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Age Dependent Portfolio Selection

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ABSTRACT

This paper addresses the issue of portfolio risk exposure as a function of age, and it focuses the debate by presenting detailed cross-sectional evidence about individual portfolios. It provides new empirical results that characterized the relationship between age and the risk exposure of individual portfolios. The evidence from cross-sectional data suggests that individuals do not follow behavior proscribed by economic theory or by Wall Street advisors, rather the results of this paper suggest that current body of theoretical literature does not adequately describe the behavior of individuals. It implies that a satisfactory model of individual behavior needs to focus on factors not linearly correlated with age.

KEYWORDS: aging, demographics, portfolio allocation, risk

JEL CLASSIFICATION: D12, G11, J10

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I. Introduction

Should an individual maintain a constant portion of his portfolio wealth in risky assets regardless of his age? The answers to this question are at best unclear and often contradictory. One side of the argument, notably economic theory, suggests that given certain assumptions an individual should maintain a constant proportion of risky assets in his portfolio. The other side of the argument, especially Wall Street advisors, argues that an individual should decrease his exposure to risk as he ages.

This paper addresses the issue of portfolio risk exposure as a function of age, and it focuses the debate by presenting detailed cross-sectional evidence about individual portfolios. It provides new empirical results that characterize the relationship between age and the risk exposure of individual portfolios. The evidence from cross-sectional data suggests that individuals do not follow behavior proscribed by economic theory or by Wall Street advisors, rather the results of this paper suggest that current body of theoretical literature does not adequately describe the behavior of individuals. It implies that a satisfactory model of individual behavior needs to focus on factors not linearly correlated with age.

The remainder of the paper proceeds as follows. First, I present a review of the existing literature concerning the allocation of assets at different ages. Next I use three surveys conducted by the Board of Governors of Federal Reserve System to present cross-sectional evidence about age dependent changes in portfolio composition.The cross-sectional evidence suggests that individuals increase their equity holdings throughout their working years and decrease their holdings of equities once they retire. I then turn to estimates of aggregate household portfolio composition to verify that aggregation does not obscure individual behavior. Using data from the post-war period, I find that in aggregate the portfolio composition of households is consistent with the behavior described by the cross-sectional data. Time-series estimates indicate that an economy with an age distribution skewed toward new entrants into the economy or toward retirees holds fewer equities than an economy that has many middle-aged individuals. The final section presents some concluding thought on the subject.

II. Age Dependent Portfolio Composition

A. Theoretical Models

The theoretical relationship between age and investment in risky assets is unclear. Casual examination of the subject indicates that the idea of a widow's portfolio may make sense. Appealing to arguments similar to the law of large numbers, it is plausible that individuals who have longer horizons should invest more of their wealth in risky assets because the long run average of their portfolio returns will have a lower variance than the average return for individuals with shorter horizons. Furthermore, younger individuals are likely to have a continuing flow of labor income until retirement, thus they are able to recoup any early loses from stock market downturns. In contrast retirees are much more dependent on their savings because they cannot offset losses with future labor.

It is these types of arguments that are pervasive in the financial sector. As an advisory column in *The Wall Street Journal* points out,[1]

> "Because stocks perform handsomely over long periods, financial advisors usually suggest putting a large chunk of a retirement portfolio into the stock market. The more years you have to go until retirement, that bigger chunk should be... Younger investors may not have much money. But they have one big advantage: time."

Another advisor states,[2]

> "One rule of thumb recommended by Ayco: Take your age and add a percent sign. You should have no more than that percentage of your money invested in fixed-income assets such as bonds. Invest the rest in stocks."

While the above arguments may appear sensible, Samuelson [1969] shows that under the assumptions of time additive and separable utility, identically and independently distributed returns, and complete markets, individuals with constant relative risk aversion should not alter their portfolio as their investment horizon changes. Furthermore Samuelson [1963] shows that the

[1] Clements [1993]

[2] Damato [1993]

law of large numbers is not applicable to the portfolio allocation problem because individuals care about wealth, not average returns. While the variance of average returns does indeed decrease with the length of the horizon, the variance of wealth increases.[3]

In contrast to Samuelson, Arrow [1964] argues for theoretical reasons that relative risk aversion should increase with wealth. Since wealth increases with age, Arrow's argument suggests that older individuals will invest a smaller fraction of their wealth in risky assets as a by-product of the correlation between age and wealth. Thus older individuals should place larger fractions of their portfolios in safe assets as they age.

There have been other, more recent attempts to justify Wall Street advice. Fischer [1983] argues that the high degree of serial correlation present in Treasury bill returns makes them a much less appealing to long term investors. Samuelson [1989] suggests that changing the utility function to include a minimum subsistence level while maintaining the other assumptions, and ignoring human capital, provides a rationale for reduction in risky assets among older individual. Older individuals rationally reduce their risk exposure because they need to insure that their savings provide sufficient means to satisfy levels of minimum consumption.

Bodie, Merton and Samuelson [1992] suggest younger individuals will act in a manner that is consistent with lower risk aversion because they have more flexibility about their labor leisure decisions. This flexibility allows young individuals to increase their labor input to compensate for any losses from holding risky assets.

Finally, Samuelson [1991] suggests mean reversion in asset returns leads to greater risk taking by those who have longer horizons.[4] Younger individuals can exploit the low frequency mean reversion since their horizon is greater than older individuals. In essence if mean reversion is true, equities change their return to risk relationship as the investment horizon changes. Thus an individual whose risk aversion parameter remains constant over his lifetime will find equities more attractive when his investment horizon is long and less so as his horizon shrinks.

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[3]The variance of wealth grows at a rate proportional to $\sqrt{T}$, where T is the investment horizon.

[4]Poterba and Summers [1988] and Fama and French [1988] find evidence that stock returns exhibit mean reversion over a long horizon.

B. Previous Empirical Studies

The empirical research on the subject has been mixed. Several studies suggest that risk aversion increases with age. Morin and Suarez [1983], in a cross-sectional study of 14,034 Canadian households surveyed in 1969 find evidence of increasing risk aversion with age although the households appear to become less risk averse as their wealth increases. Blume and Friend [1975] in a study using the 1962 Survey of Financial Characteristics of Consumers indicate increasing or constant risk aversion with wealth. Given the increase in wealth over an individual's lifetime, increasing risk aversion suggests that older individuals will most likely have higher risk aversion than younger. Shorrocks [1982] using survey of UK households finds cash and savings increase with age. Bossons [1973] also finds similar results using the 1962 survey. However a paper by Cohn, Lewellen, Lease and Schlarbaum [1975] finds in survey of investors with stocks that risk aversion decreases with age and wealth.

III. A Cross-Sectional Examination

To understand how an individual's portfolio risk exposure changes over his lifetime, I first turn to three cross-sectional surveys conducted by the Federal Reserve: 1962 Survey of the Financial Characteristics of Consumers, and the 1983 and 1986 Surveys of Consumer Finances. The surveys contain information about the allocation of wealth for individual households. Before I apply regression analysis to isolate the effect of aging on portfolio allocation, I turn to some simple facts about an individual's age and his allocation of assets.

A. Individual Attitudes

The 1962 Survey of the Financial Characteristics of Consumers and the 1983 Survey of Consumer Finances ask questions about each household's attitudes toward risk, investment objectives and liquidity preferences. Although responses to such questions do not provide concrete answers about the variation of an individual's portfolio risk over his lifetime, the answers provide an interesting overview of the topic.

Table 1 shows the responses to the question asked in the 1962 survey

about each household's investment objectives.[5] Of the 6 categories of answers provided, the table shows the percentage of each age group that sought two extreme objectives.[6]

Table 1: Investment Objectives (1962 SFCC)

age	maximize return	safety of capital
< 25	20.00	13.33
25-34	11.94	16.42
35-44	9.12	17.13
45-54	8.39	22.10
55-64	6.54	24.52
65+	6.93	24.03

According to the responses, a larger proportion of individual's under the age of 25 sought to maximize the return to their investment. In addition the percentage of individuals seeking maximum returns progressively diminishes as the age of a household increases. At the same time the fraction of individuals seeking to safeguard their investment increases with age. Although the evidence is far from conclusive, table 1 suggests that psychologically, individuals of different ages have different priorities when they determine the composition of their portfolios.

The 1983 survey includes a more direct question about individual's attitude toward risk and returns. The survey asked respondents about their

[5]The survey asked all households that participated in the survey about their investment objectives as an open-ended question. The survey lists the six most common answers. They are:

1. Maximum current cash return.
2. Safe steady return.
3. Growth of capital through appreciation in value.
4. Safety of capital.
5. Liquidity, ready availability or marketability.
6. Minimizing income taxes.

[6]The number of respondents to the question was 2557.

preferences for risk versus return.[7] Table 2 shows an individual's willingness to trade higher risk for higher returns by different age groups.[8]

Table 2: Attitudes toward Risk and Returns (1983 SCF)

	response			
age	(1)	(2)	(3)	(4)
< 25	9.21	12.17	38.16	38.16
25-34	6.34	13.02	39.75	39.98
35-44	6.34	11.86	43.59	37.24
45-54	5.24	10.82	42.76	39.09
55-64	5.74	8.70	35.56	47.59
65+	4.31	5.17	26.44	60.34

Of those that answered the question, most are very risk averse, not willing to take any risk for greater returns. The table also indicates that younger individuals are more likely to accept higher risk for higher returns than the older individuals. Furthermore, the willingness to accept risk as measured by the response to the question decreases with age. Thus individuals under the age of 25 appear to be less risk averse than those aged 25 to 34, who in turn are less risk averse than those aged 35 to 44, etc.

B. Age and Portfolio Composition. A Second Look

To verify the consistency of behavior with expressed attitudes, I calculated some simple means. If an individual behaves in a manner consistent with his expressed views, the share of safe assets such as cash, government

[7]The survey asked all households that participated in the survey, "Which of the following statements on this response card comes closest to the amount of financial risk you are willing to take when you save or make investments?"

1. Take substantial financial risks expecting to earn substantial returns.
2. Take above average financial risks expecting to earn above average returns.
3. Take average financial risks expecting to earn average returns.
4. Not willing to take any financial risks.

[8]Results based on 4009 households.

bonds, and savings bonds should increase as he ages because equities are riskier than bonds or cash equivalents.[9]

Table 3 shows the mean percentage of the portfolio held in cash equivalents, bonds and equities by five age groups for the three surveys.[10]

Table 3: Mean Holdings of Assets as % of Wealth

	1962			1983			1986		
age	cash	bonds	stocks	cash	bonds	stocks	cash	bonds	stocks
25-34	86.37	1.05	12.58	92.61	1.06	6.33	93.69	2.61	3.69
	1.62	*0.44*	*1.54*	*1.36*	*0.26*	*0.57*	*0.67*	*0.39*	*0.52*
35-44	77.77	1.71	20.52	86.84	2.11	11.05	90.18	4.21	5.61
	1.57	*0.39*	*1.51*	*1.38*	*0.27*	*0.67*	*0.78*	*0.53*	*0.58*
45-54	69.03	2.84	28.14	82.01	3.30	14.69	85.80	4.86	9.34
	1.61	*0.50*	*1.51*	*1.50*	*0.43*	*0.85*	*1.11*	*0.62*	*0.91*
55-64	63.02	4.10	32.88	76.65	5.20	18.15	81.73	5.42	12.85
	1.77	*0.59*	*1.65*	*1.52*	*0.52*	*0.99*	*1.29*	*0.60*	*1.08*
65+	65.10	5.58	29.32	79.08	6.01	14.91	80.57	7.03	12.39
	2.11	*0.78*	*1.91*	*1.39*	*0.56*	*0.88*	*1.21*	*0.65*	*0.95*

Note: standard errors in italics.

[9]The average annual real return of equities between 1926 and 1988 is 8.8% with a standard deviation of 21.2%. For long-term government bonds, 1.6% and 10.2%, respectively. For the same period Treasury bills offered an average annual return of 0.5% with a standard deviation of 4.4%.

[10]Cash equivalents include: checking accounts, money market accounts, savings accounts, CD's and savings bonds. Measures of equities held include all mutual funds holdings, including those that invest in government securities and money markets.

The 1962 means uses financial wealth as the measure of household wealth. It includes cash equivalents, bonds and equities.

The 1983 column uses paper wealth as the measure of wealth. It includes: financial wealth, life insurance, lonas owed to households, gas leases, gross value of land contracts and thrift accounts.

The sample size for the 1986 calculations is 2685. The 1986 column uses financial wealth.

Table 4: Weighted Mean Holdings of Assets as % of Wealth

	1962			1983			1986		
age	cash	bonds	stocks	cash	bonds	stocks	cash	bonds	stocks
25-34	12.84	18.48	68.68	51.93	25.97	22.10	93.26	2.79	3.95
35-44	11.66	12.59	75.75	21.73	25.00	53.27	57.08	9.86	33.06
45-54	13.59	11.20	75.21	19.69	11.64	68.66	54.68	8.29	37.03
55-64	9.08	9.79	81.13	16.80	14.93	68.27	41.17	10.39	48.44
65+	10.82	15.67	73.50	16.01	21.47	62.51	37.89	15.67	46.45

All three surveys suggest a path of portfolio allocation over an individual's lifetime that differs from the existing empirical literature and the views expressed in tables 1 and 2. Table 3 indicates that the share of a portfolio held in cash diminishes throughout an individual's working life and increases thereafter. The riskier assets, bonds and equities, reflect an inverse pattern, increasing until an individual retires and decreasing after his retirement.

While table 3 shows the behavior of an average individuals within each age group, table 4 shows the behavior of an average dollar held within each age group. The results are similar to table 3. The data from the 1962 survey indicates increasing risk exposure before retirement and decreasing risk exposure after retirement. The 1983 and 1986 data suggest allocations that are less clear. The two surveys reveal monotonic decrease in risk exposure, while the holdings of equities indicates an increasing preference for stocks as an individual ages with a turning point near retirement age.

Not only does the pattern exhibited by the means contradict most of the empirical literature, but it also disputes the hypotheses put forth by Bodie, et al. and by Fischer. Their models predict that holdings of risky assets should diminish uniformly over an individual's lifetime. However the evidence suggests that the change is not uniform, moreover individuals appear to increase their investments in risky assets throughout their working lifetime.

C. Regression Estimates of Portfolio Composition

To isolate the effects of other factors that may confound estimates of an individual's risk exposure, I now turn to multiple regressions. Unlike other empirical works cited, I estimated tobit regressions to compensate for the

boundaries at zero and one for the share of wealth held in any one asset. The regression estimated is,

$$\begin{aligned} \%\ in\ asset = \beta_0 + \beta_1\ age\text{: } 25\text{-}34 + \beta_2\ age\text{: } 35\text{-}44 + \beta_3\ age\text{: } 45\text{-}54 \\ +\beta_4\ age\text{: } 55\text{-}64 + \beta_5\ age\text{: } 65^{+} + \beta_6\ \#\ of\ children \\ +\beta_7\ \#\ of\ adults + \beta_8\ gender + \beta_9\ race + \beta_{10}\ marriage\ status \\ +\beta_{12}\ high\ school + \beta_{13}\ college + \beta_{14}\ income + \beta_{15}\ wealth \end{aligned} \tag{1}$$

The variables number of children, number of adults and marriage status control for life-cycle factors. Gender, race, high school graduate, college graduate are proxies for human capital. Income and wealth check the dependence of portfolio allocation on financial status.

I also estimated a secondary regression imposing the restriction that the coefficients for each age lie on a quadratic equation. This allows me to test hypotheses about the slope of the relationship between portfolio allocation and age.

$$\begin{aligned} \%\ in\ asset = \gamma_0 + \gamma_1\ age + \gamma_2\ age^2 + \gamma_3\ \#\ of\ children \\ +\gamma_4\ \#\ of\ adults + \gamma_5\ gender + \gamma_6\ race + \gamma_7\ marriage\ status \\ +\gamma_8\ high\ school + \gamma_9\ college + \gamma_{10}\ income + \gamma_{11}\ wealth \end{aligned} \tag{2}$$

Table 5 displays the results of the regressions with the fraction of assets held as cash by individuals using the data from the three Federal Reserve surveys. The data sets include only those individuals that had positive wealth.[11]

Estimates of equation (1) confirm the findings of the means shown in table 3. All three surveys indicate a decrease in holdings of cash throughout the working years followed by an increase in cash holdings in retirement. The likelihood ratio statistic tests the null hypothesis that the coefficients for the age variables are jointly insignificant. In all six cases the null hypothesis is rejected at the 99% confidence level.

[11]The wealth measures for all regressions are those used in table 3.

Table 5: Estimates of Cash Holdings as % of Wealth

	1962		1983		1986	
	(1)	(2)	(1)	(2)	(1)	(2)
constant	1.206	1.676	0.833	1.090	1.077	1.278
25-34	-0.035		-0.048		0.016	
	0.79		*1.82*		*0.40*	
35-44	-0.120		-0.111		0.003	
	2.78		*4.05*		*0.08*	
45-54	-0.231		-0.126		-0.044	
	5.40		*4.49*		*1.07*	
55-64	-0.310		-0.128		-0.088	
	7.21		*4.58*		*1.07*	
65+	-0.317		-0.106		-0.062	
	7.11		*2.66*		*1.37*	
age		-0.022		-0.015		-0.007
		7.14		*6.06*		*3.90*
age^2		1.52E-4		1.37E-4		4.76E-5
		4.94		*5.27*		*2.52*
# of children	-0.010	-0.004	-0.003	0.001	-0.002	0.003
	1.69	*0.74*	*0.41*	*0.18*	*0.34*	*0.54*
# of adults	0.015	-0.016	-0.015	-0.012	0.002	0.001
	1.42	*1.52*	*1.57*	*1.26*	*0.38*	*0.12*
gender	-0.086	-0.085	-0.036	-0.037	-0.003	-0.007
(1 = male)	*2.49*	*2.48*	*1.85*	*1.93*	*0.20*	*0.44*
race	-0.043	-0.043	-0.067	-0.065	-0.030	-0.029
(1 = white)	*2.27*	*2.30*	*3.89*	*3.76*	*2.02*	*1.96*
married	-0.044	-0.043	0.155	0.150	-0.025	-0.024
(1 = yes)	*1.41*	*1.37*	*7.59*	*7.31*	*1.62*	*1.53*
high school	-0.183	-0.186	0.028	0.029	-0.081	-0.082
(1 = yes)	*11.11*	*11.26*	*1.81*	*1.84*	*6.94*	*6.98*
college	-0.341	-0.339	0.023	0.022	-0.203	-0.200
(1 = yes)	*19.15*	*19.06*	*1.38*	*1.31*	*16.02*	*15.79*
income	1.27E-7	1.22E-7	-2.88E-7	-2.86E-7	-9.89E-8	-9.86E-8
	1.93	*1.86*	*8.26*	*8.21*	*5.44*	*5.42*
wealth	-1.11E-7	-1.12E-7	-1.73E-8	-1.79E-8	-1.76E-8	-1.77E-8
	9.27	*9.30*	*4.97*	*5.16*	*8.78*	*8.76*
n	2215		3746		2685	
LR statistic	115.11*	156.60*	35.94*	45.80*	55.18*	51.60*

Note: t-ratios in italics.

* denotes joint significance at 1% significance level.

Table 5 also indicates that individuals with greater wealth hold less cash. This contradicts the argument put forth by Arrow. All six regressions indicate an increasing tolerance for risky assets among wealthier individuals, and all coefficients for the wealth variable are statistically significant at 99% confidence level. Furthermore those individuals who can expect higher lifetime income, white men with college degrees, are willing to accept greater risk in their portfolios, the exception to this being the coefficients for the education variable from the 1983 survey.

I also estimated equations (1) and (2) using the percentage of wealth held in bonds as the dependent variable. Unfortunately the 1962 and 1983 surveys do not include many individuals that held bonds.[12] Therefore I could not estimate equation (1) for the two surveys. Table 6 shows the tobit regression coefficients for the share of wealth held in bonds.

The results from table 6 are comparable to those shown in table 3. Households increase their holdings of bonds during their working years and then decrease their holdings once they retire. As before, the age coefficients are individually and jointly significant and the regression indicate individuals with higher expected lifetime incomes hold more bonds as do those with higher wealth.

Since many people consider bonds, especially government bonds, as safe assets, I estimated equations (1) and (2) using the fraction of wealth held in cash or bonds as the dependent variable. Table 7 shows the results of the six regressions.

Finally table 8 shows similar estimates with the fraction of portfolio invested in equities as the dependent variable. It should be noted again that the three surveys include all mutual fund holdings in the figures for equities. Since there is no way to separate the mutual funds into one of the three categories, cash equivalents, bonds and equities, the data for equities overstate the fraction of wealth held in equities.

All six regressions indicate that age is a significant factor in determining the portfolio composition. They also suggest that households increase their holdings of equities while working and decrease their risk exposure once they retire. As implied by tables 5 through 8, the evidence suggests that wealthier individuals have greater tolerance for risk than others and individuals with greater lifetime income invest more heavily in risky assets.

[12] For the 1962, 1983 and 1986 surveys, 14.2%, 9.5% and 29.9% of the households with positive wealth, respectively, held any bonds.

Table 6: Estimates of Bond Holdings as % of Wealth

	1962	1983	1986	
	(2)	(2)	(1)	(2)
constant	-2.197	-2.270	-0.602	-0.821
25-34			0.022	
			0.25	
35-44			0.063	
			0.72	
45-54			0.093	
			1.06	
55-64			0.129	
			1.45	
65+			0.147	
			1.54	
age	0.040	0.047		0.011
	4.60	*4.14*		*2.95*
age^2	-2.45E-4	-3.78E-4		-7.69E-5
	3.12	*4.83*		*2.17*
# of children	0.015	-0.022	0.011	0.011
	1.17	*1.17*	*1.27*	*1.26*
# of adults	-0.064	-0.018	0.006	0.004
	2.74	*0.80*	*0.56*	*0.37*
gender	0.165	0.339	0.005	0.007
(1 = male)	*2.08*	*3.83*	*0.14*	*0.21*
race	0.014	0.070	0.066	0.065
(1 = white)	*0.34*	*1.52*	*2.20*	*2.17*
married	0.084	-0.559	0.072	0.069
(1 = yes)	*1.22*	*5.73*	*2.47*	*2.35*
high school	0.234	-0.030	0.165	0.163
(1 = yes)	*5.84*	*0.83*	*6.70*	*6.63*
college	0.353	-0.317	0.281	0.278
(1 = yes)	*8.45*	*5.00*	*10.90*	*10.78*
income	-1.25E-8	4.60E-7	7.96E-8	7.82E-8
	0.14	*8.83*	*3.01*	*2.96*
wealth	7.13E-8	5.94E-9	4.81E-9	5.05E-9
	4.35	*1.21*	*1.64*	*1.73*
n	2215	3746	2685	
LR statistic	57.30*	79.68*	18.61*	20.80*

Note: t-ratios in italics.

* denotes joint significance at 1% significance level.

Table 7: Estimates of Cash and Bond Holdings as % of Wealth

	1962		1983		1986	
	(1)	(2)	(1)	(2)	(1)	(2)
constant	1.175	1.601	0.832	1.052	1.074	1.211
25-34	-0.030		-0.041		0.003	
	0.71		*1.56*		*0.09*	
35-44	-0.107		-0.101		-0.001	
	2.61		*3.72*		*0.04*	
45-54	-0.200		-0.110		-0.038	
	4.92		*4.00*		*1.14*	
55-64	-0.265		-0.102		-0.074	
	6.50		*3.71*		*2.22*	
65+	-0.251		-0.073		-0.036	
	5.93		*1.87*		*1.00*	
age		-0.020		-0.013		-0.005
		6.87		*5.29*		*3.45*
age^2		1.46E-4		1.20E-4		3.46E-5
		5.02		*4.67*		*2.28*
# of children	-0.008	-0.003	-0.001	-0.003	-0.001	0.005
	1.44	*0.56*	*0.14*	*0.55*	*0.19*	*1.22*
# of adults	0.005	0.005	-0.017	-0.015	0.001	-0.001
	0.48	*0.53*	*1.83*	*1.69*	*0.20*	*0.18*
gender	-0.053	-0.053	-0.027	-0.028	-0.009	-0.013
(1 = male)	*1.63*	*1.62*	*1.40*	*1.48*	*0.71*	*0.99*
race	-0.043	-0.044	-0.061	-0.058	-0.025	-0.024
(1 = white)	*2.41*	*2.46*	*3.58*	*3.41*	*2.14*	*2.06*
married	-0.047	-0.046	0.127	0.123	-0.010	-0.010
(1 = yes)	*1.59*	*1.54*	*6.28*	*6.07*	*0.81*	*0.78*
high school	-0.164	-0.166	0.027	0.028	-0.056	-0.057
(1 = yes)	*10.44*	*10.58*	*1.77*	*1.80*	*6.02*	*6.06*
college	-0.310	-0.308	0.008	0.007	-0.144	-0.142
(1 = yes)	*18.31*	*18.22*	*0.49*	*0.43*	*14.12*	*13.91*
income	1.70E-7	1.65E-7	-1.46E-7	-1.44E-7	-6.80E-8	-6.81E-8
	2.71	*2.64*	*4.24*	*4.19*	*4.64*	*4.65*
wealth	-1.01E-7	-1.01E-7	-1.73E-8	-1.88E-8	-1.62E-8	-1.63E-8
	8.88	*8.90*	*5.34*	*5.49*	*10.05*	*10.10*
n	2215		3746		2685	
LR statistic	120.17*	121.25*	27.56*	33.14*	47.68*	38.26*

Note: t-ratios in italics.

* denotes joint significance at 1% significance level.

Table 8: Estimates of Equity Holdings as % of Wealth

	1962		1983		1986	
	(1)	(2)	(1)	(2)	(1)	(2)
constant	-1.305	-2.407	-0.699	-1.039	-1.152	-1.632
25-34	0.301		0.099		0.094	
	2.47		*1.91*		*0.70*	
35-44	0.524		0.238		0.161	
	4.31		*4.56*		*1.21*	
45-54	0.725		0.282		0.250	
	6.01		*5.36*		*1.88*	
55-64	0.848		0.324		0.344	
	7.00		*6.20*		*2.58*	
65+	0.826		0.309		0.240	
	6.71		*4.43*		*1.71*	
age		0.060		0.019		0.024
		8.67		*4.49*		*4.91*
age^2		-4.64E-4		-1.33E-4		-1.80E-4
		6.87		*3.00*		*3.72*
# of children	0.008	0.006	-0.040	-0.034	-0.015	-0.022
	0.66	*0.57*	*3.43*	*3.16*	*1.22*	*1.83*
# of adults	-0.003	-0.009	-0.004	-0.002	0.001	0.011
	0.15	*0.43*	*0.26*	*0.16*	*0.64*	*0.73*
gender	0.108	0.112	0.253	0.253	0.093	0.108
(1 = male)	*1.48*	*1.54*	*6.39*	*6.39*	*2.29*	*2.66*
race	0.109	0.114	0.110	0.116	0.206	0.198
(1 = white)	*2.79*	*2.93*	*3.81*	*4.03*	*4.47*	*4.31*
married	0.123	0.117	-0.469	-0.470	0.033	0.027
(1 = yes)	*1.88*	*1.79*	*10.36*	*10.34*	*0.88*	*0.73*
high school	0.429	0.432	-0.040	-0.042	0.318	0.318
(1 = yes)	*12.03*	*12.12*	*1.62*	*1.69*	*8.72*	*8.70*
college	0.688	0.687	-0.153	-0.153	0.587	0.581
(1 = yes)	*18.26*	*18.26*	*5.30*	*5.28*	*15.38*	*15.26*
income	-1.87E-7	-1.80E-7	3.91E-7	3.91E-7	1.37E-7	1.37E-7
	1.64	*1.58*	*8.76*	*8.75*	*4.15*	*4.15*
wealth	1.26E-7	1.25E-7	1.68E-8	1.71E-8	1.94E-8	1.95E-8
	6.06	*6.03*	*3.88*	*3.95*	*5.40*	*5.41*
n	2215		3746		2685	
LR statistic	153.16*	168.62*	75.04*	68.98*	26.77*	54.78*

Note: t-ratios in italics.

* denotes joint significance at 1% significance level.

Figures 1 through 3 show the coefficients for each age calculated from γ_1 and γ_2 in equation (2). The figures graphically illustrate the relationship between age and portfolio composition. The three figures confirm the pattern exhibited by the dummy variables in equation (1).

Figure 1: Composition of Portfolio (1962 SFCC)

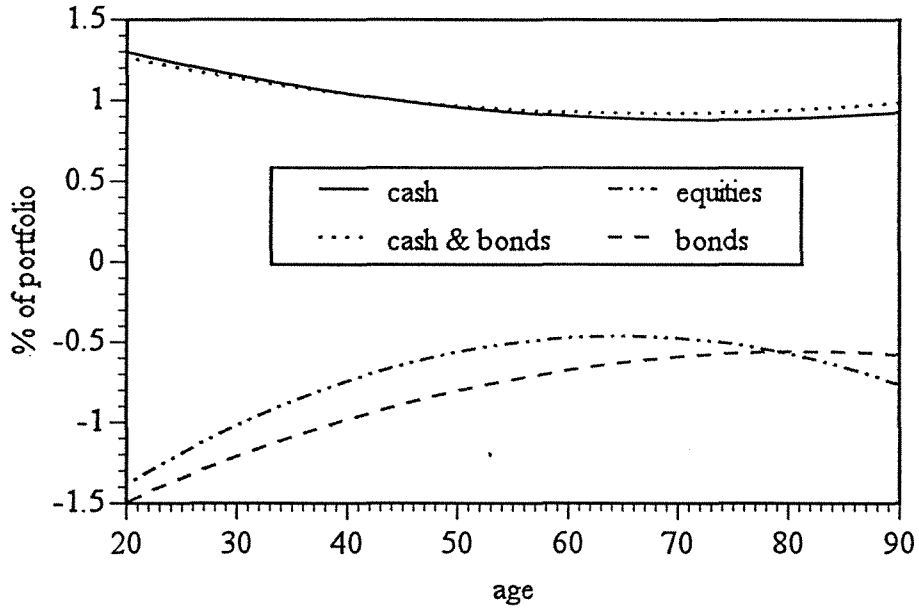


Figure 2: Composition of Portfolio (1983 SCF)

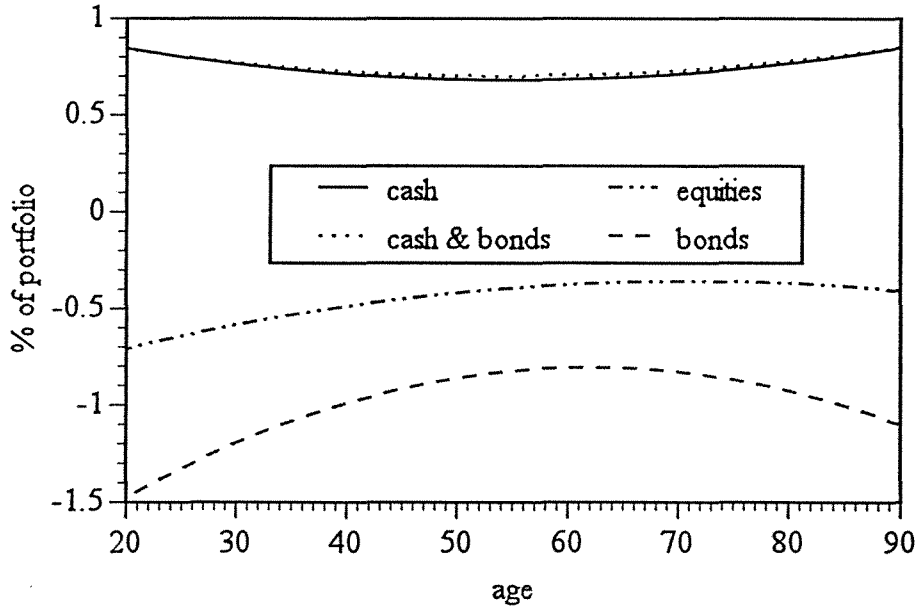
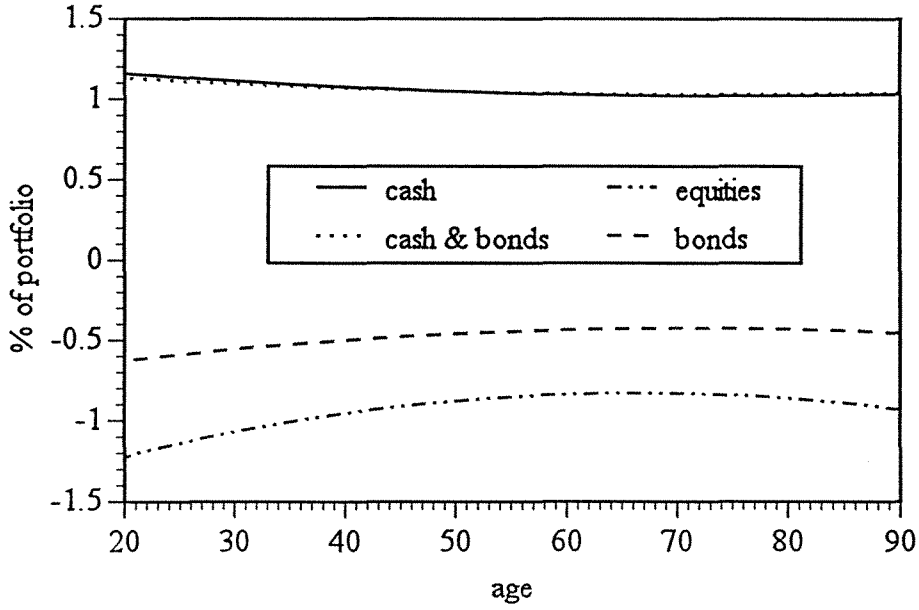


Figure 3: Composition of Portfolio (1986 SCF)



The questionnaires indicate attitudes that are consistent with the Wall Street advisors and the hypotheses put forth by Samuelson, Arrow, and Bodie, et al. However once some other characteristics are taken into consideration, the pattern of portfolio allocation preferences changes. The cross-sectional evidence suggests that working individuals increase their holdings of risky assets until they approach retirement. Thereafter their preferences shift toward cash.

Of the theoretical models present in the literature, Samuelson's suggestion that increasing preference for safe assets due to mean reversion appears to be irrelevant given the current body of works that suggest that mean reversion does not exist.[13] The argument put forth by Arrow is inconsistent with the results of increasing risk exposure among wealthier individuals.

Finally, the cross-sectional evidence is inconsistent with Bodie, et al.'s argument that it is rational for young to prefer equities because they have greater labor flexibility in their labor leisure decision. As the estimates show greatest exposure to risk occurs near retirement, not near entry into the labor force.

IV. Aggregate Household Portfolio Composition

Given the results in section three it appears as if the correlation between portfolio composition and age is not linear. I now turn to time series estimates of the relationship between age and portfolio composition by using aggregate household data to provide an independent verification of the cross-sectional findings. If the pattern of increasing and decreasing investment in risky assets is true and stable over time, time series estimates using aggregate household portfolio composition and population age distribution should reveal a similar pattern.

[13] Kim, Nelson and Startz [1991] suggest that mean reversion is an artifact of pre-World War II data. Fama and French also report finding zero autocorrelation using post-1940 data. Conrad and Kaul [1993] find that mean reversion disappears once they control for measurement errors.

Figure 4: Aggregate Household Portfolio Composition

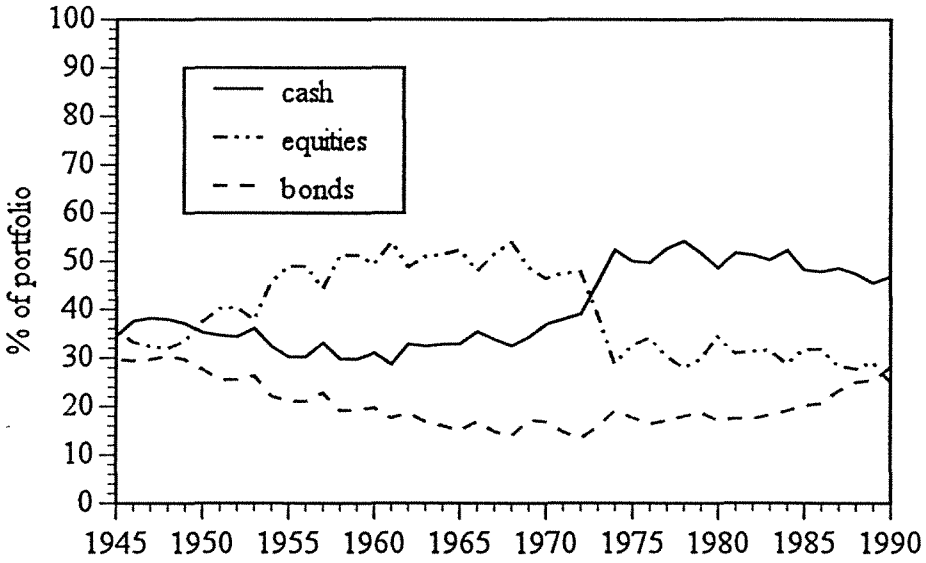


Table 9: Aggregate Portfolio Composition

age	cash	bonds	equities
25-34	0.040	0.221	-0.063
	7.88	*6.51*	*7.95*
35-44	-0.083	0.010	0.074
	4.38	*0.77*	*2.53*
45-54	-0.087	0.042	0.046
	1.88	*1.36*	*0.64*
55-64	-0.218	-0.028	0.247
	2.56	*0.50*	*1.89*
65+	-0.021	-0.001	0.022
	1.04	*0.04*	*0.70*
DW	1.77	1.86	1.84
adj. R^2	0.95	0.93	0.90

Note: t-ratios in italics

The data for aggregate household portfolio composition comes from the Federal Reserve's *Balance Sheet for the U.S.* It includes estimates for total household holdings of cash equivalents, bonds and equities, as well as mutual fund holdings. The measure of wealth equals the sum of the four types of assets. I included wealth held in mutual funds after 1984; prior to 1984 mutual funds did not constitute a large fraction of financial wealth for households. I separated the total for mutual funds by using information about the asset holdings of mutual funds provided by the Investment Company Institute.[14] The age distribution information comes from Census Bureau's estimates.

The time-series estimates indicate that the pattern observed in cross-section data exists in aggregate data for the post-World War II era. The population holds more of its wealth in cash when there are many young or many old individuals, and it holds more of its wealth in risky assets when a larger fraction of the population is middle aged.

V. Conclusion

The cross-sectional evidence presented in this paper indicate that the relationship between aging and portfolio allocation is not linear; young and retired individuals demand less risky assets than middle-aged individuals. Time-series estimates support the cross-sectional findings. These results indicate models that predict a uniform relationship between age and willingness to invest in risky assets are not sufficient.

The implications for age dependent behavior is many fold. First and foremost, changing tolerances of risky exposure suggests future research using representative agent models to describe aggregate risk tolerances needs to be aware of demographic changes in the population and their subsequent effects on aggregate risk tolerances. It is unfortunate that cross-sectional data separating different assets by risk rather than by broad categories such as equities, bonds, deposits do not exist. Given the large differences in the risk characteristics of equities, it is impossible to distinguish between an individual holding stocks with low volatility versus another individual holding stocks with much greater variances. Such a data set would provide more information about the demand for risky assets among individuals.

[14] ICI sends questionnaires to affiliated mutual funds. The funds then profice information about the composition of their funds.

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