Rational Choice With Complex Products: Consumer Valuation of Annuities

Chris Browning, Michael S. Finke, and Sandra J. Huston

This study explores consumers' ability to accurately estimate the value of a life annuity product. Using a special experimental module from the 2008 Health and Retirement Study, higher levels of financial sophistication and numeracy showed no impact on an individual's ability to accurately value life annuity benefits. The results suggest that rational and behavioral valuation factors have little influence on valuation. These findings are evidence of a widespread lack of understanding surrounding complex annuity products.

Key Words: annuities, financial literacy, household finance, retirement policy

Introduction

A major concern for individuals entering retirement is managing longevity risk, the risk of outliving one's resources. Because lifespans are uncertain, a consumer is exposed to the risk of outliving their retirement savings. The life annuity eliminates income uncertainty and provides stable consumption by paying the consumer a regular income until death in exchange for a lump sum of money. The primary benefit of annuitization is the ability to transfer longevity risk to an institution, such as an insurance company, pension or government, at a reasonable cost. Because life annuities provide significant benefits to retirees, the lack of demand for life annuities is a puzzle that is not well understood. It has been hypothesized that some combination of ambiguity aversion, the desire to leave inheritances, and liquidity needs reduce annuity demand. However, a life annuity is a complex financial product unfamiliar to many consumers. The inability to assess the value of a life annuity with any reasonable degree of accuracy requires numeracy skills and financial knowledge that may be beyond the reach of an average individual investor.

Using data from the 2008 Health and Retirement Study, we investigated the value respondents placed on a hypothetical $500 monthly life annuity payment at age 65. In addition to testing factors theoretically related to annuity valuation when investors have full information, the current study modeled the impact of financial sophistication on the ability to reasonably estimate the value of a hypothetical life annuity. Results from this study provide evidence that the majority of respondents are not able to come close to a reasonable estimate of annuity value.

Literature Review
Benefits of Annuitization

Longevity risk prevents individuals with uncertain lifespans from optimally decumulating assets during retirement. If an individual chooses an aggressive consumption path, they face the risk of significant drops in consumption as they age, while consuming too conservatively can lead to unintended bequests and decreased lifetime utility from wealth (Brown, 2007). Life annuities decrease longevity risk by converting a lump sum into a stream of income that is guaranteed for the remainder of an annuitant's life (Ibbotson, Milevsky, Chen, & Zhu, 2007). Because mortality risk, the risk of death at a given point in time, is largely uncorrelated across individuals, annuity providers can pool the mortality risk of participants and use the resources of those that exit the risk pool prematurely to pay mortality premiums to survivors (Brown, 2008). Such premiums allow survivors in the risk pool to earn superior investment returns, leading to higher levels of sustainable lifetime consumption through annutization than what is achievable through other asset decumulation strategies (Brown, 2007).

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Evidence of this can be seen in Brown (2004) where the amount of annual income available from life annuities dominates that available from other draw-down strategies.

Economic theory suggests that annuitization will increase lifetime utility regardless of how long an individual lives by increasing income certainty and lifetime consumption while eliminating the risk of running out of money in old age (Brown, Casey, & Mitchell, 2007). Risk-averse individuals should hold a significant portion of their retirement portfolio in annuitized assets. Assuming complete markets, Yaari (1965) showed that, for individuals without a bequest motive, the optimal level of portfolio annuitization is 100%. Even if markets are sufficiently incomplete, causing a substantial mismatch between an individual's optimal consumption path and the income stream available from annuities, a large portion of the retirement portfolio should still be annuitized (Davidoff, Brown, & Diamond, 2005). Few voluntarily purchase annuities in the private market despite their substantial normative value to retirees (Brown, 2007). Johnson, Burman, and Kobes (2004) showed that only 4% of those leaving their job after age 55 annuitize a portion of their retirement portfolio and only 10% leaving their job after age 65 annuitize.

The Impact of Financial Sophistication

Consumers are assumed to make rational saving and spending decisions in order to maximize utility from consumption over their lifetime. Assessing the value of annuitization requires the ability to sum expected utility from consumption in each year of retirement discounted to a present value and multiplied by the probability of survival from their current age to their oldest possible age. Consumption and savings in each period are determined by labor income and the return on assets while the individual is working and by Social Security benefits, pension benefits and return on assets for each period in retirement (Ando & Modigliani, 1963). Accurate valuation assumes that consumers have reasonable expectations about survival probabilities, discount rates, investment returns, earnings, Social Security benefits, and pension benefits.

A life annuity provides an income stream until death that is roughly equal to the present value of a monthly income flow discounted at the rate of return of a safe investment for a length of time equal to median longevity. A knowledgeable consumer will value this stream using a subjective valuation of their longevity and an appropriate market discount rate. For example, a 65-year old American woman has a life expectancy of 20 years (CDC, 2010). The value of a $500 monthly annuity is the present value of the monthly flow discounted for the expected longevity period. At a very conservative discount rate of 2%, the value will be $98,837. Most private annuity providers use a higher interest rate. For example, TIAA-CREF uses 4% (2010). At a 4% rate, the present value of the annuity is $82,511. An individual could roughly estimate an annuity value by multiplying the $500 monthly value by 12 to come up with an annual annuity payment of $6,000, multiply by expected longevity, then discount this amount to account for a positive rate of interest or time preference. This set of skills – the ability to multiply by 12, estimate and multiply by expected longevity, then apply an appropriate rate of discounting – requires significant mathematical ability and the financial sophistication to understand the salient components of an annuity product.

The difficulty in assessing valuation may affect consumer willingness to pay for annuities despite their considerable advantages in retirement. It is clear from the above example that substantial financial sophistication is needed to make optimal annuitization decisions (Brown, 2008). Even if consumers have some financial skill and knowledge, it may not transfer to complex and unfamiliar annuity markets. An inability to estimate the value of an annuity with any degree of accuracy may be an important contributor to reduced demand for annuities. Understanding which consumers are able to make a reasonable estimate of annuity valuation will provide insight that can be used to improve knowledge and disclosure to enhance product choice.

Factors Influencing Annuity Valuation

Annuity valuation, or the ability of an individual to reasonably estimate the dollar value of an annuity product, is hypothesized to be influenced by an individual's level of financial sophistication. The motivation for purchasing annuity products may stem from a variety of rational and/or behavioral factors that need to be controlled for to better isolate the impact that financial sophistication has on annuity valuation.

Financial Sophistication. General financial knowledge and numeracy skills can be used to indicate an individual's level of financial sophistication. It is hypothesized that, after controlling for rational and behavioral valuation factors, higher levels of sophistication will result in more accurate annuity valuations.

Rational Valuation Factors. Standard economic models indicate a number of factors that may rationally influence

the value individuals place on annuitization. Pre-existing annuitization in the form of Social Security and defined benefit pension plans may serve to decrease the value of additional annuitization (Brown, 2007; Dushi & Webb, 2004; Pashchenko, 2009). This is especially true for low-income individuals and those who hold a significant portion of their unannuitized wealth in illiquid assets (Pashchenko, 2009). Theoretically, we would expect that lower income individuals (or those with pensions and high illiquid asset holders) would have less interest in annuity products. However, it has been shown that the shrinking existence of defined benefit pension plans has not increased the demand for annuities (Hu & Scott, 2007).

Bequest motives, or one's desire to leave an inheritance, may also decrease the value individuals place on annuitization (Bernheim, 1987; Lockwood, 2009; Pashchenko, 2009). The expense of an annuity effectively depletes wealth in order to provide life income, reducing the amount of assets that can be transferred through bequests. However, the uncertainty of lifespan creates uncertainty in the value of bequest. Without annuitization, bequests are random in both size and time and those who are risk averse to size of the bequest benefit from at least partial annuitization (Davidoff et al., 2005). This increase in bequest certainty through annuitization may, however, be less salient than the immediate drop in heritable wealth that occurs when a consumer buys an annuity.

Another characteristic that may decrease annuity valuation is illiquidity. In most cases, the future value of a life annuity product cannot be borrowed against, nor can its payment stream be altered (Brown, 2007). Health shocks are often considered a potential concern as they are uncertain, impossible to fully insure against, and can be quite expensive (Brown, 2007). Sinclair and Smetters (2004) and Turra and Mitchell (2005) found that health shocks may shorten life expectancy, causing the value of annuitization to decrease as the need for cash increases. Brown et al. (2007) found that those with poor health are more likely to prefer lump-sum payments. However, the uncertainty of medical costs may increase the values individuals place on annuitization as there is a positive relationship between age and medical costs, causing longevity insurance and insurance against medical uncertainty to become complements. (Pashchenko, 2009).

Behavioral Valuation Factors. Because rational limitations on valuation are not sufficient to explain why so few annuitize, many have begun to explore the impact of behavioral factors on limited demand. Framing can influence the value individuals place on the decision to annuitize. Concern that they will not live long enough to recoup their principal in an annuity investment leads some consumers to frame annuities as a gamble (Hu & Scott, 2007). This is because many consumers mistakenly view the insurance purchase as a failure if they do not receive a payout from the insurance company equal to the cost of the insurance. Such narrow framing fails to consider annuities in the context of overall portfolio optimization, which requires consumers to weigh a variety of possible outcomes and available investment instruments (Brown, 2007). Individual levels of loss aversion may also impact how annuity decisions are framed. Those that believe that they will outlive their resources will place a high value on annuities. Conversely, those that believe that they will die before recouping their capital investment in an annuity will value annuities less (Angew, Anderson, Gerlach, & Szykman, 2008).

The impact of time preference on the decision to annuitize has also been considered. An individual's time preference is a measure of how much weight an individual gives to well-being in the future, or the discount rate one places on future consumption. An individual's subjective discount rate can be significantly altered by their perceived probability of survival. Those who believe they will die young may exhibit a high rate of time discounting and seek to shift consumption from future periods to current periods, placing little value on annuitization (Sheshinski, 2009). There is also evidence that individuals may be hyperbolic discounters and have inconsistent time preferences. Hyperbolic consumers appear to be very present oriented in short-run decisions and more future oriented when making decisions that have long-run consequences (Laibson, 1997). Recognition of a tendency to compromise long-run goals by yielding to short-run temptation leads to the use of commitment devices that constrain short-run behaviors. Hyperbolics who recognize their self-control problem may value annuities as a commitment device that prevents overspending in current periods, while those with less insight will place lower values on annuitization since they prefer to spend more in the present (Brown, 2008).

Methods
Data
The current study uses the Health and Retirement Study (HRS) to model life annuity valuation. The HRS, a nationally representative longitudinal data set of Americans age 50 and older, has been administered by the University of

Michigan on a biennial basis since 1992 and is supported by the National Institute on Aging and the Social Security Administration. In addition to the core survey that gathers information on respondents' health, financial status, labor force participation, and retirement planning methods, the 2008 survey offers a unique module on annuitization. The data gathered within this module was the primary focus of the current study.

Sample

The sample used consisted of 681 individuals and was drawn from an experimental module on annuitization in the 2008 HRS. The data were first censored to include only those respondents within the module who were financial respondents. The financial respondent was the member in the household who was responsible for making household financial decisions. Once the sample was limited solely to financial respondents, the data were further censored to include only those who provided complete responses to the questions used to construct the variables in the analyses.

Dependent Variable

The question used to measure the value individuals assign to life annuity benefits was:

> "Imagine you are 65 years old, and you are receiving $1,000 per month in Social Security benefits. Suppose you had a choice: either you could keep that $1,000 monthly benefit for life, or you could exchange it for a monthly benefit half that size, $500 per month for life, plus you'd get a one-time, lump sum payment. What is the smallest lump-sum that you would be willing to accept in exchange for reducing your lifetime benefit by $500 per month?"

Life annuity valuation was modeled using two methods. The first used an ordinary least squares (OLS) regression to model the dollar value the respondent would accept to give up a $500 per month annuity payment at age 65. This OLS regression provided the valuation of the life annuity as the dependent variable regardless of its accuracy. To allow for comparison among those who provide reasonable estimates versus those who do not, the second method modeled whether the life annuity valuation response was low, rational, high or irrationally high in order to assess the characteristics associated with product knowledge. Because the dependent variable within the second method was categorical, a multinomial logistic regression was used to model the likelihood of providing a reasonable (rational category) life annuity valuation.

To determine the values that are appropriate for the rational category, a present value of an annuity calculation was used. The components of this calculation included a discount rate, life expectancy, future value, and payment. The purpose of the calculation was to estimate a lump-sum value that respondents should be willing to trade half of their lifetime $1,000 monthly benefit for, given their life expectancy and discount rates. Because everyone was assumed to be 65 when asked the question, we assumed a life expectancy of 20 years in our calculations. This is based on the 2006 Period Life Table provided by the Social Security Administration. In this table, males at age 65 have a life expectancy of 17 years and females have a life expectancy of 19.72 years. The range of discount rates we used (from 2% to 8%) was based on expected returns from varying market investments. The 2% rate was based on the three month Treasury bill rate, considered to be the risk free rate, in 2008 and the 8% rate was based on the average return of the S&P 500 from 1950 to 2008. The question asked respondents how much they would be willing to "accept in exchange for reducing your lifetime benefit by $500 per month," which implies no inflation adjustment. However, the questions also linked this reduction to social security, which was inflation adjusted. The value of an inflation-indexed $500 monthly payment to a 65-year-old male is $106,000 (Schirripa, 2009). Since no respondents chose values more than $100,000 and less than $120,000, the range of rational valuation was set between $60,000, corresponding to a $500 monthly payment discounted at 8%, and $100,000, which corresponds with both a 2% discount rate without inflation adjustment and a fair market price for an inflation-adjusted annuity payment. For specific calculation details on the upper and lower cutoffs for the rational valuation category, see Appendix A.

The low valuation category consisted of responses ranging from $10 to $50,000. We considered these valuations low because they required a discount rate greater than 10%. For a respondent to estimate a value below $50,000 they would have to use a discount rate not justified by market returns, indicating that reasonable or rational expectations were not driving their estimate. Responses in the high valuation category ranged from $120,000 to $450,000. A valuation of $120,000 assumed a 0% discount rate or $14,000 above the market price of an inflation-adjusted annuity payment. To calculate this value, the respondent could simply multiply the $500 by 12 months and then by 20 years. The irrationally high category consists of valuations of $500,000 and above. Of the 681 person sample, 282 individuals were in this category. These responses

were considered irrational since an individual would have to have a life expectancy of approximately 148 years, assuming a 0% discount rate, to be equivalent to the minimum valuation for this category.

Independent Variables

Financial Sophistication. The financial sophistication variable was constructed using questions from the annuitization module concerning the risk and return characteristics of different market securities. The module asked respondents to rate the riskiness and expected return characteristics for a single stock, mutual fund, corporate bond, government bond, and money market mutual fund on a scale of 1 to 5, with 1 being the least risky/lowest expected return and 5 being the most risky/highest expected return. With that information, we were able construct a set of five comparisons - three related to risk and two related to return. For example, one of the comparisons constructed asked respondents to rate the risk of a corporate bond in relation to that of a government bond. If the respondent indicated a lower level of risk for the government bond, we considered that to be a correct comparison and awarded them a point. We constructed similar comparisons for the asset return questions. In addition to the risk and return comparisons, we also included a question that asked respondents which type of investment would most likely be held in a money market mutual fund; stocks, long-term bonds, or treasury bills. Those that choose treasury bills were awarded a point for a correct response. These variables were used to create an instrument for scoring the financial sophistication of each respondent, with possible scores ranging from 0 to 6. The score calculated for each respondent determined whether they were placed in the below average, average, or above average sophistication category. Those with scores of 2 or 3 were in the middle two quartiles of respondent scores and were placed in the average category, while those in the above average and below average categories had scores in the top and bottom quartiles, respectively.

A variable measuring the numeracy of each respondent was also included as a measure of financial sophistication. Brown et al. (2007) found that simple division and compounding questions were positively correlated with increased annuity demand. The same questions used in their study were used to construct a numeracy variable. To construct this variable, responses to the following questions were considered.

> If five people all have the winning numbers in the lottery and the prize is two million dollars, how much will each of them get?

> Let's say you have $200 in a savings account. The account earns 10% interest per year. How much would you have in the account at the end of two years?

Respondents who answered both questions incorrectly were considered to have no numeracy, those who answered one question correctly were considered to have some numeracy, and those who answered both questions correctly were considered to have full numeracy.

Rational Valuation Factors. The rational demand factors that may influence the life annuity valuation included an individual's desire for income certainty, bequest motives, liquidity preferences, and the presence of pre-existing annuities. Income certainty was measured by the participant's response to a question concerning their preference for regular monthly income during their retirement years, bequest motives were determined by responses to a question measuring the respondent's desire to leave money to others at their death, and liquidity was measured by questions concerning the importance of having access to assets in times of medical need. The questions regarding income certainty, bequest motives, and liquidity constraints each had responses ranging from very important to not at all important. Respondents were considered to have a preference for the above items if they considered them to be very important.

To measure the impact of pre-existing annuities, a dummy variable was created and coded as 1 if the respondent had an existing annuity or an existing defined benefit plan and 0 otherwise.

Behavioral Valuation Factors. The variables used to test the impact of behavioral demand factors on the life annuity valuation were time preference, control, and framing. To estimate the effect of time preference, responses to questions regarding the expected timeframe for spending the lump-sum benefit were used. Respondents who indicated that they would likely spend the entire lump sum over a one-year period were considered to have a high time preference. Conversely, respondents indicating that they would spend the lump sum payout gradually over the remainder of their lifespan were considered to have a low time preference. Preferences for control were measured by considering participants' responses to a question addressing the importance of maintaining control over their investments. Respondents who stated that control was very important were considered to have a preference for control.

Perceived health and longevity were used to capture the concept of framing. To measure perceived health, responses to a question asking participants to rate their own health were used. If a respondent rated their health as excellent or very good they were considered to have above average health. Responses of good health were assigned to the average health category, while responses of fair or poor were assigned to the below average health category. To measure perceived longevity, responses to a question asking individuals to estimate their likelihood of living to age 95 were used. Because everyone surveyed was assumed to be 65, the 2000 Annuity Mortality tables were used to determine the probability of living to age 95, which is approximately 15% for males and 20% for females. To account for variation in health status and family health history, responses between 10% and 30% were considered to represent average longevity expectations. Responses above 30% were considered to represent long longevity expectations, while responses of less than 10% were considered to represent short longevity expectations.

Demographics. Sex, race, income, financial wealth, and whether or not the respondent was currently receiving Social Security were also included as control variables in the model. Sex was measured as a dummy variable where 1 represented male and 0 represented female. The race variable was constructed in a similar fashion where 1 represented White and 0 represented non-White. The income variable may, in part, serve as a proxy for education under the assumption that education and income were positively correlated. Education was excluded from the model because of its positive correlation with the independent variables of interest, financial sophistication and numeracy. Income and financial wealth were measured as a binary variable where

1 represented income/financial wealth above the median income of the sample and 0 represents income/financial wealth below the median. The variable addressing whether or not the respondent was receiving Social Security was intended to serve as a proxy for age, above or below 65, while also capturing how being a Social Security participant influenced perceptions of annuity value.

Results

Univariate Analysis

Descriptive statistics for annuity valuation are presented in Table 1. The mean value within the irrationally high category (minimum of $500,000) was $3.5 million. Two of every five respondents valued the $500/month life annuity at $500,000 or more, and more than half of the irrationally high category valued the annuity at $5 million (includes respondents who would not give up their annuity for any lump sum value). Among those who valued the annuity at between $120,000 and less than $500,000 (high valuation category), the average valuation was $210,374 and the median $200,000. A value of $200,000 corresponds with an expected longevity of 98 years at a 0% discount rate or an infinite longevity with a discount rate of 4% (since $200,000 produces $8,000 per year, which is greater than the foregone $6,000 per year annuity).

One fifth (20%) of respondents fell within the rational valuation category (annuity valuation between $60,000 and less than $120,000), and the average annuity valuation among those who provided a reasonable lump sum estimate was $90,511 and the median was $100,000. An annuity valuation of $90,511 corresponded with an expected longevity of 88 years at a discount rate of 4%. Almost one fifth (17%) of respondents fell within the low annuity valu-

Table 1. Descriptive Statistics for the Annuity Valuation Categories

	Irrationally high	High	Rational	Low
Mean	3,481,215	210,374	90,511	27,155
Min	500,000	120,000	60,000	10
25%	1,000,000	150,000	75,000	10,000
Median	5,000,000	200,000	100,000	25,000
75%	5,000,000	250,000	100,000	50,000
Max	5,000,000	450,000	100,000	50,000
N	282	147	135	117

Table 2. Crosstabs on Annuity Valuations by Participant Characteristics

Variable	Irrationally high	High	Rational	Low	*n*
Financial sophistication					
Below average sophistication	50.86	13.71	16.00	19.43	175
Average sophistication	38.80	23.44	20.31	17.45	384
Above average sophistication	36.07	27.05	23.77	13.11	122
No numeracy	48.59	12.85	16.87	21.69	249
Some numeracy	41.67	23.21	20.24	14.88	336
Full numeracy	21.88	38.54	26.04	13.54	96
Rational valuation factors					
Income certainty - very important	44.54	19.63	19.45	16.38	586
Income certainty < very important	22.11	33.67	22.11	22.11	95
Leave inheritance - very important	46.25	17.92	18.75	17.08	240
Leave inheritance < very important	38.78	23.58	20.41	17.23	441
Medical access - very important	47.18	20.78	16.02	16.02	231
Medical access < very important	38.44	22.00	21.78	17.78	450
Defined benefit plan	41.46	19.51	18.70	20.33	123
No defined benefit plan	41.40	22.04	20.07	16.49	558
Behavioral valuation factors					
Control over investments - very important	45.39	19.20	20.45	14.96	401
Control over investments < very important	35.71	25.00	18.93	20.36	280
Very likely to spend in 1 year	55.56	11.11	4.44	28.89	45
< Very likely to spend in 1 year	40.41	22.33	20.91	16.35	636
Shorter than average longevity	39.46	19.28	21.08	20.18	223
Average longevity	31.15	27.64	23.62	17.59	199
Longer than average longevity	50.96	18.92	15.83	14.29	259
Below average health	51.23	11.73	15.43	21.61	162
Average health	42.79	22.33	19.53	15.35	215
Above average health	35.20	26.32	22.37	16.11	304
Demographic factors					
Receiving Social Security	47.58	18.48	19.09	14.85	330
Not receiving Social Security	35.62	24.50	20.51	19.37	351
Male	35.06	27.01	20.69	17.24	348
Female	48.04	15.92	18.92	17.12	333
White	38.16	24.04	21.47	16.33	545
Other than White	54.41	11.76	13.24	20.59	136
Income above the median	32.85	28.15	23.46	15.54	341
Income below the median	50.00	15.00	16.18	18.82	340

Table 3. Robust Regression Results

Variable	Estimate	X^2
Financial sophistication		
Average sophistication	-0.3005	2.44
Above average sophistication	-0.2188	0.76
Some numeracy	0.2257	1.56
Full numeracy	-0.1991	0.53
Rational valuation factors		
Income certainty - very important	0.4709	3.79
Leave inheritance - very important	-0.1205	0.49
Medical access - very important	0.2664	2.51
Defined benefit plan	0.1995	0.91
Behavioral valuation factors		
Control over investments - very important	-0.0545	0.10
Very likely to spend in 1 year	**0.9377	8.72
Average longevity	-0.1730	0.72
Longer than average longevity	*0.4057	4.26
Average health	-0.0647	0.09
Above average health	-0.2806	1.71
Demographic characteristics		
Receiving Social Security	**0.4799	8.00
Male	-0.1152	0.46
White	-0.3811	3.32
Income above the median	-0.1201	0.46

Adj. R^2 = .0796**; *$p < .05$. **$p < .01$. ***$p < .001$.

ation category, with a mean annuity valuation of $29,077 and a median valuation of $25,000. This mean value corresponded with an expected longevity of 70.3 years, or an additional 5.3 years after the age of 65.

Cross-tabulations of respondent characteristics by annuity valuation category are presented in Table 2. Additional descriptive statistics for the total sample can be found in Appendix B.

The mean financial sophistication score for the sample was 2.27 out of six. Only two respondents out of 681 received a score of six. The low percentage of correct responses to basic financial knowledge questions suggests that there low levels of financial sophistication are pervasive and supports findings in prior research (Brown, 2008; Lusardi & Mitchell, 2007, 2009). The finding may also serve as an explanation for the substantial number of respondents (41%) in the irrationally high valuation category. Alternatively, there appears to be an inverse monotonic relationship between the extreme valuation categories and levels of financial sophistication, and a positive monotonic relationship between the middle valuation categories and levels of financial sophistication. Similar relationships existed between the valuation categories and levels of numeracy.

Income certainty was stated as very important by 86% of respondents. This was evidence of uncertainty aversion and highlighted the value individuals place on consistent ongoing payments overtime, like those provided by a life annuity, to minimize uncertainty. Respondents with bequest motives, liquidity and investment control preferences had higher percentages in the irrationally high valuation category and lower percentages in the lower valuation categories than those who did not exhibit these preferences. These valuations were contradictory to rational expectations, as we expected a negative relationship between these characteristics and annuity valuations. However this may be explained by the perceived need for cash related to these preferences. Those with defined benefit plans had a greater percentage than those without in the low valuation category, which may suggest that pre-existing annuitization reduced the value individuals place on annuities in the private market.

Respondents with a high time preference showed a greater percentage in the low valuation category than those with a low preference. Those with a high time preference also had a low percentage in the rational valuation category and high percentage in the irrationally high valuation category. These findings were inconsistent and may represent hyperbolic discounting. There was a positive monotonic relationship between perceived longevity and the irrationally high valuation category and a negative monotonic relationship between perceived longevity and the low valuation category, which was consistent with rational annuity demand.

There was a relatively even split between respondents in the sample that were receiving Social Security and those

that were not. The percentage of valuations in the irrationally high category was greater for those who were receiving Social Security and the percentage of respondents in the low valuation category was greater for those who were not receiving Social Security. Those with income above median were more heavily concentrated in the middle valuation categories while those with income below the median were more heavily concentrated in the extreme valuation categories. To the extent that income serves as a proxy for education, there is evidence that those with higher levels of education may have a greater ability to accurately value a life annuity product.

Multivariate Analysis
Predictors of the life annuity valuation are presented in Table 3. The only significant predictors of respondent valuation on the $500 monthly life annuity benefit were having a high time preference, perceived longevity, and receiving Social Security. Characteristics related to financial sophistication, rational or behavioral annuity valuation were unrelated to the value an individual placed on the life annuity. These results were concordant with the large and inconsistent variation in annuity valuation (see Table 4).

The hypothesized impact of the valuation factors on annuity valuations in relation to the rational valuation category are shown in Table 4. A multinomial logistic regression was estimated (see Table 5) to measure the impact of the predictor variables on life annuity valuation categories, where respondents who provided reasonable annuity valuation estimates (rational category) were the reference group.

Financial sophistication did not have a significant impact on a respondent's likelihood of providing a reasonable annuity valuation. A similar finding occurred when comparing the valuation estimates of those with some numeracy to those with no numeracy. Evidence that neither sophistication nor numeracy led to more accurate valuations suggests a widespread lack of understanding surrounding annuities. It also suggests that financial sophistication may not be comprehensive or transferrable, especially when considering markets, such as the annuity market, that are complex and less developed.

There was little evidence that rational factors influenced the valuations individuals place on the hypothetical annuity. Those with a preference for medical expense liquidity were significantly less likely than those without such preferences to be in the rational valuation category when compared to the irrationally high category. This finding

Table 4. The Hypothesized Impact of the Annuity Valuation Factors on Annuity Valuations in Reference to the Rational Valuation Category

Variable	Hypothesized Effect on Values in Relation to Rational Valuations
Financial sophistication	
Below average sophistication	↓ / ↑
Average sophistication	↓ / ↑ / =
Above average sophistication	=
No numeracy	↓ / ↑
Some numeracy	↓ / ↑ / =
Full numeracy	=
Rational valuation factors	
Income certainty - very important	↑
Leave inheritance - very important	↓
Medical access - very important	↓
Defined benefit plan	↓ / =
Behavioral valuation factors	
Control over investments – very important	↓
Very likely to spend in 1 year	↓
Shorter than average longevity	↓
Longer than average longevity	↑
Below average health	↓
Above average health	↑
Demographic characteristics	
Receiving Social Security	↑ / =
Male	↓
White	↓ / =
Income above the median	=

Table 5. Multinomial Logistic Regression Results for Annuity Valuation

Variable	Irrationally high	High	Low
Financial sophistication			
Average sophistication	0.1336	-0.0475	0.1271
Above average sophistication	0.1713	-0.0152	0.2869
Some numeracy	0.0192	-0.1354	0.2112
Full numeracy	0.3266	-0.1730	0.3512
Rational valuation factors			
Income certainty - very important	-0.3135	0.1386	0.0292
Leave inheritance - very important	-0.0178	0.0145	-0.0282
Medical access - very important	*-0.2515	-0.1892	-0.1583
Defined benefit plan	-0.1792	0.0188	-0.2245
Behavioral valuation factors			
Control over investments - very important	0.1097	0.1229	0.2762
Very likely to spend in 1 year	*-0.9232	-0.4606	**-1.0115
Average longevity	0.0714	-0.1083	0.0073
Longer than average longevity	*-0.2867	-0.2154	-0.0578
Average health	0.0875	-0.1533	0.1434
Above average health	0.2517	-0.1224	0.1727
Demographic characteristics			
Receiving Social Security	-0.0155	0.0790	0.2119
Male	-0.0052	-0.1986	-0.1084
White	0.2378	-0.0457	0.2039
Income above the median	0.2395	-0.0130	0.2625

$*p < .05. **p < .01. ***p < .001.$

may be explained by the fact that individuals treated longevity and high medical costs as complements and viewed annuities as a valuable tool to eliminate longevity risk and insure that resources were available to cover the cost of healthcare in old age. Evidence of low levels of financial sophistication provided little support for this hypothesis, indicating that the inconsistency in our findings was more likely the result of a lack of understanding related to complex annuity products. This finding may also be related to the idea that those with a strong preference for medical liquidity want or perceive a need for higher lump-sum values to fund the costs of their medical expenses.

Time preference had a significant impact on life annuity valuations. Those who report that they would spend the money received from a lump-sum distribution within a year were significantly less likely to be in the rational valuation category than both the low and irrationally high categories. Those who expected greater longevity were significantly more likely to be in the irrationally high valuation category than the rational category. This finding is consistent with theory and indicates that overoptimistic longevity expectations can affect optimal intertemporal consumer decision making through an unwillingness to acknowledge mortality. Individuals with income or financial

wealth above the median were not more likely to be in any of the three rational valuation categories.

Conclusions and Implications

The current study investigated the factors related to annuity valuation by consumers. We found that only behavioral predictors had an impact on the value a respondent places on a $500 per month life annuity payment, while financial sophistication and numeracy had no impact at all. Similarly, when the life annuity valuations were broken down to reasonable and unreasonable responses based on average longevity at age 65 and realistic discount rates, we found that a higher knowledge of financial concepts and numeracy did not increase the likelihood that the respondent would give a reasonable response. Results from this study indicate the potential existence of a widespread lack of knowledge about annuity products.

These results suggest that those with below-average sophistication and those with above-average sophistication are equally likely to place a rational value on the life annuity benefits. Those with liquidity preferences, bequest motives, and control preferences are heavily concentrated in the irrationally high valuation category. Such inconsistencies between preferences and valuations may further indicate a lack of understanding. This finding may also suggest that financial sophistication is not comprehensive or transferrable, especially when considering markets that are complex and less frequently used by consumers.

Responses are concentrated in the irrationally high annuity valuation category. This finding contradicts prior research that suggests individuals place a low value on annuitization. One explanation is that respondents may view the decrease of $500 as a loss relative to a social security payment reference point, leading to a biased value of the lump sum required to compensate for this over-weighted loss of income (Tversky & Kahnemann, 1991). One explanation is that individuals place a high value on annuities, but an insufficient understanding of these products prevents individuals from gathering and effectively using the information necessary to accurately estimate annuity values. This is evidenced in a study by Gustman, Steinmeier, and Tabatabai (2010) that found that numeracy and other measures of cognitive ability were not determinants of pension or Social Security knowledge. When parameters of uncertain decisions are unknown, it is rational for consumers to avoid making the decision as a result of ambiguity aversion (Schmeidler, 1989). This aversion to uncertainty may result in a loss of consumer welfare if

demand for annuities falls well below what would exist if consumers had full information. Chalmers and Reuter (2011) showed that the demand for life annuities dropped in their sample of public employees when the risk-free rate dropped. They hypothesized that a drop in interest rates is a proxy for economic uncertainty in the marketplace resulting in lump-sum values greater than what is available through life annuity payments. Because proxies for economic uncertainty were found to have little effect in subsequent testing, they later attributed the behavior of their sample to financial illiteracy, noting confusion about the link between discount rates and annuity values (Chalmers & Reuter, 2011). Lusardi and Mitchell (2007) found that only 18% of respondents were able to accurately estimate the impact of compound interest on security valuation. Such confusion would cause consumers to inaccurately value annuity products, potentially leading to lower levels of annuity demand and the loss of consumer welfare in retirement. Additionally, Clark, Morrill, and Allen (2010) showed that, after providing seminars on retirement plan distributions, employees with both defined benefit and defined contribution plans had a higher propensity for annuitization. This is likely the result of highlighting the salient benefits of annuitization, eliminating ambiguity and helping participants better understand how annuitization can help them navigate the difficult task of decumulating retirement assets. Because levels of financial sophistication are low, increasing basic understanding about the benefits of annuitization can lead to annuities being the path of least resistance for individuals' plan for the distribution of the retirement assets. For someone with limited financial knowledge it would be much simpler to annuitize retirement wealth than to manage their retirement portfolio and be faced with investment selection decisions, rebalancing, withdrawal rates, and tax planning (Agnew & Szykman, 2010).

Policy intervention, which either force annuitization (such as Social Security) or increase information availability, may enhance consumer welfare for those who would otherwise under-annuitize. However, evidence that higher levels of numeracy and financial sophistication are not related to increased product understanding should cause concern for policy makers who might assume that increased financial knowledge will improve savings habits and lead to the optimal decumulation of assets after retirement. To the extent that governments promote education, it should place significant emphasis on pension-related topics that focus on retirement needs and longevity risk (Cappelletti, Giovanni, & Tommasino, 2011).

Immediate life annuities are complex financial products. Annuities have a reputation as an opaque product class that is often sold at high prices that provide generous commissions to agents. The reluctance to provide simple information about fees and expenses associated with annuities has not enhanced the perception of annuities among consumers. The decision to maintain product opacity as a marketing technique to extract rents from consumers unable to accurately determine quality or price may contribute to the low rate of annuity ownership in the United States. Improved product disclosure that improves the ability to value an annuity, standardization of annuity products, and better regulation of suitability standards within the industry promises to benefit both consumers while increasing competition among annuity providers.

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Appendix A. Valuation Category Calculations

Valuations	Life expectancy	Discount rate	Payment per month	Future value of the annuity	Present value of the annuity
Rational – lower bound	20*12	8%/12	$500	0	$59,777.15
Rational – upper bound	20*12	2%/12	$500	0	$98,837.02
Low – upper bound	20*12	10%/12	$500	0	$51,812.31

Note. The calculations are worked as an annuity due indicating that payments are received at the beginning of each period. By multiplying and dividing the life expectancy and discount rates respectively, we are assuming monthly compounding and accounting for the fact that the $500 payment is a monthly payment. Values are rounded to the nearest $5,000 for the purposes of determining the valuation category cutoffs.

The lower bound value of the high valuation category assumes a 0% discount rate and is calculated as ($500*12)*20 = $120,000, which is also $14,000 higher than the market price for an inflation-protected $500 annuity in 2008 (Schirrippa, 2009). The upper bound value on the high valuation category (lower bound value on the irrationally high valuation category) is somewhat arbitrary. The motivation for establishing this threshold was to distinguish extreme irrationality among those with high valuations.

Appendix B. Descriptive Statistics for the Total Sample (*N* = 681)

Variable	Min	Max	*Md*	*M*	*SD*
Annuity valuation	10	5,000,000	200,000	1,509,580	2,109,212
Financial sophistication	0.00	6.00	2.00	2.27	1.32
Numeracy	0.00	2.00	1.00	0.78	0.68

	Count	%
Financial sophistication		
Below average sophistication	175	25.70
Average sophistication	384	56.39
Above average sophistication	122	17.91
No numeracy	249	36.56
Some numeracy	336	49.34
Full numeracy	96	14.10
Rational demand factors		
Income certainty - very important	586	86.05
Leave inheritance - very important	240	35.24
Medical access - very important	231	33.92
Defined benefit plan	123	18.06
Behavioral demand factors		
Control over investments - very important	401	58.88
Very likely to spend in 1 year	45	6.61
Shorter than average longevity	223	32.75
Average longevity	199	29.22
Longer than average longevity	259	38.03
Below average health	162	23.79
Average health	215	31.57
Above average health	304	44.64
Demographic factors		
Receiving Social Security	330	48.46
Male	348	51.10
White	545	80.03
Income above the median	341	50.07