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Tapen Sinha

BOND UNIVERSITY
School of Business

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University Drive,
Gold Coast,QLD,4229
AUSTRALIA

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Tapen Sinha

School of Business

Bond University

Gold Coast, Queensland 4229

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Abstract: In a laboratory experiment, I used an interactive method to determine the effects of difference in ages on risk taking. Two sets of subjects were chosen: one group was "young" (mean age 21) another group was "old" (mean age 65), I found risk (loss) aversion for monetary gains (losses) were higher for older people. The implications of the result given the population aging are explored.

Are Older People More Risk Averse?

Do different age cohorts have different attitudes to quantitative risk taking? I answer this question with the results of a microeconomic experiment at the individual level. The results are of potential interest to all countries with aging population. If the results from age cohorts apply to countries with aging population, the macroeconomic effect is change in the risk taking characteristics of an entire nation.

I studied quantitative risk taking: situations with outcomes completely specified in dollars and cents and the probabilities explicitly stated. Economics literature contains many investigations of indirect observations derived from choices made in the market (e.g., Watts and Tobin, 1967; Blume and Friend, 1978). No study was ever undertaken to elicit direct responses to assess the effects of age differences on quantitative risk taking.

Novel features of this study are: (1) Direct analysis of data collected at the individual level in an experimentally controlled setting (unlike most economic analysis). (Thus, our study is free from "other things" that typically do not stay constant when aggregate data are analyzed.) (2) Quantitative analysis of the data (unlike most psychological studies). For example, many psychological studies on risk taking relied on (modified versions of) Kogan and Wallach (1964) questionnaires. In Kogan and Wallach questionnaire, the payoffs are qualitative (e.g., "you are a prisoner of war; you can escape with probability 1/2; but if you are caught, you will be severely punished..."; the losses or gains are never specified in monetary terms. (3) The subjects were taken from a group of individuals who have at least high school education with some college graduates. Thus, the level of education was controlled without sacrificing the age difference. (4) Unlike all previous investigations studying the impact of age differences on risk taking, I provided a complete specification of the all possible outcomes in an experimental environment (i.e., the pay off for each outcome was described in monetary terms and the probability of each outcome was also stated explicitly). (5) I use a new method of determining "certainty equivalent sum" by giving a series of binary choices to subjects seated at a computer terminal.

The only other study specifically designed to find age effects on risk taking was by Vroom and Pahl (1971). They studied qualitative risk taking among firm managers of different age groups using a shorter version of the Kogan and Wallach (1964) questionnaire. Their measures of risk taking were qualitative. Thus, their environment left a lot of ambiguities.

Method

Subjects

Two groups of male (volunteer) subjects were chosen from a list of names of past and present employees of a bank in south-eastern Wisconsin. The criteria for choosing the groups were as follows: (1) For both the younger and the older groups, the required level of education was at least a high school diploma. (2) The younger group was chosen from a list of employees who have joined the bank within the last five years and who are no more than twenty five years old. (3) The older group was chosen from a list of past employees who have retired within the past five years.

Focussing on bank employees has two advantages: (1) The bank employees are used to dealing with dollars and cents during their working lives. Hence, the quantitative experimental frames are easily understandable to them. (2) All the subjects were used to dealing with menus on computer screens during their working lives. Hence, they did not suffer from "fear of computers". In my earlier experiments with older people in general, I found many were uncomfortable in using a keyboard and a computer terminal.

The experimenters seated the subjects individually in booths with IBM personal computer with instructions displayed on the screen (CRT). No explicit oral instruction was given. However, two experimenters (one male and one female) sat outside the booth to clarify any doubts after a session began. A session began with a subject entering personal socioeconomic information using the keyboard (e.g., age, family income, family wealth, family size). Then, the subject faced a screen displaying the following:

Four situations will be described to you. You are to make decisions in each such situation. There is no "correct" decision. Do what you "feel" to be the right decision for you. Press the return key when you are ready.

Upon pressing the return key, each respondent faced the following situation:

Situation L1

You are going on a safari with luggage worth $1,000. There is a 50% chance that the luggage will be lost forever. You have the following choices:

Choice 1

You buy an insurance policy that reimburses you the full $1,000 if the baggage is lost. But, the insurance plan itself costs $500.

Choice 2

You do not buy the insurance policy; in which case, there is a 50% chance that you will lose $1,000 worth of luggage and of course, there is a 50% chance that you will not lose the luggage.

If you prefer choice 1, then type 1; if you prefer choice 2, then type 2; if you have a hard time choosing between the two, then type 3.

Suppose the respondent keyed in choice 1 or choice 2, the screen then displayed a different insurance cost in choice 1. Specifically, if the respondent picked choice 2, the program automatically lowered the dollar number he or she had to pay for the insurance policy in choice 1 to $400. Similarly, if the respondent picked choice 1, the program automatically raised the dollar number in choice 1 to $600. The idea of the program is to keep altering the dollar number in choice 1 by progressively smaller steps so as to brings the choices closer together in value. If two choices are equally valued, the subject is said to be indifferent between the choices, and the amount paid for certain reimbursement was the subject's score. When a "3" was typed, it meant that the subject was indifferent between choice 1 and choice 2 and the trial stopped. If the respondent never typed "3" but the difference between successive values of choice 1 became less than $10 (or 1% of $1,000), the process was terminated after recording the last value.

Situation L5 described a situation similar to situation L1. But the monetary values were increased fivefold. The rest of the process for situation L5 is continued in the fashion described above for situation L1. The same questions with monetary values of $10,000 and $20,000 were used.

Next, the respondent faced four more scenarios involving gains:

Situation G1

You work for a company which has made a large profit this year. It offers you the following choices of a **one time** bonus.

Choice 1

The company pays you the amount of $500.

Choice 2

The company lets you enter into a "lottery" where a coin is tossed. If a head comes up (50% chance), you get a bonus of $1,000. If a tail comes up (50% chance), you get nothing ($0).

If you prefer choice 1, then type 1; if you prefer choice 2, then type 2. If you have a hard time choosing between the two, then type 3.

The rest of the process for situation G1 is continued in the fashion described above for situation L1. Situation G5 (G10, G20) is the same as situation G1, except the monetary values are increased to $5,000 ($10,000 and $20,000).

I can summarize the eight eventual choices of the respondents as follows: a number $z was obtained such that the subject was indifferent between winning (losing) $z with certainty and the gamble of winning (losing) $y with a 50% chance (and therefore, a 50% chance of winning (losing) $0). This $z is called the certainty equivalent sum of the gamble between winning (losing) $y with a 50% chance and winning (losing) $0 with a 50% chance. The certainty equivalent sum z is the dollar amount for which the respondent is indifferent between having the risky venture (gain/loss) or z dollars (gain/loss) for sure. Each subject was given ample time to complete the task. Most subjects took 10 to 15 minutes. A few took as long as 30 minutes. Similar methods of eliciting certainty equivalent sums using binary choices at computer terminals were also used by Schkade and Johnson (1989) to study preference reversals.

Results

The certainty equivalent sums from situations Y1, Y5, Y10, Y20; G1, G5, G10, G20 were given the following names: YG1, YG5, YG10, YG20, YL1, YL5, YL10, YL20 for young group (L stands for loss Y for young, G for gain and the corresponding number refers to the dollar number in thousands) and OG1, OG5, OG10, OG20, OL1, OL5, OL10, OL20 for old group (L stands for loss O for old, G for gain and the corresponding number refers to the dollar number in thousands).

Table 1, about here

Pearson Product-Moment correlations were calculated for between among L1, L5, L10 and G1, G5, G10 for both young and old separately. These are reported in Table 2.

Table 2, about here

Finally, analysis of variance with four levels (L1, L5 and L10, L20) and two age groups (old and young) in the loss domain as well as in the gain domain (G1, G5, G10, G20). The variables showed a highly significant interaction term.

Table 3, about here

The interaction term became insignificant once the variables were transformed with natural logarithms (e.g., OG1 was transformed to ln(OG1)). The results of 4x2 ANOVA with natural logarithms of certainty equivalent sums are presented in Table 4.

Table 4, about here

Discussion

Table 1 shows on the average for gain situations older people are more risk (loss) averse than younger people. The results of risk aversion in the domain of gains and loss aversion in the domain of losses is consistent with most empirical investigations (Kahneman and Tversky, 1979; 1984). The correlation between the loss situations and gains situations were very low (Table 2). A multivariate Box test of the bottom left 4x4 submatrix of cross correlations in Table 2 shows that the hypothesis of zero correlation between gain and loss situations cannot be rejected at 5% level of significance. On the other hand, cross correlation among gain situations (and among loss situations) are significantly positive. This finding is consistent with Cohen, Jaffray and Said (1987).

ANOVA for gain and loss situations (Table 3) shows that there is a significant interaction between age and level of gamble. However, the interaction term becomes insignificant once a logarithmic transformation is made. It shows that the underlying decision process contains the main effects in a multiplicative form. We would expect the level of the gamble to be significant (that is, it matters to the individual what the certainty equivalent sum is for different levels of gambles). More of interest is the clear significant effect of the age variable.

Conclusion

In all western countries the population is aging: the proportion of elderly people are set to at least double over the next three decades. Thus, consumption array that are sensitive to age will change significantly (e.g., demand for primary schools and jails will fall, demand for pacemakers and dentures will rise!).

Researchers have neglected what population aging would mean for consumption of goods and services that are sensitive to risk taking characteristics of the population. This paper addresses that question in a simple and direct laboratory experiment. Clearly there is a need to expand the scope of this paper with different groups of individuals. There is also a need to expand the study to include both males and females.

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Table 1: Summary statistics of relevant variables

variable	number	mean	sd
age (old)	50	21.02	2.29
age (young)	50	65.04	2.54
OG1	50	362.40	182.48
YG1	50	433.40	178.92
OG5	50	1703	1032.26
YG5	50	2029	773.70
OG10	50	3044	1838.72
YG10	50	4436	2227.36
OG20	50	5200	3809.98
YG20	50	8360	3540.78
OL1	50	417.20	183.97
YL1	50	431.60	188.67
OL5	50	1683	913.59
YL5	50	2060	911.60
OL10	50	4003.20	1884.61
YL10	50	4330	1737.13
OL20	50	7132	3760.94
YL20	50	8716	3723.09

Table 2

Pearson Product-Moment Correlations among certainty equivalent sums for old and young groups

	OG1	OG5	OG10	OG20	OL1	OL5	OL10	OL20
OG1								
OG5	+0.06							
OG10	+0.17	+0.51						
OG20	+0.17	+0.46	+0.46					
OL1	-0.10	-0.15	+0.17	-0.05				
OL5	-0.05	+0.04	+0.38	+0.10	+0.53			
OL10	-0.12	+0.08	+0.28	-0.01	+0.52	+0.45		
OL20	-0.01	+0.17	+0.30	+0.06	+0.51	+0.51	+0.49	

	YG1	YG5	YG10	YG20	YL1	YL5	YL10	YL20
YG1								
YG5	+0.38							
YG10	+0.59	+0.58						
YG20	+0.56	+0.48	+0.50					
YL1	+0.16	+0.21	+0.06	+0.09				
YL5	+0.12	+0.08	+0.06	+0.31	+0.51			
YL10	+0.08	-0.03	+0.03	+0.09	+0.50	+0.60		
YL20	+0.16	-0.17	-0.06	+0.19	+0.34	+0.33	+0.40	

Table 3 (a): Analysis of Variance for certainty equivalent sums in loss dimension

source	df	F-ratio	probability
level	3	236	0
age	1	7.30	0.0072
interaction	3	2.63	0.0498
error	392		
total	399		

Table 3 (b): Analysis of Variance for certainty equivalent sums in gain dimension

source	df	F-ratio	probability
level	3	163	0
age	1	33.0	0.0000
interaction	3	10.6	0.0000
error	392		
total	399		

Table 4 (a): Analysis of Variance for certainty equivalent sums in log(loss)

source	df	F-ratio	probability
level	3	401	0
age	1	11.2	0.0009
interaction	3	1.01	0.3885
error	392		
total	399		

Table 4 (b): Analysis of Variance for certainty equivalent sums in log(gain)

source	df	F-ratio	probability
level	3	261	0
age	1	39.8	0.0000
interaction	3	2.10	0.1002
error	392		
total	399		