)
0.04	6.00	91 (–)	94 (–)	97 (–)

Note: The age of wealth exhaustion corresponds to $T+64$. In cases where the age range is blank, marketable wealth is never dissaved less rapidly than annuity wealth.

period t (V_t) is calculated at the end of period $t-1$. Thus, the age profile of annuity wealth is determined by calculating V_t in successive years according to

$$(7)\qquad V_t(Y,r)=\sum_{\tau=t}^{M} Y\frac{S_\tau}{S_{t-1}}(1+r)^{-(\tau-t+1)},$$

where S_τ/S_{t-1} is the probability of surviving to period τ given that the individual has survived to period $t-1$.

The age profiles of annuity wealth in two cases are shown by the sequence of empty circles in Figures 1 and 2. There are only three age profiles of annuity wealth calculated in this study—one for each of the three interest rate values—and some information about these profiles is presented in Table 2. The panel labeled "Age Profile" shows the value of annuity wealth at selected ages, expressed as a percentage of the initial annuity wealth V_1. At age 80, which is just short of the expected length of life (from age 64), annuity wealth stands about 50 to 60 percent of its initial amount. The right panel shows the one-year rates of dissaving $[-(V_{t+1}-V_t)/V_t]$ at selected ages along the profiles.

Comparisons of the age profiles of marketable and annuity wealth were carried out for the 45 parameter combinations in our parameter space. Overall, the comparisons fall into two classes. In the first class, the age profile of marketable wealth (per initial dollar) lies fully *below* that for annuity wealth and the rates of dissaving of marketable wealth are greater than those for annuity wealth at every relevant age. (After marketable wealth is exhausted, its rate of dissaving is undefined and not relevant to the comparisons we are making.) Such a case is shown in Figure 1. In the second class of cases, the age profile of marketable wealth lies

TABLE 2
INDIVIDUAL ANNUITY WEALTH: AGE PROFILE AND RATE OF DISSAVING

		Age Profile			Rate of Dissaving		
Age	S	$r=0.01$	$r=0.03$	$r=0.05$	$r=0.01$	$r=0.03$	$r=0.05$
65	0.98	100.00	100.00	100.00	3.72	3.16	2.70
70	0.87	81.80	84.18	86.17	4.26	3.73	3.28
75	0.72	65.04	68.78	72.04	4.88	4.38	3.95
80	0.55	49.76	53.96	57.76	5.68	5.24	4.85
85	0.36	36.76	40.77	44.49	6.17	5.79	5.45
90	0.18	26.52	29.98	33.28	6.78	6.45	6.15
95	0.06	18.28	21.01	23.69	7.94	7.66	7.41
100	0.01	11.68	13.62	15.56	9.66	9.44	9.22
105	0.00	6.61	7.79	9.00	12.94	12.76	12.60
110	0.00	2.80	3.33	3.88	22.61	22.49	22.38

Note: S is the probability of surviving from age 64 to each particular age.

above that of annuity wealth in the early years of retirement but it lies *below* in the later years. Such a case is shown in Figure 2.

Further information about the comparisons is contained in Table 1. For each case, the entry in parentheses shows the age range when marketable wealth is dissaved less rapidly than annuity wealth. The blank entries (–) signal important information: they flag the cases in which marketable wealth is never dissaved less rapidly than annuity wealth. The only "observations" of marketable wealth being dissaved less rapidly occur in the other cases.

These comparisons of the rates of dissaving constitute our main findings. In all the cases with $r=0.01$ and most of those with $r=0.03$, the dissaving of marketable wealth is *never* less rapid than that of annuity wealth through all the relevant years of retirement. In the two cases where this does not hold, it fails to do so only in the first few years of retirement. Only when $r=0.05$ do we find many cases in which marketable wealth is dissaved less rapidly than annuity wealth; these occur mostly when the rate of time preference (ρ) is low. In these cases the less rapid dissaving of marketable wealth occurs only in the early years of retirement. The implications of these findings are discussed in the Conclusion.[7]

These findings can be partially understood by noting that two phenomena are at work. First, with the assumed utility function and the parameter values considered here, life-cycle behavior leads marketable wealth to become exhausted relatively early in retirement—well short of the greatest possible age, to which there is only a small chance of surviving. The reason for this can be traced to equation (4): as the age-specific probability of death q_t rises, one period's consumption becomes less and less attractive compared with the previous period's.

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[7] When calculations were done using mortality rates from life tables for men and women separately, the overall results were about the same. Life expectancy (from age 64) is between 4 and 5 years longer for women than for men. The age at which marketable wealth is exhausted ($T+64$) was usually 3 or 4 years greater for women than men. For women, the occurrence of marketable wealth being dissaved less rapidly than annuity wealth was slightly more prevalent and of longer duration than the results in Table 1. For men, the occurrence was slightly less prevalent and of shorter duration. Of course, one need not think of these only as gender-based findings: one can think of them as pertaining to new retirees who have either a relatively long life expectancy ("women") or a relatively short life expectancy ("men").

Hence consumption falls with age under optimal planning, at least in the later years of retirement. Unless Social Security and pension income (Y) is quite low compared with the initial level of marketable wealth (W_1), there would be no desire to hold marketable wealth to supplement this annuity income at very high ages. Hence, marketable wealth tends to be dissaved at a relatively rapid rate.

Second, annuity wealth is dissaved less rapidly than might be thought. Roughly speaking, annuity wealth depends on the expected length of life. As an individual ages one year, the remaining length of life tends to be reduced but not by so much as a whole year. This is because an individual's expected date of death is continually pushed farther into the future as a result of being successful in surviving. It is even possible for annuity wealth to increase with age.[8]

4. AGGREGATE WEALTH-AGE PROFILES

The primary focus of our work has been to make comparisons between the age profiles of marketable wealth and annuity wealth in a way that is relevant for empirical research on the behavior of individuals. However, life-cycle theory was developed to explain aggregate wealth-holding, so we consider here the dissaving of annuity wealth and marketable wealth in the aggregate.

Consider a retirement cohort of n individuals who are of the same age and are subject to the same mortality probabilities. Using these probabilities as proportions, the number of individuals alive at period t is nS_t. If all the individuals are entitled to the same annuity benefit, Y, the age profile of aggregate annuity wealth (V^n) is given by successive values of the discounted sum of future benefits:

$$V_t^n(Y,r)=\sum_{\tau=t}^{M} YnS_\tau(1+r)^{-(\tau-t+1)}. \tag{8}$$

The age profile of aggregate annuity wealth corresponds to the time profiles of funds that would be held by an insurance company that is contracted to pay these benefits, presuming that the funds earn interest at the rate r.

Some information about these profiles, based on the same mortality data and interest rates used earlier, is presented in Table 3. The panel labeled "Age Profile" shows the value of aggregate annuity wealth at selected ages, expressed as a percentage of the initial amount. The right panel shows the one-year rates of dissaving at selected years along the profiles. In comparison with Table 2, it can be seen that the dissaving of aggregate annuity wealth proceeds much more rapidly than that for an individual annuitant. The key difference, of course, arises from the fact that the individual profiles describe the wealth of living persons, whereas some of the dissaving of aggregate annuity wealth is due to individuals' deaths and the consequent evaporation of their annuity wealth.

The age profile of the aggregate marketable wealth of a retirement cohort is more difficult to specify. Even with no bequest motive, a portion of this wealth

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[8] Consider a group of retired soldiers recalled to active duty. While serving in a dangerous situation, each has a short expected life and an annuity wealth of some particular amount. Those who survive find themselves with a longer expected life than before and thus a greater amount of annuity wealth. As a numerical example, let $Y=100$, $r=0$, $M=4$, and $S_t=1.0$, 0.9, 0.3, 0.2, 0.1, for $t=0,\ldots,M$. Applying equation (7), we find $V_t=150$, 67, 100, 50 for $t=1,\ldots,M$.

TABLE 3

AGGREGATE ANNUITY WEALTH: AGE PROFILE AND RATE OF DISSAVING

Age	S	Age Profile			Rate of Dissaving		
		$r=0.01$	$r=0.03$	$r=0.05$	$r=0.01$	$r=0.03$	$r=0.05$
65	0.98	100.00	100.00	100.00	5.56	5.01	4.56
70	0.87	73.07	75.19	76.79	6.95	6.43	6.00
75	0.72	49.05	51.87	54.32	8.86	8.38	7.97
80	0.55	29.16	31.63	33.85	11.60	11.18	10.82
85	0.36	14.50	16.08	17.55	15.41	15.06	14.75
90	0.18	5.60	6.33	7.03	20.51	20.23	19.98
95	0.06	1.49	1.72	1.94	27.73	27.51	27.31
100	0.01	0.22	0.26	0.30	38.18	38.03	37.88
105	0.00	0.01	0.01	0.02	53.30	53.21	53.12
110	0.00	0.00	0.00	0.00	75.31	75.27	75.23

Note: S is the probability of surviving from age 64 to each particular age.

will be transferred to individuals' estates or heirs at death. Hence, from a social point of view, the marketable wealth held by a cohort at retirement is not fully exhausted over the longest possible lifetime. By contrast, of course, annuity wealth is fully exhausted. At least in this sense, aggregate marketable wealth is dissaved less rapidly over the course of retirement than is aggregate annuity wealth—the opposite of our most common finding at the individual level.

5. CONCLUSION

The ability to construct measures of retired persons' annuity wealth presents empirical researchers with new tasks of interpretation and new opportunities for testing some aspects of the life-cycle theory of consumption. Life-cycle theory seeks to explain the discretionary dissaving of marketable wealth, and thus tests that focus on this are appropriate. The theory does not bear directly on the dissaving of annuity wealth, because pension and Social Security benefits are predetermined for retired persons and the associated dissaving is automatic. Nonetheless, one might expect life-cycle theory to predict some linkage between the two forms of dissaving, and the main aim of the paper is to explore this linkage. The results show how data on annuity wealth might be used to test predictions of the theory.

Our simulations show that whether marketable wealth would be dissaved more (or less) rapidly than annuity wealth depends on various parameters. Although it is difficult to say what parameter values are "realistic" in the context of an abstract model, many researchers cite $r=0.03$ as the most realistic value for the rate of interest in models like the present one. Taking this to be the appropriate basis, one finds that a realistic prediction from our life-cycle model is that marketable wealth would be dissaved *more* rapidly than annuity wealth. Even if the interest rate were somewhat higher, this statement would still hold, with some qualifications.

Hence, it seems fair to suggest that empirical wealth-age profiles that show slow dissaving of marketable wealth being accompanied by faster dissaving of annuity wealth (or, by faster dissaving of total wealth) are not consistent with life-cycle theory in normal cases. That is, the dissaving of marketable wealth in this situation is too slow to be consistent with pure life-cycle theory.

Alternative theories that include a bequest motive or some precautionary considerations would tend to predict less rapid dissaving of marketable wealth than pure life-cycle theory does. Hence, the empirical pattern of dissaving just discussed would tend to be consistent with these theories while inconsistent with life-cycle theory.

The dissaving of annuity wealth, of course, is not based on behavior but on actuarial definitions. We provide calculations that show the distinction between this dissaving at the aggregate and the individual levels: aggregate dissaving of annuity wealth is more rapid than individual dissaving. Perhaps not making this distinction has caused other researchers to hold mistaken beliefs regarding what life-cycle theory predicts about the relative rates of dissaving of annuity wealth and marketable wealth at the individual level.

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