HOW ELDERLY HOUSEHOLDS ALLOCATE THEIR ASSETS: PORTFOLIO CHOICE AND HEALTH CARE EXPENDITURE

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INTRODUCTION

As health care costs have risen rapidly in recent years, it became an increasingly important factor influencing financial management. One of the main themes of the research in financial management is portfolio choice. Many recent related studies have focused on the health status and the medical expenditure of elderly households (Edwards, 2008; De Nardi, French, and Jones, 2006; Love and Perozek, 2007; and Yogo, 2008). In these studies, a household consisting of a couple is usually assumed to act as a single agent and a unique utility function can be used to represent the household independently of the household structure. However, this assumption has been rejected by many papers (Mazzocco, 2004; Mazzocco, 2008; and Ashraf, 2009). The reason is that utility functions of risk sharing and intertemporal preferences can be different between the individuals in a household.

One implication of this intra-household heterogeneity is that the adjustment in portfolio allocation is determined by the result of negotiation and bargaining among household members when the husband or the wife is ill. For example, a negative health shock could lead to a household's divestment of its assets. Assume the husband has a higher risk tolerance and would like to liquidate the safe assets such as government bonds. But the wife has a lower risk tolerance and would like to sell some stocks. Their final decision largely depends on how big the difference is between their risk preferences and who compromises more. To avoid this complication, the typical practice is to estimate separate equations for single and married individuals. But few have explicitly examined if and how the impact of the health shock will differ because husbands and wives have different risk preferences.

The purpose of this paper is to empirically examine how the health risk is related to the share of wealth held in various asset categories. The health risk is measured by the level of out-of-pocket medical expenses, the volatility of out-of-pocket medical expenses, and the household's health status. I also examine if heterogeneity in the intra-household risk preferences has any impact on the relationship between health care expenses and portfolio choices.

The remainder of the paper is organized as follows. The second section reviews previous related literature. The third section describs the model and the data. In the fourth section, the impact of out-of-pocket medical expenses on households' portfolio choice is estimated and the results are discussed. The fifth section concludes with a summary and suggestions of future research.

LITERATURE REVIEW

There are many studies demonstrating how the elderly households' concerns on health care influence their portfolio choices (Edwards, 2008; Scholz, Seshadri, and Khitatrakun, 2006; Coile and Milligan, 2006; Goldman and Maestas, 2007; Love and Perozek, 2007; Pang and Warshawsky, 2008; and Horneff, Maurer, Mitchell, and Stamos, 2008). Rosen and Wu (2004) examined the impact of self-report health status in the Health and Retirement Study (HRS) data on the households' portfolio choices. The findings showed that the probability of owning different types of financial assets and the share of financial wealth are significantly affected by the health status. Smith and Love (2010) used panel data method to control for the unobserved heterogeneity among elderly singles to estimate the impacts of medical costs. Their conclusion was that the relationship between their health measures and portfolio decisions is insignificant after they controlled for the heterogeneity. Yogo (2008) treated health expenditures as investments in health in a portfolio choice model and used HRS data to assess the welfare gains of an annuity market. He concluded that the welfare gain of an annuity was less than 1 percent of wealth for the median-health retirees at age 65 and was about 10 percent of wealth for the healthiest.

Regarding the intra-household heterogeneous risk preferences, a large literature has shown that the intra-household risk and intertemporal preferences are heterogeneous (Mazzocco, 2004; Friedberg and Webb, 2006; Mazzocco, 2008; and Ashraf, 2009). Barsky et al. (1997) actually used HRS data to develop a measurement of the heterogeneity of intra-household risk preferences and found evidence that heterogeneous preferences have an impact on a couple's portfolio choice. Neelakantan, Lyons, and Nelson (2009) simulated the bargaining power of household members and estimated its impact on portfolio choice. Their findings supported that the risk aversion of the spouse with more bargaining power determines household portfolio allocation.

MODEL AND DATA

Data

The data sources are eight waves of HRS data which are collected from interviews conducted every two years from 1992 to 2006. HRS contains a national representative panel that covers respondents older than 51. The survey collects detailed information on health, wealth, income, and other demographic information. The RAND version of the HRS data is used since it has a clean and consistent subset of variables of the raw HRS. In addition, only households that had no missing values in the fields of out-of-pocket medical expenditure throughout the sample period are included in the sample.

Model Specification

Following the strategy in Rosen and Wu (2004), I discuss portfolio shares and ownership probabilities, respectively. In this paper, there are three variables that measure health risks facing the elderly households: the level of out-of-pocket medical expenses, the volatility of out-of-pocket medical expenses, and health status. De Nardi, French, and Jones (2006) suggested that out-of-pocket medical expenses are highly related to the level of wealth, since rich people usually live longer and can afford more discretionary spending on health care. To control for the wealth effect, I use the proportion of out-of-pocket medical expenses to a household's total wealth to measure the level of the household's out-of-pocket medical expenses. The volatility of out-of-pocket medical expenses is computed as the coefficient of variation of the household's previous out-of-pocket medical expenditures. This measure proxies the perceived uncertainty of the household's health care expenditure.

Out-of-pocket medical expenses are net of any insurance benefits that households might have received. Number of insurance plans is used to measure the insurance coverage enjoyed by households. Everyone is supposed to participate in Medicare at age 65 in the United States. A dummy variable is also used to indicate a household with at least one of its members 65 or older. To measure policy changes on Medicare policies, such as introduction of a "means test" in 2003 and Part D in 2006. Year-effect dummy variables are used. With year-effect dummy variables in the model, the financial market cycles and monetary policy changes are also controlled for.

Households' health status is strongly linked to the risk of medical expenses and impacts the portfolio allocation. An individual's self-report health status question in the HRS interview is: "Would you say your health in general is excellent, very good, good, fair, or poor?" The respondent has five options: 5 means poor health, 4 means fair health, 3 means good health, 2 means very good health, and 1 means excellent health. Since the husband and the wife are assumed to pool their income and share their risks together when one experiences a health shock, a composite health status of the household is constructed to reflect that the health status is positively linked to the risk of medical expenses of the household. Moreover, the medical expenditure rises at an increasing growth rate when the health status becomes worse. Therefore, the composite health status is calculated as the sum of squares of the self-report health status of every household member.

To measure the impact of the across-household composite risk preference, I follow the method developed in Chetty (2006) to use existing estimates of labor supply elasticities to calculate the coefficient of relative risk aversion. To measure intra-household risk preferences, HRS provides a set of questions to measure individual risk preferences. Answers to those questions are used

to separate different individual risk preferences, which are ranked from 1 to 4 by risk aversion without assuming a utility function form. Barsky et al. (1997) used the difference between risk preferences of the primary respondent and the secondary respondent to measure heterogeneity in the intra-household risk preference.

The level of wealth is an important determinant of portfolio allocation. With HRS data, the total wealth of the household *i* equals the sum of the household's stock assets, IRA, business investment, bond assets, checking accounts, CD, and total value of their primary house. Another issue is the definition of the different categories of the assets (Hurd, 2002; Kimball, Sahm, Shapiro, 2008; and Yogo, 2008). In this paper, the total wealth is collapsed into three assets: risky financial assets, safe financial assets, and real assets. The categorizing method is similar to the one used in Yogo (2008). Risky financial assets include stocks, IRA, and business investment. Safe financial assets include bond assets, checking accounts, CD, and the net value of all other savings. Real assets mostly include primary house owned by the household. The sum of shares of risky financial assets, safe financial assets, and real assets equals one for every household.

Other independent variables include bequest motive, the share of debt, the highest degree held by the members of the household, and the age variable.

In the approach to estimate portfolio shares, there are three endogenous variables: the share of risky financial assets, the share of safe financial assets, and the share of real assets. Let $S_{risk,i}$, $S_{safe,i}$, and $S_{real,i}$ represent the shares of assets held in risky, safe, and real assets by household i respectively. Then the variables to determine the shares of various asset classes are included in the equations as follows:

$$\textbf{(1)}\quad S_{risk,i} = a_1 + b_1 S_{debt,i} + b_2 E_{med,i} + b_3 H_{status,i} + b_4 W_{total,i} + b_5 U_{med,i} + b_6 Bq_i + b_7 R_{risk,i} + b_8 X_i + \varepsilon_{risk,i}$$

$$\textbf{(2)}\quad S_{safe,i} = a_2 + c_1 S_{debt,i} + c_2 E_{med,i} + c_3 H_{status,i} + c_4 W_{total,i} + c_5 U_{med,i} + c_6 Bq_i + c_7 R_{risk,i} + c_8 X_i + \varepsilon_{safe,i}$$

$$\textbf{(3)}\quad S_{real,i} = a_3 + d_1 S_{debt,i} + d_2 E_{med,i} + d_3 H_{status,i} + d_4 W_{total,i} + d_5 U_{med,i} + d_6 Bq_i + d_7 R_{risk,i} + d_8 X_i + \varepsilon_{real,i}$$

$$\textbf{(4)}\quad S_{risk,i} + S_{safe,i} + S_{real,i} = 1.$$

In equations (1)-(3), $S_{debt,i}$ is the share of debt in the total wealth for household *i* where the debt includes the total mortgage of primary residence, value of other home loans of primary residence, and other debts; $E_{med,i}$ is the share of the out-of-pocket medical expenditure to the total wealth; $H_{status,i}$ represents the combined health care status of the household; $W_{total,i}$ is the total wealth; $U_{med,i}$ measures the volatility of medical expenses; Bq_i measures the bequest motive which is the self-reported probability of leaving a bequest of more than $100,000; $R_{risk,i}$ indicates the household's composite risk preference computed by labor income and labor supply decision; and X_i represents a vector of independent variables including age (Age_i), education background ($Degree_i$), the number of health insurance plans ($Policy_i$), a dummy variable indicating that at least one of the household members are at or older than age 65, and a group of dummy variables representing the waves of the conducted surveys .

To estimate ownership probabilities, three dummy variables are used as dependent variables, $ownstock_i$, $ownbond_i$, and $ownreal_i$. If households own any category of assets, the corresponding dummy variable equals one. Otherwise, the dummy variable is zero. The control variables in this estimation are the same as the variables used in the portfolio share approach.

EMPIRICAL RESULTS

Summary Statistics

Table 1 presents the summary statistics of major inputs of the model. The average value of risky assets owned by households over the 16-year period is $197,684 per household. But the median value of risky assets is just $34,500, much lower than the mean value. For safe financial assets, the mean holding is $64,727 and the median value of holding is $15,000. The mean holding of real assets is $164,369 and the median value is $115,000. The mean share of risk financial assets to the total

Table 1
Summary Statistics

	Mean	*Median*	*Minimum*	*Maximum*	*Std.*
Risk Assets	$197,684	$34,500	-$7,000	$75,060,000	$935,504
Safe Assets	$64,727	$15,000	$0	$25,075,000	$298,961
Real Assets	$164,369	$115,000	$0	$30,500,000	$418,309
Debt	$37,278	$6,000	$0	$6,000,000	$90,299
Household Income	$81,567	$58,136	$0	$1,416,908	$93,949
Total Wealth	$426,780	$211,000	$3	$77,210,000	$1,161,756
Share of Risk Assets	0.26	0.18	-0.28	1.00	0.27
Share of Safe Assets	0.16	0.07	0.00	1.00	0.21
Share of Real Assets	0.58	0.60	0.00	1.26	0.31
Share of Debt	0.45	0.04	0.00	750.00	10.30
Out-of-pocket Expense	$4,597	$2,277	$0	$1,503,464	$15,946
Std. of Expense	3,134	1,613	0	611,570	9,678
Marriage Status	0.98	1.00	0.00	1.00	0.15
Household Ages	124	124	76	164	13
Household Health Status	13.95	13.00	1.00	50.00	9.23
Highest Degree	3.20	3.00	0.00	7.00	1.91
Bequest Motive	55.60%	75%	0	100%	43.38%

wealth is 0.26. The mean share for the safe financial assets is 0.16. The mean share of real assets is the highest among all three categories of assets: 0.58. The mean out-of-pocket medical expenditure is $4,597, which is a small proportion of the household's financial assets and total wealth. Most of the households consist of a couple over the sample period from 1992 to 2006. The mean household's self-reported health status is 13.95, which implies that the household member has a "good" or "very good" health status.

Estimation Results for Portfolio Shares

Following the approach employed by Kimball, Sahm, and Shapiro (2008) and Neelakantan, Lyons, and Nelson (2009), generalized method of moment (GMM) is used to account for the endogeneity resulting from equation (4) and control the possible unknown heteroskedasticity in the models.

Table 2 presents the estimates of the model that includes the composite risk preference variable but not the difference in risk preferences. The total wealth is significantly and negatively associated with the shares of safe financial assets and real assets. $U_{med,i}$ is negative for shares of both risky financial assets and safe financial assets. However, only the coefficient on risky financial assets appears statistically significant.

Out-of-pocket medical expenses ($E_{med,i}$) are significantly positive for both risky financial assets and safe financial assets. The results indicate that an increase of 1 percent in out-of-pocket medical expenses increases 1.91 percent of wealth held in risky financial assets. Edwards (2008) explained that the health care cost inflation only affects the precautionary saving but not the portfolio allocation. Yogo (2008) considered medical expenses as endogenous investments in human capital so that the inflation of health care prices is correlated to the assets return. My result is consistent with the theory in Yogo (2008).

$H_{status,i}$ is significant and negative for risky financial assets, consistent with the conclusions in Rosen and Wu (2004) Pang and Warshawsky (2008). The share of safe financial assets also drops for households with poor health. This evidence contradicts the findings in Rosen and Wu (2004) and Pang and Warshawsky (2008), but is consistent with the result in Yogo (2008). The reasons probably are: (1) home ownership and other consumer durable

Table 2
Estimation Results of Portfolio Allocation Model

Dependent variables: Shares of different assets

Risky Assets	*Coefficient*	*P-Value*	*Safe Assets*	*Coefficient*	*P-Value*	*Real Assets*	*Coefficient*	*P-Value*
Intercept	-1.2085594	0.172	Intercept	0.51241255	<.0001	Intercept	1.69614683	0.0314
$S_{debt,i}$	0.00004228	0.99	$S_{debt,i}$	0.00956144	<.0001	$S_{debt,i}$	-0.0096037	0.8681
$E_{med,i}$	1.91458352	0.0074	$E_{med,i}$	1.60519367	0.0345	$E_{med,i}$	-3.5197772	0.9748
$H_{status,i}$	-0.0016587	<.0001	$H_{status,i}$	-0.0010098	<.0001	$H_{status,i}$	0.00266855	0.07
$W_{total,i}$	0.09173633	<.0001	$W_{total,i}$	-0.0442519	<.0001	$W_{total,i}$	-0.0474844	<.0001
$U_{med,i}$	-0.0091022	0.0975	$U_{med,i}$	-0.0018176	0.6244	$U_{med,i}$	0.01091979	0.84
Bq_i	0.0000935	0.2305	Bq_i	0.00041161	<.0001	Bq_i	-0.0005051	0.0106
$R_{risk,i}$	-0.023426	0.5134	$R_{risk,i}$	-0.0269831	<.0001	$R_{risk,i}$	0.05040938	0.4967
Policy	0.0201012	0.0455	*Policy*	0.00806038	<.0001	*Policy*	-0.0281616	0.3326
$Degree_i$	0.02227875	<.0001	$Degree_i$	0.0057852	<.0001	$Degree_i$	-0.0280639	0.0405
Age_i	0.00246917	0.7801	Age_i	0.00094486	<.0001	Age_i	-0.003414	0.7005
Dummy(Age 65)	-0.0081932	0.9811	*Dummy(Age 65)*	0.00844763	0.0746	*Dummy(Age 65)*	-0.0002545	0.9994

Year effects are not reported in the table.

Table 3
Estimation Results of Portfolio Allocation Model-New Sample

Dependent variables: Shares of different assets

Risky Assets	*Coefficient*	*P-Value*	*Safe Assets*	*Coefficient*	*P-Value*	*Real Assets*	*Coefficient*	*P-Value*
Intercept	15.3815902	<.0001	Intercept	-8.2774336	<.0001	Intercept	-6.1041566	<.0001
$S_{debt,i}$	-0.0242985	0.0153	$S_{debt,i}$	-0.028426	0.035	$S_{debt,i}$	0.05272449	0.8492
$E_{med,i}$	37.2877604	<.0001	$E_{med,i}$	46.6795325	<.0001	$E_{med,i}$	-83.967293	0.2246
$H_{status,i}$	-0.0014983	0.0828	$H_{status,i}$	-0.0009452	0.112	$H_{status,i}$	0.00244357	0.0599
$W_{total,i}$	0.11394663	<.0001	$W_{total,i}$	-0.0093741	0.3853	$W_{total,i}$	-0.1045725	<.0001
$U_{med,i}$	-0.0086109	0.5931	$U_{med,i}$	0.00886889	0.3273	$U_{med,i}$	-0.000258	0.9904
Bq_i	-0.000216	0.3384	Bq_i	0.00014656	0.4625	Bq_i	0.00006947	0.8915
$R_{risk,i}$	-0.043628	0.0488	$R_{risk,i}$	-0.0402013	0.0084	$R_{risk,i}$	0.0838296	0.2615
Policy	0.028876	0.0001	*Policy*	0.00961295	0.122	*Policy*	-0.0384889	0.1638
$Degree_i$	0.02154848	<.0001	$Degree_i$	0.00053525	0.8814	$Degree_i$	-0.0220837	0.0513
Age_i	0.00311782	0.3804	Age_i	0.00020049	0.867	Age_i	-0.0033183	0.3975
Dummy(Age 65)	-0.0358862	0.7374	*Dummy(Age 65)*	0.00420135	0.8601	*Dummy(Age 65)*	0.03168488	0.6974

Year effects are not reported in the table.

Table 4

Estimation Results of Portfolio Allocation Model-New Sample, With Difference in Risk Preferences

Dependent variables: Shares of different assets

Risky Assets	*Coefficient*	*P-Value*	*Safe Assets*	*Coefficient*	*P-Value*	*Real Assets*	*Coefficient*	*P-Value*
Intercept	15.3815623	<.0001	Intercept	-8.2772652	<.0001	Intercept	-6.1042971	<.0001
$S_{debt,i}$	-0.025365	0.0101	$S_{debt,i}$	-0.0296457	0.0322	$S_{debt,i}$	0.05501072	0.0554
$E_{med,i}$	38.1582972	<.0001	$E_{med,i}$	47.850634	<.0001	$E_{med,i}$	-86.008931	0.0058
$H_{status,i}$	-0.0015355	0.0413	$H_{status,i}$	-0.0009741	0.1013	$H_{status,i}$	0.00250964	0.0095
$W_{total,i}$	0.11430733	<.0001	$W_{total,i}$	-0.0085595	0.4382	$W_{total,i}$	-0.1057478	<.0001
$U_{med,i}$	-0.0120296	0.4607	$U_{med,i}$	0.00637097	0.4771	$U_{med,i}$	0.00565863	0.7858
Bq_i	-0.000207	0.3387	Bq_i	0.00013615	0.4963	Bq_i	0.00007084	0.8262
$R_{risk,i}$	-0.042380	0.0562	$R_{risk,i}$	-0.039057	0.0108	$R_{risk,i}$	0.08143658	0.0084
Policy	0.02865442	0.0001	*Policy*	0.00991095	0.103	*Policy*	-0.0385654	<.0001
$Degree_i$	0.02132884	<.0001	$Degree_i$	0.00040904	0.9097	$Degree_i$	-0.0217379	<.0001
Age_i	0.00303941	0.038	Age_i	0.00022513	0.8526	Age_i	-0.0032645	0.103
Dummy(Age 65)	-0.0351147	0.2767	*Dummy(Age 65)*	0.00442698	0.8525	*Dummy(Age 65)*	0.03068774	0.4414
Diff	-0.0124841	0.6573	*Diff*	-0.007642	0.4108	*Diff*	0.02012587	0.4338

Year effects are not reported in the table.

Table 5
Estimation Results of Portfolio Allocation Model

Dependent variables: Ownership of Different Assets

Risky Assets	*Coefficient*	*P-Value*	*Safe Assets*	*Coefficient*	*P-Value*	*Real Assets*	*Coefficient*	*P-Value*
Intercept	-14.24381	<.0001	Intercept	-5.8812166	<.0001	Intercept	-10.624506	<.0001
$S_{debt,i}$	-0.3410734	<.0001	$S_{debt,i}$	-0.0914691	0.0047	$S_{debt,i}$	0.1293386	0.0001
$E_{med,i}$	11.0227952	0.0025	$E_{med,i}$	820.153507	<.0001	$E_{med,i}$	-116.11928	0.0966
$H_{status,i}$	-0.0209904	<.0001	$H_{status,i}$	-0.015173	<.0001	$H_{status,i}$	0.03881227	<.0001
$W_{total,i}$	1.07711791	<.0001	$W_{total,i}$	0.61938423	<.0001	$W_{total,i}$	1.71065974	<.0001
$U_{med,i}$	-0.1214716	0.0139	$U_{med,i}$	-0.3972694	<.0001	$U_{med,i}$	-0.0461043	0.6975
Bq_i	0.00289078	<.0001	Bq_i	0.00388944	<.0001	Bq_i	-0.0066778	<.0001
$R_{risk,i}$	0.147567	0.0259	$R_{risk,i}$	0.03681181	0.7021	$R_{risk,i}$	-0.208161	0.1962
Policy	0.26896634	<.0001	*Policy*	0.28523377	<.0001	*Policy*	-0.2865248	<.0001
$Degree_i$	0.25237119	<.0001	$Degree_i$	0.12947307	<.0001	$Degree_i$	-0.3900572	<.0001
Age_i	0.01626045	<.0001	Age_i	0.00447737	0.2835	Age_i	-0.0338517	<.0001
Dummy(Age 65)	-0.1561945	0.0122	*Dummy(Age 65)*	0.08810703	0.339	*Dummy(Age 65)*	0.17212949	0.2453

Table 6
Estimation Results of Portfolio Allocation Model-New Sample

Dependent variables: Ownership of Different Assets

Risky Assets	*Coefficient*	*P-Value*	*Safe Assets*	*Coefficient*	*P-Value*	*Real Assets*	*Coefficient*	*P-Value*
Intercept	-20.897573	<.0001	Intercept	-3.9786468	0.1971	Intercept	-4.3809242	0.2995
$S_{debt,i}$	-0.4574448	0.0345	$S_{debt,i}$	0.1970213	0.0629	$S_{debt,i}$	0.11002597	0.2426
$E_{med,i}$	270.075308	0.0204	$E_{med,i}$	1729.79418	0.0248	$E_{med,i}$	-65.487237	0.5592
$H_{status,i}$	-0.0359583	<.0001	$H_{status,i}$	-0.0217757	0.0489	$H_{status,i}$	0.09094576	0.0013
$W_{total,i}$	1.24390713	<.0001	$W_{total,i}$	0.63265522	<.0001	$W_{total,i}$	1.63636254	<.0001
$U_{med,i}$	-0.1385648	0.4779	$U_{med,i}$	0.10329107	0.7015	$U_{med,i}$	-0.6216863	0.1776
Bq_i	-0.0030711	0.1547	Bq_i	0.00282563	0.3425	Bq_i	-0.0022466	0.6714
$R_{risk,i}$	0.188686	0.419	$R_{risk,i}$	-0.5187573	0.1139	$R_{risk,i}$	-0.5543882	0.3458
Policy	0.28936132	0.0005	*Policy*	0.33373624	0.0021	*Policy*	-0.6153986	0.0008
$Degree_i$	0.1797888	<.0001	$Degree_i$	0.08739224	0.1599	$Degree_i$	-0.4952571	<.0001
Age_i	0.05407823	<.0001	Age_i	-0.0074473	0.6994	Age_i	-0.0737159	0.0429
Dummy(Age 65)	-0.5685664	0.0187	*Dummy(Age 65)*	-0.0206906	0.9492	*Dummy(Age 65)*	0.56721265	0.3114

Year effects are not reported in the table.

Table 7

Estimation Results of Portfolio Allocation Model-New Sample, With Difference in Risk Preferences

Dependent variables: Ownership of Different Assets

Risky Assets	*Coefficient*	*P-Value*	*Safe Assets*	*Coefficient*	*P-Value*	*Real Assets*	*Coefficient*	*P-Value*
Intercept	-20.857408	<.0001	Intercept	-3.9233895	0.2039	Intercept	-3.699547	0.3926
$S_{debt,i}$	-0.4593246	0.0338	$S_{debt,i}$	0.19931243	0.0603	$S_{debt,i}$	0.13202658	0.1705
$E_{med,i}$	270.419368	0.0202	$E_{med,i}$	1721.49979	0.0251	$E_{med,i}$	-96.378041	0.4031
$H_{status,i}$	-0.0358578	<.0001	$H_{status,i}$	-0.0216949	0.0499	$H_{status,i}$	0.09303749	0.0012
$W_{total,i}$	1.24351563	<.0001	$W_{total,i}$	0.63258422	<.0001	$W_{total,i}$	1.65190316	<.0001
$U_{med,i}$	-0.1430491	0.4647	$U_{med,i}$	0.09566724	0.7234	$U_{med,i}$	-0.6368143	0.1685
Bq_i	-0.003008	0.1645	Bq_i	0.00289107	0.3326	Bq_i	-0.0017492	0.7475
$R_{risk,i}$	0.189979	0.4158	$R_{risk,i}$	-0.5139738	0.1177	$R_{risk,i}$	-0.5538546	0.3422
Policy	0.28758653	0.0006	*Policy*	0.33221297	0.0022	*Policy*	-0.6130674	0.0009
$Degree_i$	0.1802119	<.0001	$Degree_i$	0.08752123	0.1597	$Degree_i$	-0.5172403	<.0001
Age_i	0.05405969	<.0001	Age_i	-0.0075329	0.6965	Age_i	-0.07745	0.0389
Dummy(Age 65)	-0.5694003	0.0186	*Dummy(Age 65)*	-0.0185922	0.9543	*Dummy(Age 65)*	0.61384213	0.2837
Diff	-0.0573221	0.7018	*Diff*	-0.078088	0.7075	*Diff*	-0.6705689	0.0923

Year effects are not reported in the table.

goods are not included in the Rosen and Wu (2004) and Pang and Warshawsky (2008); and (2) differing from those papers, the predicted shares of assets are constrained to add to one in this paper and the marginal effects sum to zero.

Among other independent variables, the household's composite risk preference ($R_{risk,i}$) is negative for both risky financial assets and safe financial assets, but only significant for safe financial assets. For real assets, $R_{risk,i}$ is insignificantly positive.

I use a dummy variable for answers of the primary respondent and secondary respondent to the HRS risk aversion question. If household members' answers to the questions are different, the variable equals one. Otherwise it is zero. If the respondent is single, the variable is zero. Because HRS did not ask the questions in wave 2 and 3, the number of non-missing observations dramatically drops after the new variable is added. Therefore, the models (1)-(4) are re-estimated, without the dummy variable, but with a much smaller new sample. The models are then re-run with the dummy variable in the new sample.

Tables 3 and 4 presents the results. Table 3 shows the estimates from the new sample that observations with missing information on difference between individual risk preferences are excluded. Impacts of out-of-pocket medical expenses on portfolio choice are generally consistent with the results shown in Table 2. The share of medical expenses is significantly and positively associated with the shares of both risky financial assets and safe financial assets. A household's combined health status is significantly and negatively associated with the share of risky financial assets. However, the volatility of the medical expense is insignificant for all assets. The composite risk preference ($R_{risk,i}$) of the household is significant and negative for both risky financial assets and safe financial assets.

In Table 4, new variable (diff), measuring the difference between the intra-household risk preferences, is added to the model. Controlling for this heterogeneity, there are only a few changes in the new estimates. The effect of out-of-pocket medical expenses becomes significantly negative for real assets. Households with higher composite risk aversion preferences significantly increase their investments in real assets. Number of insurance policies significantly reduces the share of assets allocated to real assets. However, the coefficient of the variable of the difference between the individual risk preferences is insignificant for all assets. This is consistent with the findings in Barsky et al. (1997). Estimates of out-of-pocket medical expenses, the volatility of the medical expense, and the household health status change little for financial assets.

Estimation Results for Ownership Probabilities

Following previous papers, probit and logit models are used to estimate impacts of health and heterogeneous risk preferences on probabilities of owning assets. The results are similar and only estimates from the logit model are reported in tables. Table 5 presents the estimation results of the model without the heterogeneous risk preferences and with the full sample. The findings are largely consistent with the evidences in Table 2. Households with increasing out-of-pocket medical expenses are more likely to own financial assets, both risky and safe ones. Worse health status and higher uncertainty of out-of-pocket medical expenses reduce that likelihood. Table 6 reports the estimation results of the new sample that observations with missing information on differences in risk preferences are excluded. Most of estimates are similar to the results in Table 3. Out-of-pocket medical expenses have strong and positive links to ownerships in both financial assets. The combined household's health status is significantly and negatively associated with the probability of owning both financial assets. The volatility of out-of-pocket medical expenses is insignificant for all assets.

Table 7 shows the estimates when the difference in risk preferences is added to the model. Coefficients of most independent variables do not change significantly. Out-of-pocket medical expenses increase households' probabilities to own both risky and safe financial assets. Health status is negatively linked to the probability of holding financial assets, but positively associated with the ownership of real assets. Composite risk preferences and the volatility are insignificant for all assets. However, the difference between the individual's heterogeneous risk preferences is significantly and negatively linked to the ownership of real assets.

CONCLUSION

This paper has documented the existence of a statistically significant relationship between out-of-pocket medical expenses of the elderly households and their portfolio allocation decisions. After controlling for the total wealth and constraining shares of all assets to add to one, a household with a higher share of out-of-pocket medical expenses will increase investments in financial assets, both risky and safe ones. Explicitly estimating the relative risk aversion based on the household's income and labor supply information, I find out that high-risk aversion households prefer real assets over financial assets. Consistent with other papers, the volatility of out-of-pocket medical expenses significantly reduces the investment in risky financial assets.

Heterogeneity in the intra-household risk preferences could complicate a household's portfolio allocation decisions when they react to health shocks. However, I do not find strong evidence to support that the heterogeneous risk preferences significantly influence the allocation of financial assets. This limitation might be due to the fact that I only control for the difference between the intra-household risk preferences, but not the bargaining powers. Future studies may be able to explore ways to measure and model the decision-making process in the household and further examine the impact of health on the household's portfolio choice.

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