Health and the share of wealth held in risky assets

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Abstract

This paper focuses on the correlation between negative health shocks and the households' share of wealth held in risky assets. By using U.S. data from the Health and Retirement Study, we try to establish a link between negative health shocks and financial outcomes such as a household's probability of owning risky assets and share of risky assets held. In our definition of a recent negative health shock, we include: cancer or malignant tumor diagnoses, stroke or transient ischemic attack, and heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems. We find an important negative correlation between a negative health shock to the female and her household's probability of owning risky assets and share of risky assets held, respectively. In contrast, we do not find a corresponding statistically significant correlation for males.

JEL code: G50, G11, I10

Keywords: aging couples, health shock, household portfolio choice, share of risky assets, risky financial assets, Health and Retirement Study

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1 Introduction

The purpose of this study is to analyze the correlation between negative health shocks and the households' ownership of risky financial assets and share of risky financial assets in their portfolios. For our analysis, we use a sample of aging couples in the U.S. derived from 11 waves (1994-2014) of the Health and Retirement Study (HRS). The HRS provides a very rich set of data that includes information on recent negative health shocks as diagnosed by a medical doctor, the households' financial wealth, as well as various demographic and economic variables.

Exploring the factors that affect the financial decisions of aging couples is particularly interesting since this segment of the population holds a substantial amount of the total U.S. household net worth (Coile and Milligan 2009). For example, in 2004, households where the spouses were 65 years old or older had a median net worth of 190,100 USD, which lies well above the 93,100 USD median net worth of all households in the U.S. (Bucks et al. 2006). Moreover, we would expect aging couples to be more exposed to negative health shocks than younger counterparts, which motivates us to investigate whether there is an effect of such shocks on their financial decisions. Finally, it is also interesting to investigate this in light of an aging population; we can expect that in the future, there will be a larger number of older people holding a considerable amount of wealth in the U.S.

According to Rosen and Wu (2004) and Edwards (2008), we should expect a lower share of wealth invested in risky financial assets among households that have experienced a recent negative health shock. One reason for this change might be that these households tend to sell risky assets in order to cover medical expenses. However, unlike Rosen and Wu 2004, who use self-perceived health ratings, and Edwards 2008, who use expectations regarding health, we choose to use an objective measure of health, in this case conditions that have been diagnosed by a medical doctor. That way, we avoid the subjectivity that is inevitable in any type of self-rated variable. Furthermore, compared with Wu (2003), who examined the same measure of negative health shock as we do, we focus on an older age group and use more waves of the HRS, i.e., from 1994 to 2014.

Moreover, we contribute to the existing literature by presenting a theoretical model that helps explain the household's investment choice in risky assets when taking into account the spouses' health. Earlier studies (Wu 2003, Rosen and Wu 2004, and Berkowirtz and Qiu 2006) focus their work only on empirical modelling and estimation and do not model the households' choice of consumption and investment in risky assets. We go further and present a theoretical model, which serves as a background to the empirical analysis. That way, our study provides further understanding of how negative health shocks, as a source of background risk, might affect households' ownership of and share of wealth held in risky assets.

We also present a simple theoretical model that helps us analyze the effect of a recent negative health shock to one of the spouses on their household's investment in risky assets. This model is important since it provides a description of the mechanisms behind this relationship. The mechanisms show that there are no theoretical reasons to expect households to change the amount invested in risky assets in a particular fashion in response to negative health shocks. Therefore, we perform a numerical analysis based on the model's comparative statics and find that the direction of the change in the amount invested in risky assets will depend on the functional form of the household's utility function and that risk aversion does not necessarily induce the households in question to reduce their investment in risky assets.

The insights of the theoretical model suggest that it remains an empirical question to determine the direction of the change in the households' share of wealth held in risky assets. We address this issue and find that a negative health shock to the female is associated with a 1.2 percentage-point reduction in a household's probability of owning risky assets, and with a 2 percentage-point reduction in its share of wealth held in such assets.[1] We do not find any statistically significant correlation between negative health shocks to the male and outcome variables.[2]

Finally, we reconcile the theoretical and empirical models and suggest that, on average, the households insure themselves against the cost of the female's negative health shock by reducing the share of risky assets. This result is important because it suggests that households are to some extent poorly insured against the cost of a negative health shock to the female. The results also suggest that households are better insured against the male facing a negative health shock, which implies that the households' consumption is less affected by such a shock. The share of wealth held in risky assets is less affected as well.

The rest of this paper is structured as follows. Previous literature is reviewed in Section 2. Section 3 presents the theoretical model. Section 4 discusses the data, and Section 5 specifies the empirical models. The results are presented in Section 6. Finally, conclusions are drawn in Section 7.

2 Literature review

Our study builds upon and aims to further develop existing literature that examines the effect of health events on household wealth and portfolio decisions. It has already been documented that negative health

[1]Even though we are mostly interested in the risky share and whether it increases or decreases after a negative health shock, we also believe it is important to investigate the association between the probability of owning risky assets, i.e., stock market participation, and negative health shocks.

[2]We do not claim that we have established a casual effect between health shocks and the specific economic decisions we study even though we have controlled for covariates that previous literature has suggested play a role in these decisions. We believe there could still be other factors unaccounted for in our analysis that may affect a households' decision to own risky assets and share of risky assets held.

shocks affect the economic status of married couples approaching retirement. In our case, we focus on older households where both spouses are 65 years old or older, while the literature mentioned in this section that uses the US HRS focuses on households where the survey's main respondent was 51 years old or older. Specifically, Wu (2003) looks into the effect of severe exogenous health shocks on household wealth, income, and consumption by using data on couples from the first two waves of the HRS. He estimates quantile regressions where the dependent variable is change in household wealth between periods, and finds that new severe diagnoses of diseases or health conditions reduce household wealth, yet the effect is asymmetric between females and males. More precisely, there is a statistically significant drop in household wealth associated with a negative health shock facing the female, an effect that persists even after controlling for initial health condition and changes in retirement decisions. For males, on the other hand, the impact of negative health shocks on household wealth disappears.

Apart from the effect of health on wealth, the existing literature has also documented how negative health shocks influence households' ownership of various types of assets. Rosen and Wu (2004) use four waves of the HRS and focus on the impact of changes in the individual's perception of health on financial assets. They classify assets into four categories consisting of safe assets (checking and savings accounts, money market funds, CDs, government savings bonds, and T-bills), bonds (corporate, municipal and foreign bonds, and bond funds), risky assets (stocks and mutual funds), and retirement accounts (IRAs and Keoghs[3]). They estimate a probit model for each asset category in their classification, and their results show that poor health is associated with a lower probability of holding financial assets, a larger share of financial wealth held in safe assets, and a smaller share allocated to other asset classes.[4]

Rosen and Wu (2004) argue that the effect of poor health on portfolio decisions can operate through three different channels: risk aversion, planning horizons, and/or health insurance. To investigate whether the effect of self-reported health status on asset allocation operates through increasing the respondents' risk aversion, through decreasing their planning horizon, or through their access to health insurance, they create binary variables for each channel and include those as independent variables in their original model. Specifically, they include a binary variable that takes the value one if the individual answers affirmatively to a question designed to provide information about the respondents' being risk averse, and zero otherwise.[5] They create dichotomous variables for planning horizon by using the answers provided to

[3]Keogh plans: Keogh accounts allow self-employed individuals to invest in a tax-deferred retirement plan, where the maximum permitted contribution is considerably higher than for IRAs (Hira et al. 2009).

[4]The explanatory variables they use include a dichotomous variable for poor health and controls for total wealth, income and other individual characteristics.

[5]The question being whether the respondent would take a job that would double their income with a 50 percent probability and reduce it by half with a 50 percent probability (Rosen and Wu 2004).

questions designed to measure the respondents' financial planning periods.[6] They also use a dichotomous variable taking a value of one when the household has health insurance and zero otherwise. The authors show that including risk aversion, planning horizon, and health insurance variables in the model does not affect the relationship between health shocks and financial outcomes, and argue that this indicates that the impact of poor health on portfolio decisions does not operate through any of these channels. Finally, they suggest that there is a robust relationship between health status and portfolio decisions, and that the channels through which poor health operates are not entirely clear.

Berkowitz and Qiu (2006), regarding negative health shocks, distinguish between the effect on financial and non-financial wealth and show that new severe diagnoses, such as a heart problem, stroke, cancer, lung disease, and diabetes, have a greater impact on financial wealth than on non-financial wealth for single households. For married couples, the results indicate that a negative health shock facing the female affects negatively household financial and non-financial assets while a negative health shock facing the male does not have a statistically significant effect. They mention that the latter could be attributed to a liquidity effect and eligibility requirements for public insurance.

By using data from the first six waves of the HRS, Coile and Milligan (2009) document that ownership of different types of assets (principal residence, vehicle, real estate, and business) declines while ownership of liquid assets, time deposits, IRAs[7], stocks, and bonds increases with negative health shocks such as a stroke, a heart attack, or a diagnosis of a new chronic disease. Finally, following these results, they suggest that households have larger reductions in the share of risky than of liquid assets.

Edwards (2008) focuses solely on elderly individuals and examines how self-perceived risky health affects portfolio allocation.[8] He uses individual-level data from the Study of Assets and Health Dynamics Among the Oldest Old in the US (AHEAD), individuals aged 70 or older, which reveals that health risk prompts safer investment. He finds that elderly singles respond the most to health risk and that poor health may explain 20 percent of the age-related decline in financial risk taking after retirement. He suggests that retired individuals tend to view their health as risky, and they appear to decrease their exposure to financial risk by hedging against it. Because health tends to deteriorate with age, the presence

[6] For example, they create the variable plan1, which takes the value 1 if "the next few months" are the most important when the household plans its saving and spending, and zero otherwise. They create five possible planning types in total. Plan 5 takes the value 1 if "more than 10 years" is the most important time horizon for the household.

[7] IRAs: IRAs stands for Individual Retirement Accounts. IRAs were established in 1974 as part of the Employee Retirement Income Security Act to encourage retirement savings by employees without private pension plans. The availability of IRAs was extended to all employees and the contribution limit was raised by the Economic Recovery Tax Act of 1981 (Wise 1987).

[8] In the AHEAD surveys, respondents were asked to report the probability that medical expenses will use up all of the household's savings in the next five years. Edwards (2008) uses these answers for the self-perceived risky health variable.

of undiversifiable health risk may explain why investors on average decrease their financial risk with age after retirement (Edwards 2008).

Our study is positioned within the literature that explores the effect of health on portfolio decisions. However, as mentioned previously, it differs from previous studies in the field by the large number of HRS waves that we have included in our analysis. Particularly, to our knowledge, we are the first ones to use data from 11 waves of the RAND HRS Longitudinal File 2014, i.e., from 1994 to 2014, to explore the potential link between actual health decline (i.e., recent negative health shocks as diagnosed by a medical doctor) and the probability of owning, and the share of a household's wealth allocated to, risky assets. We use data for households where both spouses are at least 65 years old, while previous literature that uses the HRS considers households where the main respondent is 51 years old or older. Furthermore, compared with previous studies that only focus on empirical results (Wu 2003, Rosen and Wu 2004, and Berkowirtz and Qiu 2006), we also present a theoretical model in order to provide a foundation for our empirical analysis.

3 Theoretical framework

We extend the framework presented by Eeckhoudt et al. (2005) by considering a household that invests an amount of its wealth in a risky asset. Moreover, the household comprises two spouses, each of whom faces a probability of enjoying good health.[9] In this way we can capture both health risk and uncertainty in the financial market within a simple framework. To begin with, we consider a model where the household derives utility solely from its consumption, c. The utility function $u(c)$ is increasing in its argument and strictly concave. The male's probability of enjoying good health is p^m and his probability of experiencing poor health is $1 - p^m$. Likewise, the female experiences good health with probability p^f and poor health with probability $1 - p^f$. This means that the household faces four possible states: both spouses are in good health, gg; the female is in good health and the male in poor health, gb; the female is in poor health and the male in good health, bg; and both spouses are in poor health, bb. Second, the household invests an amount α of its total wealth A in a risky asset with an associated uncertain risky rate r. The remainder of A is invested in a risk-free asset at a risk-free rate ρ. There is also a monetary cost for the household when either the female or the male face poor health, k_f and k_m, respectively. The household must make its consumption and portfolio choice before the health status of the spouses and the rate of return of the risky asset materialize. Hence, the household maximizes the expected utility function, $Eu(\cdot)$, with respect

[9] In Eeckhoudt et al. (2005, pp. 142-145) the agent can invest in preventive measures that reduce the probability of a certain outcome occurring. In contrast, we assume that the probability of good health is not affected by the household decisions. We do this to maintain a certain degree of simplicity in our model.

to c, and α,

$$\max_{c,\alpha} \quad p^f p^m Eu(c^{gg}) + p^f(1-p^m)Eu(c^{gb}) +$$
$$(1-p^f)p^m Eu(c^{bg}) + (1-p^f)(1-p^m)Eu(c^{bb}) \tag{1}$$
$$s.t. \quad c^{ij} = A(1+\rho) + \alpha(r-\rho) - k_f^i - k_m^j, \quad i \in \{b,g\}, \quad j \in \{b,g\} \tag{2}$$
$$A > 0,$$
$$k_f^g = k_m^g = 0.$$

Note that the consumption in each state is a random variable, since the risky rate of return is random. We substitute equation (2) into equation (1), solve an unconstrained maximization problem in α, and obtain the following first-order condition:

$$p^f p^m E[u'^{gg}\delta] + p^f(1-p^m)E[u'^{gb}\delta] + (1-p^f)p^m E[u'^{bg}\delta] + (1-p^f)(1-p^m)E[u'^{bb}\delta] = 0, \tag{3}$$

where u' indicates the marginal utility of consumption in each state. The superscripts indicate that both spouses face good health, u'^{gg}; the female faces good health and the male faces poor health, u'^{gb}; the female faces poor health and the male faces good health, u'^{bg}; and both are face poor health, u'^{bb}. $\delta = r - \rho$ is the excess return of the risky asset. Equation (3) is the condition for optimal investment and implies that the sum of the expected products of the marginal utility of consumption in each state and the difference in return equals zero. We use the first-order condition to compute the change in α, the amount invested in the risky asset, when p^f or p^m changes, respectively.[10] The change in the amount invested in the risky asset when the female's probability of good health changes is given by

$$\frac{d\alpha}{dp^f} = -\frac{1}{D}\{p^m\big(E[u'^{gg}]\hat{\delta} - E[u'^{bg}]\hat{\delta} + cov[u'^{gg},\delta] - cov[u'^{bg},\delta]\big)$$
$$+ (1-p^m)\big(E[u'^{gb}]\hat{\delta} - E[u'^{bb}]\hat{\delta} + cov[u'^{gb},\delta] - cov[u'^{bb},\delta]\big)\}. \tag{4}$$

Similarly, the expression for the change in the amount invested in the risky asset when the male's probability of good health changes can be written as

$$\frac{d\alpha}{dp^m} = -\frac{1}{D}\{p^f\big(E[u'^{gg}]\hat{\delta} - E[u'^{gb}]\hat{\delta} + cov[u'^{gg},\delta] - cov[u'^{gb},\delta]\big)$$
$$+ (1-p^f)\big(E[u'^{bg}]\hat{\delta} - E[u'^{bb}]\hat{\delta} + cov[u'^{bg},\delta] - cov[u'^{bb},\delta]\big)\}. \tag{5}$$

In equations (4) and (5), $\hat{\delta} = E[\delta] > 0$, and $D < 0$ by the second-order conditions.[11] The sign of these equations is undetermined. For example, on the right-hand side of equation (4), there are two differences:

[10] See the Appendix for the mathematical derivation.

[11] $D = p^f p^m E[u''^{gg}\delta^2] + p^f(1-p^m)E[u''^{gb}\delta^2] + (1-p^f)p^m E[u''^{bg}\delta^2] + (1-p^f)(1-p^m)E[u''^{bb}\delta^2]$.

the difference between the products of expectations and $\hat{\delta}$, and the difference between covariances. What we know from this model is that the difference between the products of expectations and $\hat{\delta}$ is negative because the marginal utility of consumption in a state with poorer health is higher than the marginal utility of consumption in a state with better health.

We also know that the covariance between the marginal utility of consumption and δ is negative; however, the difference between covariances can be either positive or negative. If it is negative, then the right-hand side of equation (4) will be negative and the household will decrease its investment in risky assets when the probability of good health increases. If it is positive and larger in absolute value than the difference between the products of expectations and δ, then the right-hand side of equation (4) will be positive. Hence, the household increases the amount invested in risky assets when the probability of good health increases. As suggested by the numerical analysis carried out later, the sign of the difference in covariances will be determined by the functional form of the household's utility function.

To go further we assume that the household faces a monetary cost related to the female's poor health and that the household is fully insured against the male facing poor health ($k_f^b > 0$, and $k_m^b = 0$).[12] It follows that the household's consumption when the male is ill equals the household's consumption when both spouses are healthy. Thus, $u'^{gg} = u'^{gb} < u'^{bg} = u'^{bb}$. If we substitute these in equations (4) and (5), respectively, we obtain the following expressions:

$$\frac{d\alpha}{dp^f} = -\frac{1}{D}\left[(E(u'^{gg})\hat{\delta} - E(u'^{bb})\hat{\delta}) + cov(u'^{gg}, \delta) - cov(u'^{bb}, \delta)\right] \tag{6}$$

$$\frac{d\alpha}{dp^m} = 0, \tag{7}$$

where $E(u'^{gg}) - E(u'^{bb}) < 0$. Even in this case, equation (6) can be either positive or negative depending on the sign and magnitude of the difference between the covariances. If this difference is positive and larger in absolute value than the difference between expectations, then equation (6) is positive, otherwise it is negative. Furthermore, we have also shown in equation (7) that if the household is fully insured against the male facing poor health the amount invested in the risky asset does not change when his probability of good health changes.

Now we assume that the cost of the female's poor health and the cost of the male's poor health are the same ($\bar{k} = k_f^b = k_m^b > 0$) to show that, in this case, the changes in the amount invested in the risky asset when the probabilities of good health change will not be symmetrical. It follows that $u'^{gg} < u'^{gb} = u'^{bg} < u'^{bb}$. We substitute the latter in (4) and (5) and obtain the following expressions for

[12] The analysis is symmetrical if we consider that the household is fully insured against the female facing poor health.

the female and male, respectively:

$$\frac{d\alpha}{dp^f} = -\frac{1}{D}\{p^m\big(E[u'^{gg}]\hat{\delta} - E[u'^{bg}]\hat{\delta} + cov(u'^{gg},\delta) - cov(u'^{bg},\delta)]$$
$$+ (1-p^m)\big(E[u'^{bg}]\hat{\delta} - E[u'^{bb}]\hat{\delta} + cov(u'^{bg},\delta) - cov(u'^{bb},\delta)\big)\} \tag{8}$$
$$\frac{d\alpha}{dp^m} = -\frac{1}{D}\{p^f\big(E[u'^{gg}]\hat{\delta} - E[u'^{bg}]\hat{\delta} + cov(u'^{gg},\delta) - cov(u'^{bg},\delta)]$$
$$+ (1-p^f)\big(E[u'^{bg}]\hat{\delta} - E[u'^{bb}]\hat{\delta} + cov(u'^{bg},\delta) - cov(u'^{bb},\delta)\big)\} \tag{9}$$

Equations (8) and (9) will differ unless $p^f = p^m$. The probabilities of good health may differ between the female and the male, since health depends on many factors, e.g., health history, and genetic background. Henceforth, the model suggests that changes in the probability of good health facing the female and male, respectively, may not have a symmetrical effect on the household's decision to invest in risky assets even if the household faces the same monetary costs of the spouses' health.

3.1 Numerical analysis

Since we cannot sign equations (4) and (5) without further assumptions, we choose two different utility functions and do a numerical analysis to illustrate that the right-hand side of equation (4) can be positive or negative. For each utility function we use the same values for the parameters of interest: $p^f = 0.7, p^m = 0.5, A = 5, k_m = 1$ and $k_f = 1$.[13] We also use a uniform distribution between $[-0.05, 0.05]$ for δ. With this information, we calculate the optimal value of α, and the sign of the right-hand side of equation (4).

First, we assume that the utility function is logarithmic $u(c) = ln(c)$. In this case, we find that the two differences between covariances are positive, i.e., $cov(u'^{gg},\delta) - cov(u'^{bg},\delta) > 0$ and $cov(u'^{gb},\delta) - cov(u'^{bb},\delta) > 0$. We also find that the difference between covariances dominates the difference between the products of expectations and $\hat{\delta}$, and thus the right-hand side of equation (4) is positive. It follows that the amount invested in risky assets increases with an increase in the probability of good health.

Second, we assume a cubic utility function of the following form $u(c) = c - \frac{1}{1000}\frac{c^2}{2} - \frac{1}{10000}\frac{c^3}{3}, \quad c \in (0, 95)$.[14] In this case we find the opposite result. The covariance between the household's marginal utility of consumption and the excess return is smaller in absolute value when one of the spouses faces poor health than when both spouses face good health. It follows that all differences between covariances are negative, and the right-hand side of equation (4) is negative. The amount invested in risky assets decreases with an

[13] We chose a higher probability for the female in this case since the data shows that females face fewer health shocks than males. We also performed the analyses with different values for the parameters, and obtained the same qualitative results for the sign of the right hand side of equation (4). For example, in one of the analyses we chose $p^f = 0.4, p^m = 0.6, A = 2, k_f = 1$ and $k_m = 0$, while in another we chose $p^f = 0.5, p^m = 0.3, A = 5, k_f = 2$ and $k_m = 1$.

[14] $c \in (0, 95)$ in order for $u'(c) > 0$.

increase in the probability of good health. Furthermore, for low (high) levels of consumption a decrease in the probability of good health will have a larger (smaller) effect on the marginal utility of consumption for prudent households than for imprudent ones. We choose these utility functions to show that prudence may play an important role for the household's decision to invest in risky assets when the probability of being healthy increases or decreases, and that risk aversion does not necessarily induce the household to reduce the investment in risky assets when the probability of being healthy decreases.[15] Prudence is represented by the utility function's third derivative. If the third derivative is positive then the household is prudent, and if it is negative then the household is imprudent. It follows that a household with logarithmic preferences is prudent while a household with the cubic preferences in our example is imprudent.

If we think of a negative health shock as a decrease in the probability of good health, it follows that the prudent household prefers to invest less in the risky asset as an insurance against loss in consumption due to facing poor health. On the other hand, the imprudent household chooses to invest more in the risky asset when having experienced a negative health shock.

3.2 Adding health capital

In this subsection, we add health capital to the model, in such a way that it influences the utility of the household. We assume that the health capital stock varies exogenously over the health states. Specifically, s_f, and s_m represent the female's and male's health capital, respectively. The household solves the following program:

$$\begin{aligned} \max_{c,\alpha} \quad & p^f p^m Eu(c^{gg}, s_f^g, s_m^g) + p^f(1-p^m)Eu(c^{gb}, s_f^g, s_m^b) + \\ & (1-p^f)p^m Eu(c^{bg}, s_f^b, s_m^g) + (1-p^f)(1-p^m)Eu(c^{bb}, s_f^b, s_m^b) \\ s.t. \quad & c^{ij} = A(1+\rho) + \alpha(r-\rho) - k_f^i - k_m^j, \quad i \in \{b,g\}, \quad j \in \{b,g\}, \\ & A > 0, \\ & k_f^g = k_m^g = 0, \\ & s_i^g > s_i^b \quad i \in \{f,m\}. \end{aligned} \tag{10}$$

The utility function u has the same properties with respect to consumption as before, and is, in this case, also increasing in s_f, and s_m. The superscripts g and b indicate good and poor health, respectively. The first-order condition with respect to α takes the same form as before. The change in the amount invested in the risky asset when the female's probability of good health changes takes the same form as equation

[15] Note that in our example, both utility functions are concave. Their first derivative with respect to c is positive and the second is negative.

(4), i.e.,

$$\frac{d\alpha}{dp^f} = -\frac{1}{D}\big\{p^m\big(\hat{\delta}(E[u'^{gg}] - E[u'^{bg}]) + cov[u'^{gg}, \delta] - cov[u'^{bg}, \delta]\big) \\ + (1-p^m)\big(\hat{\delta}(E[u'^{gb}] - E[u'^{bb}]) + cov[u'^{gb}, \delta] - cov[u'^{bb}, \delta]\big)\big\}. \quad (11)$$

The sign of the right-hand side of equation (11) will, as discussed in the previous section, depend on the differences between the products of expected marginal utilities and $\hat{\delta}$ and the differences between covariances, respectively. However, the difference in expected marginal utilities of consumption now depends on two distinct effects. First, for given levels of health capital, the household consumes more when the spouses are healthy than when they are not, hence the marginal utility of consumption will be smaller when the household is healthy (consumption effect). Second, if consumption and health are complements, more health capital contributes to increasing the marginal utility of consumption, ceteris paribus (health effect).

The consumption effect contributes to making the differences $E[u'^{gg}] - E[u'^{bg}]$ and $E[u'^{gb}] - E[u'^{bb}]$ negative, whereas the health effect contributes to making them positive. The sign of the difference between the expectations will depend on which effect dominates. If the consumption effect dominates the difference is negative, and if the health effect dominates the difference is positive. Furthermore, if the effects offset each other the difference may be close to zero. The interaction between the health and consumption effects constitutes another mechanism that may drive a positive relationship between p^f and α.

Now we consider the case where the household is fully insured against the cost of the male facing poor health, $k_m^b = 0$. In contrast to the model without health capital in the utility function, the change in the amount invested in the risky asset when the male's probability of good health changes is different from zero since the marginal utility of consumption also depends on the health capital. It follows that $E[u'^{gg}] \neq E[u'^{bg}]$ and $E[u'^{gb}] \neq E[u'^{bb}]$ and therefore $\frac{d\alpha}{dp^m} \neq 0$. Even in this case where there is no monetary cost of the male's poor health, the amount invested in the risky asset can change positively or negatively.

The theory, even in a simple setting as the one presented in this section, does not provide a clear answer to the question of the direction of the change in the amount invested in the risky asset due to a change in one of the spouse's probability of enjoying good health without making additional assumptions about the household's preferences. Yet, the model highlights some of the important underlying mechanisms that may drive the behavioral change. However, it still remains an empirical investigation to show in which direction the household's investment in risky assets changes when one of the spouses faces a negative health shock. We address the aforementioned question in the empirical specification and link its results with the theoretical framework.

4 Data

The study uses data from the University of Michigan Health and Retirement Study (HRS). The HRS is supported by the National Institute on Aging and the Social Security Administration. It is a biennial nationally representative panel that follows approximately 7,000 households in the U.S. over time. In the first wave (1992), the main respondent is 51 years old or older.

In our study, we choose to use data retrieved from the RAND HRS Longitudinal File 2014 (V2)[16]. The file contains health-related information for the respondent and the respondent's spouse, economic and demographic variables, and spousal counterparts of most individual-level variables. Of particular interest for our study is that the dataset provides information about whether the spouses had experienced a negative health shock in the two years prior to the wave. In our study, as defined by the RAND HRS, any or a combination of the following diagnoses constitutes a negative health shock: cancer or a malignant tumor of any kind except skin cancer; heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; and stroke or transient ischemic attack (TIA). These health shocks can be interpreted in terms of an increase (decrease) in the likelihood of poor health (good health), ceteris paribus, and in this way we can relate our results to the theoretical model.

The HRS also provides information on the respondent's health insurance plans and the household's ownership of retirement accounts, safe and risky financial assets, labor and non-labor income, total wealth, and various individual characteristics important for our analysis.

The respondent's government health insurance plans incorporate coverage by any of the following federal government health insurance programs: Medicare, Medicaid, VA/CHAMPUS, CHAMP-VA, or any other government-provided health insurance.

The household's financial assets reported in the RAND HRS file which we include in our definition of the household's financial portfolio are: checking, savings, and money market accounts; CDs, government savings bonds, and T-bills; corporate, municipal and foreign bonds and bond funds; stocks, mutual funds, investment trusts, and IRA and Keogh accounts. We define the household's risky assets as the sum of the net value of stocks, mutual funds and investment trusts, and calculate the household's share of wealth held in risky assets by dividing this by the sum of the net value of the household's financial portfolio. The household's non-earned income is defined as the sum of the households' capital income and the spouses' income from employer pension or annuities, social security, unemployment or workers' compensation, and all other government transfers..[17] Our total wealth measure is the sum of the net value of the primary residence, real estate (not primary residence), vehicles, businesses, financial wealth, and all other savings.

[16] http://hrsonline.isr.umich.edu/data /index.html.

[17] All types of taxable income are reported as pre-tax income.

We focus our study on heterosexual couples where both spouses are 65 years old or older and use 11 waves of the RAND HRS Longitudinal File 2014, i.e., from 1994 to 2014. We choose to focus on this age group because, as mentioned before, members of this group own a large amount of wealth, which suggests that they face lower economic barriers to investing in the stock market. Moreover, individuals who are 65 years old or older are more prone to experience health shocks than younger individuals. Occurrence of health shocks is a precondition so that we can investigate the association between these and the probability of owning risky assets and share of household wealth held in such assets, respectively. Last but not least, using this age group instead of a younger one provides a less heterogeneous sample, reducing the number of factors we have to consider in our model.

The first wave of the HRS was conducted in 1992, but we do not use this wave since it does not offer any observations where both spouses are 65 years old or older.[18] While most existing studies use a smaller number of waves (mostly 2-4 waves), we choose to include as much data as possible in order to increase the number of observations used in our analysis.

Furthermore, an advantage of focusing on these waves of the RAND HRS file is that they, in a sense, constitute an unexplored area of study. To our knowledge, these waves have not been used in previous studies that analyze the relationship between negative health shocks and the share of risky assets in financial portfolios because they were not available at that time.

Our final sample has an unbalanced panel structure, where each household is observed on average four times. The sample consists of 44,303 observations of U.S. households where both spouses are aged 65 years or older. We use 11 waves of the HRS from 1994 to 2014. Table 1 shows that 40 percent of the households own risky assets and allocate 17.7 percent of their financial wealth in risky assets. The average incidence of a negative health shock occurring differs largely between males and females in the sample: 37 percent of females had experienced such a shock, while the figure was 56 percent for males. Both numbers may seem large, but remember that the negative health shock variable includes diverse shocks like cancer diagnoses, heart problems and strokes. Heart problems account for the majority of the shocks, i.e., 39 percent in males and 23 percent in females, while 9 percent of males and 6 percent of females had had a stroke.[19] Cancer diagnoses were also higher for males than for females, i.e., 22 percent of males vs. 16 percent of females.[20]

[18]In this wave, the average age is 57 for males and 53 for females.

[19]The American Heart Association reported that from 1999 to 2012, 69.1 percent of males and 67.9 percent of females 60-79 years old experienced a cardiovascular disease (Mozaffarian et al. 2016). Using data from 1999, the American Stroke Association reported that 6.1 percent of males and 5.2 percent of females 60-79 years old had suffered a stroke at some point in life (Mozaffarian et al. 2016).

[20]According to the U.S. National Cancer Institute, approximately 38.4 percent of males and females will be diagnosed with cancer at some point during their lifetime. Source: https://www.cancer.gov/about-cancer/understanding/statistics.

Table 1: Summary Statistics

	Mean	**Standard Deviation**
Household Risky Assets Ownership	0.401	
Household Share in Risky Assets	0.177	(0.289)
Male's Negative Health Shock	0.561	
Female's Negative Health Shock	0.375	
Male's Age	75.702	(6.129)
Female's Age	73.073	(5.827)
Male's Years of Education	12.612	(3.275)
Female's Years of Education	12.637	(2.583)
Number of Children	3.291	(2.033)
Household Total Wealth*	722,133	(1,521,183)
Household Earned Income*	8,681	(3,200)
Household Non Earned Income*	63,056	(93,589)
Male's Government Health Insurance	0.981	
Male's Medicare	0.978	
Male's Medicaid	0.023	
Male's VA/CHAMPUS	0.075	
Female's Government Health Insurance	0.978	
Female's Medicare	0.976	
Female's Medicaid	0.022	
Female's VA/CHAMPUS	0.045	
Male's Private Health Insurance**	0.653	
Female's Private Health Insurance**	0.673	
Male's Out of Pocket Medical Expenditure*	2,916	(6,959)
Female's Out of Pocket Medical Expenditure*	3,007	(6,144)
N		44,303

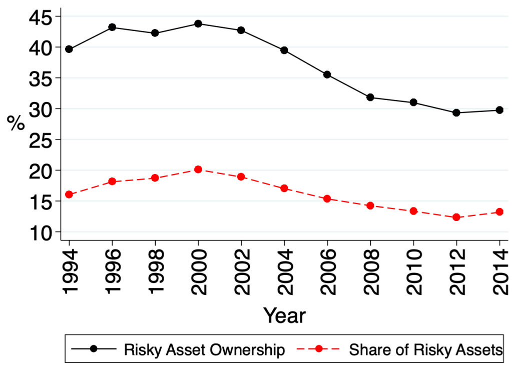
Standard deviations in parenthesis. Source: waves 1994-2014 of the RAND HRS Longitudinal File 2014 (V2). *Monetary variables are measured in 2014 U.S. dollars. **The number of observations is 44,143 due to missing data. Note. See the Appendix for a description of the variables.

The average age of females is 73 years, while the average for males is about 3 years higher, i.e., 76 years. Years of education are on average about the same for males and females: 12 years. We can also observe that households had on average more than 3 children. Approximately 98 percent of the males and females were covered by Medicare, and approximately 2.2 percent by Medicaid.[21] The latter may imply that there is a low percentage of males and females with limited income and resources in the data. Males were also more likely to have VA/Champus insurance. Table 1 also shows that the average household earned income in our sample was about $8,681, non-earned income $63,056.[22], and total wealth $722,133. Males had slightly lower out-of-pocket medical expenditures despite exhibiting a higher incidence of negative health shocks. This may suggest that they are better insured than females.

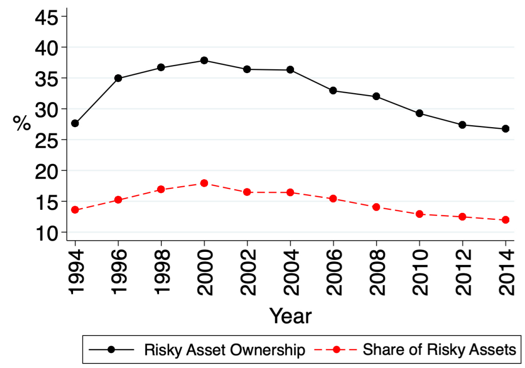
[21] Not all individuals were covered by Medicare since some may have preferred to have only private insurance. It can also be the case that some did not qualify for both Medicare and Medicaid.

[22] Non-earned income is higher since approximately 75 percent of the individuals in our data reported being retired.

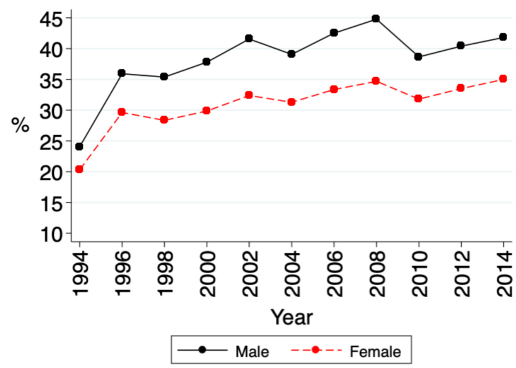
Figure 1: Risky Asset Ownership, Share of Risky Assets
and Negative Health Shocks.



(a) Risky asset ownership and share of risky assets of healthy households



(b) Risky asset ownership and share of risky assets of unhealthy households



(c) Negative health shocks

Source: waves 1994-2014 of the RAND HRS Longitudinal File 2014 (V2). There is a total of 44,303 observations where 12,753 are healthy households and 31,550 are unhealthy households. A healthy household is a household where both spouses were healthy while an unhealthy one is a household where at least one of the spouses faced a negative health shock.

Panel (a) of Figure 1 shows the risky asset ownership and share of wealth held in risky assets among households where both spouses are healthy. Panel (a) shows that the percentage of healthy households that owned risky assets increased from 1994 to 2000 and then started to decline. In 1994, approximately 40 percent of such households owned risky assets. By the year 2000, the proportion had increased to 44 percent, and then it started to decrease. Finally, in 2014, approximately 30 percent of healthy households owned risky assets. Panel (a) also shows the share of wealth held in risky assets among healthy households.

We can see that the risky asset share has a similar trajectory as risky asset ownership. In 1994, healthy households held approximately 15 percent of their portfolios in risky assets. The share peaked in the year 2000 at 20 percent and then started to fall. By the year 2014, the households held, on average, 14 percent of their portfolio in risky assets. Panel (b) shows the risky asset ownership and share of wealth held in risky assets among households where at least one of the spouses faced a negative health shock. Panel (b) shows that in general, unhealthy households had an ownership percentage lower than healthy households. For example, in 2002, 43 percent of healthy households and 36 percent of their unhealthy counterparts owned risky assets. The same is true for share of wealth held in risky assets, i.e., healthy households seem to exhibit a larger share than unhealthy households, although the difference is small.

Panel (c) shows the trajectory of negative health shocks for males and females. The rate of negative health shocks increases more for males than females, i.e., in 2014, approximately 42 percent of males reported having experienced a negative health shock, compared with only 35 percent for females. The increase in negative health shock incidence over the years can be explained by aging spouses in the data, since the HRS follows households across time. This can be seen in Table 2, i.e., older people are more likely to experience negative health shocks. Finally, Table 2 also shows that the incidence differs between males and females even when we group them by age cohorts.

Table 2: Age and Negative Health Shocks

Age	Male's Negative Health Shock	Female's Negative Health Shock
65-70	43.7%	31.4%
N	9,618	17,287
71-75	52.9%	37.0%
N	13,882	13,193
76-80	61.1%	42.9%
N	11,006	8,404
81 and older	66.9%	49.7%
N	9,797	5,419

Source: waves 1994-2014 of the RAND HRS Longitudinal File 2014 (V2). There are 44,303 observations in total.

Table 3 presents the percentage of households owning risky assets and the share of their wealth held in that asset class conditioned on the households' health state and the male's age. There are four health states: households where both spouses are healthy, households where the female is healthy and the male is unhealthy, vice versa, and households where both spouses are unhealthy. We define the individual in the household as unhealthy if they had faced a negative health shock and as healthy otherwise. We also consider four age groups: 65-70, 71-75, 76-80, and 81 and older. We observe that the first two age groups, respectively, present larger variation across household health states than the last two. For example, in the first age group, the percentage of households owning risky assets is approximately the same, 41 percent, when both spouses are healthy and when the female is healthy and the male unhealthy, yet it is lower for households where the female is unhealthy, 35.2 percent, and both spouses unhealthy, 31.6 percent. There is a similar pattern in households' share of wealth held in risky assets: households with two healthy spouses and households with an unhealthy male (17.6 percent and 16.8 percent, respectively) have larger shares of risky assets in their portfolios than households where either the female or both spouses are unhealthy (13.6 percent and 12.7 percent, respectively). We observe a similar relation in the second age group as in the first one, but the differences between health states are smaller. Finally, the differences between groups are very small in the last two age categories. This may suggest that older households in our data hold a similar share of their wealth in risky assets irrespective of their health status.

Table 3: Risky Assets Ownership and share of risky assets by Health States and Age Group of the Household

Household health states by age group	**Households owning risky assets**	**Share of risky assets**	**Households within age group**
65-70 years old			
Both Healthy	41.3%	17.6%	38.9%
Healthy Female and Unhealthy Male	41.7%	16.8%	29.2%
Unhealthy Female and Healthy Male	35.2%	13.6%	17.3%
Both Unhealthy	31.6%	12.7%	14.6%
N			9,618
71-75 years old			
Both Healthy	41.5%	17.3%	31.9%
Healthy Female and Unhealthy Male	40.5%	16.1%	33.1%
Unhealthy Female and Healthy Male	37.3%	15.2%	15.1%
Both Unhealthy	36.0%	14.1%	19.9%
N			13,882
76-80 years old			
Both Healthy	39.1%	17.7%	24.5%
Healthy Female and Unhealthy Male	41.3%	18.5%	36.9%
Unhealthy Female and Healthy Male	42.5%	19.1%	14.4%
Both Unhealthy	40.6%	18.9%	24.2%
N			11,006
81 and older			
Both Healthy	40.5%	21.1%	18.9%
Healthy Female and Unhealthy Male	41.3%	20.3%	35.3%
Unhealthy Female and Healthy Male	41.9%	21.2%	14.1%
Both Unhealthy	41.2%	21.2%	31.7%
N			9,797
N Total			44,303

Source: waves 1994-2014 of the RAND HRS Longitudinal File 2014 (V2).
An unhealthy individual has faced a negative health shock while a healthy one has not.

5 Empirical specification

We follow the model presented in Section 3 and assume that the share of wealth held in risky assets depends on negative health shocks facing the female, S_f, and the male, S_m.[23] The share of risky assets also depends on a vector of the male's individual characteristics X_m, a vector of the female's individual characteristics X_f, the household's wealth W, the household's labor income I, and the household's non-labor income NI. Taking this into account, we estimate empirical specifications for the household's probability of owning risky assets and portfolio share of risky assets, respectively.[24] Although our main interest lies in the specification for the portfolio share of risky assets, we think that it is also important to look into the household's probability of owning risky assets as a first step, i.e., the extensive margin. We start by examining whether the probability of participating in the stock market is positively or negatively associated with a health shock for either spouse. We would like to see whether households were less likely to own risky assets if one of the spouses had faced a negative health shock.

Our first empirical specification estimates the following random effects probit model for the household's probability of owning risky assets at time t.[25]

$$Y_{it}^* = \beta_0 + \beta_1 S_{mit} + \beta_2 S_{fit} + \beta_3 X_{mit} + \beta_4 X_{fit} + \beta_5 W_{it} + \beta_6 I_{it} + \beta_7 NI_{it} + \tau_t + v_i + \epsilon_{it}, \tag{12}$$

$$Y_{it} = \begin{cases} 1 & \text{if} \quad Y_{it}^* > 0 \\ 0 & \text{otherwise} \end{cases} .$$

In equation (12), τ_t is a time-specific effect, v_i is the household-specific effect, and ϵ_{it} is an error term that is normally distributed with zero mean and variance σ_ϵ^2. S_{mit} and S_{fit} are dummies for whether the male and the female, respectively, have experienced a negative health shock during in the last two years prior to the year of observation, t. The vectors X of individual characteristics for the male and female include, for each of them, explanatory variables that are available in our dataset and that the previous literature has found to have statistically significant effects on the probability of owning risky assets and on portfolio share of risky assets, i.e., age (Bertaut and Starr-McCluer 2002, Rosen and Wu 2004), education (King

[23]In section 3 we studied the amount, and not the share, of wealth invested in the risky asset and not the share of risky assets, but this does not modify the qualitative results of our analysis since the share of wealth held in risky assets would be defined as the amount invested in risky assets, α, divided by total wealth A (a positive number).

[24]Similar specifications were estimated by Berkowitz and Qiu (2006). Compared with our estimations, they use the first six waves of the HRS, and also include younger individuals in their sample.

[25]We present the estimates of random effects models rather than fixed effects models since this strategy is more practical in a short panel with relatively little time variation (Edwards 2008). Furthermore, the estimation of probit and tobit models with fixed effects results in estimates that are not consistent, i.e., the estimates of the probit case are not sufficient statistics. There may be other statistics in the sample that provide additional information as to the value of the parameter (Greene 2002).

and Leape 1998, Rosen and Wu 2004, Berkowitz and Qiu 2006), and the household's number of children (Rosen and Wu 2004).[26] To account for wealth W, we include the household's total wealth as defined in the data section. Finally, we include the household's earned income I and non-earned income NI (similar to previous studies such as Rosen and Wu [2004] that include variables for household income and net worth in their model, and Berkowitz and Qiu [2006], who include labor income as well as financial and non-financial assets).

We extend equation (12) and estimate a second model that includes dummies for private medical insurance and federal government health insurance, respectively. The latter equals one if the respondent had access to any of the following federal government health insurance programs: Medicare, Medicaid, TRI-CARE, CHAMP-VA or any other government health care plan. It equals zero otherwise. We also add the male's and female's out-of-pocket medical expenditure, respectively, to the explanatory variables. We include the insurance and out-of-pocket variables since expenditure on own health that is not covered by a medical insurance can affect the amount allocated to risky assets.

To address the determination of the share of risky assets, we estimate a Tobit model as follows:

$$\alpha_{it} = \begin{cases} \alpha^*_{it} \quad if \quad \alpha^*_{it} > 0 \\ 0 \quad if \quad \alpha^*_{it} \leq 0 \end{cases} ,$$

where the latent portfolio share of risky assets is

$$\alpha^*_{it} = \pi_0 + \pi_1 S_{mit} + \pi_2 S_{fit} + \pi_3 X_{fit} + \pi_4 X_{mit} + \pi_5 W_{it} + +\pi_6 I_{it} + \pi_7 NI_{it} + \mu_t + \kappa_i + \psi_{it}. \qquad (13)$$

In equation (13), μ_t is a time-specific effect, κ_i is the household-specific effect, and ψ_{it} is an error term that is normally distributed with zero mean and variance σ^2_ψ. We use the same explanatory variables as in (12) to estimate (13).

Finally, we relate the theoretical framework in Section 3 to the empirical specification (13) in the following way: equation (4) and equation (5) relate to π_1 and π_2, respectively. In equation (13), π_1 and π_2 can be understood as the change in the latent share of risky assets when the male's health and female's health decreases (they face a negative health shock), respectively, everything else constant. Although there are two main differences between the theoretical model and the empirical model, these do not affect the qualitative results of our analysis. First, in the theoretical model, we focus on the amount, and not share, of wealth invested in risky assets. This does not affect the sign of the right-hand side of equations (4) and (5) since the share of risky assets equals the amount of wealth invested in the risky assets divided by total wealth, which we have restricted to be positive in both the theoretical and empirical models. Second, in the theoretical model, we calculate the change in the investment in risky assets due to a change

[26] Not necessarily living in the household.

in the probability of enjoying good health. Hence, we can think of a negative health shock as a decrease in the probability of being in good health.

6 Results

6.1 Ownership probabilities

Table 4 presents the average marginal effects for the probability of owning risky assets. More specifically, we show that in all model specifications, the average marginal effect of a negative health shock facing the female is statistically significant at the 5 percent level, and it is associated with an approximately 1.2 percentage-point reduction in the household's probability of owning risky assets.[27] Based on the first model and the numerical analysis in Section 3, this result suggests that households show prudence and are more likely to own less risky assets when the female faces a negative health shock. In this way, the household insures itself against the female facing a health shock. There is no similar relationship between the probability of holding risky assets and a negative health shock facing the male: in all specifications, the effect of a negative health shock facing the male is statistically insignificant. Based on the theoretical model, this result suggests that prudent households are better insured against the male facing a negative health shock.

Table 4 also shows that the probability of owning risky assets is positively correlated with years of education. Every additional year of education attained by the male is associated with a 3.1 percentage-point increase in that probability. For females, the corresponding percentage-point increase is 2.3 in all specifications.[28] Rosen and Wu (2004) and Berkowitz and Qiu (2006) also estimated a positive effect of the male's education level on the probability of owning risky assets. This may suggest that individuals with more education may understand the financial market better and be more able to face financial risk than less educated individuals. The estimates of the average marginal effects for number of children are also statistically significant and negative in all specifications. One more child is associated with a 0.4 percentage-point reduction in the probability of owning risky assets. Hence, we can think that households with children consume more than households without children, and thus, they prefer to hold less risky assets. It can also be the case that households are closer to the age of leaving a bequest, which increases

[27] We also estimated specifications with interaction effects between the negative health shock and age, but the estimates of these interaction effects were not statistically significant and those of the other parameters remained robust compared with the specification without interaction effects.

[28] We estimated a specification with two dummy variables: 1) high school and 2) more than high school as highest attained education. The estimates for these dummies were positive and statistically significant, and the estimates of the effects of covariates remained robust.

the households' preferences for safe over risky assets. Furthermore, our results indicate that increases in household wealth are associated with increases in the probability of owning risky assets, suggesting that the households become less risk averse when wealth increases. This result is also supported by Berkowitz and Qiu (2006), who estimate the effect of wealth by including a variable for financial and a variable for non-financial wealth. Both variables seem to have a positive and statistically significant effect on the probability of owning risky assets in their study. Unlike Berkowitz and Qiu (2006), who document a positive effect of labor income on the ownership probability, although they include individuals aged 50 and older, our results suggest that non-earned income is positively associated with ownership probability. We find no statistically significant correlation between earned income and ownership probability. This seems reasonable since nearly 75 percent of the individuals in our sample reported being retired and therefore had non-earned income as their only source of income.

We can also see that government medical insurance does not seem to be significantly correlated with the probability of owning risky assets in specifications 2 and 3. Hence, we separate such insurance into different types in specifications 4 and 5 to see whether they affect the ownership probability in different directions. We find that there are statistically significant correlations between some of the government insurances and the probability of owning risky assets. Specifically, the female's MEDICARE estimate is associated with a 2.7 percentage-point increase in the probability of owning risky assets, and the male's and female's MEDICAID estimates are associated with a 3.6 and 11.6 percentage-point decrease, respectively. Finally, the estimate for the male's private medical insurance is associated with a 3.6 percentage-point increase in the ownership probability, and the female's private medical insurance estimate is associated with a 1.8 percentage-point increase. These results suggest that households where the female had access to MEDICAID are also associated with a lower probability of owning risky assets. Since this type of insurance is for those whose resources are insufficient to pay for health care, it may pick up characteristics that are not captured by the income and wealth variables that affect the household's investment in risky assets.

Table 4: Average Marginal Effects of Risky Asset Ownership Probit Model.

	(1)	(2)	(3)	(4)	(5)
Male's Negative Health Shock	-0.241	-0.313	-0.303	-0.318	-0.301
	(0.497)	(0.500)	(0.501)	(0.503)	(0.504)
Female's Negative Health Shock	-1.183*	-1.245*	-1.277*	1.215*	-1.248*
	(0.521)	(0.522)	(0.523)	(0.527)	(0.528)
Male's Age	0.137*	0.145	0.143	0.146	0.145
	(0.082)	(0.082)	(0.082)	(0.082)	(0.083)
Female's Age	0.211*	0.207*	0.208*	0.203*	0.204**
	(0.085)	(0.085)	(0.085)	(0.086)	(0.086)
Male's Years of Education	3.173***	3.137***	3.138***	3.107***	3.107***
	(0.123)	(0.124)	(0.124)	(0.125)	(0.125)
Female's Years of Education	2.356***	2.264***	2.263***	2.197***	2.196***
	(0.157)	(0.157)	(0.158)	(0.159)	(0.159)
Number of children	-0.462**	-0.417**	-0.416**	-0.377*	-0.377*
	(0.164)	(0.164)	(0.164)	(0.165)	(0.165)
Household Wealth/(10^5)	0.542***	0.546***	0.546***	0.544***	0.544***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Household Earned Income/(10^4)	-0.106	-0.121	-0.121	-0.123	-0.123
	(0.064)	(0.065)	(0.065)	(0.065)	(0.065)
Household Non Earned Income/(10^4)	0.291***	0.284***	0.281***	0.281***	0.278***
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Male's Government Insurance		1.261	1.267		
		(1.658)	(1.657)		
Males's Medicare				1.140	1.144
				(1.603)	(1.603)
Males's Medicaid				-3.639*	-3.638**
				(1.642)	(1.643)
Males's VA/CHAMPUS				-0.355	-0.350
				(0.951)	(0.951)
Female's Governement Insurance		1.865	1.867		
		(1.451)	(1.451)		
Female's Medicare				2.789*	2.791*
				(1.400)	(0.014)
Female's Medicaid				-11.621***	-11.612***
				(1.771)	(1.772)
Female's VA/CHAMPUS				0.297	0.333
				(1.450)	(1.451)
Males's Private Insurance		3.687***	3.683***	3.628***	3.624***
		(0.506)	(0.506)	(0.512)	(0.512)
Female's Private Insurance		2.108**	2.121**	1.823**	1.840**
		(0.516)	(0.517)	(0.523)	(0.524)
Males's Out of Pocket Med Exp/(10^4)			-0.042		-0.115
			(0.241)		(0.249)
Female's Out of Pocket Med Exp/(10^4)			0.326		0.340
			(0.282)		(0.288)
N	44, 303	44, 143	44, 143	43,717	43,717

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors in parenthesis. Source: waves 1994-2014 of the HRS. All specifications include year controls. The estimates of the xtprobit regression in Stata for all specifications are presented in the Appendix.

In Table 5, we divide the sample into age groups conditional on the male's age. The results show that the effect of a negative health shock to the female is statistically significant only in the group where the male is 65-70 years old, and it is associated with a 4.8 percentage-point decrease in the probability of owning risky assets. For this age group, negative health shocks are least frequent (as shown in Table 2) and might therefore be the most unexpected, which can make the effect of such a shock largest in this age group.

The estimate of the effect corresponding to the male's private insurance is statistically significant and positive in all specifications, and is associated with an increase in the probability of owning risky assets. In contrast, the estimate of the female having a private insurance is only statistically significant in specifications (2) and (3), and is also associated with an increase in the ownership probability. This suggests that the household owns more assets when it is insured against the cost of poor health. Hence, the private insurance reduces the risk of having monetary costs related to poor health.

Table 5: Average Marginal Effects of Asset Ownership Probit Model Conditioned on Male Age Groups.

	Male's Age			
	65-70	**71-75**	**76-80**	**81 and older**
	(1)	**(2)**	**(3)**	**(4)**
Male's Negative Health Shock	-0.908	0.024	0.095	-1.076
	(1.057)	(0.862)	(0.964)	(1.081)
Female's Negative Health Shock	-4.801***	-1.142	0.440	-1.584
	(1.130)	(0.917)	(0.991)	(1.047)
Male's Age	0.178	-0.044	-0.544*	-0.102
	(0.311)	(0.251)	(0.271)	(0.201)
Female's Age	-0.226	0.133	0.411**	0.182
	(0.253)	(0.151)	(0.135)	(0.141)
Male's Years of Education	2.545***	2.939***	2.833***	2.748***
	(0.228)	(0.180)	(0.193)	(0.211)
Female's Years of Education	2.291***	1.664***	1.931***	2.094***
	(0.276)	(0.228)	(0.255)	(0.287)
Number of children	-1.167***	-0.579*	-0.511*	-0.162
	(0.304)	(0.239)	(0.259)	(0.302)
Household Wealth/(10^5)	0.316***	1.008***	1.291***	1.133***
	(0.032)	(0.050)	(0.061)	(0.067)
Household Earned Income/(10^4)	-0.070	-0.307**	-0.132	-0.481
	(0.105)	(0.108)	(0.207)	(0.311)
Household Non Earned Income/(10^5)	0.651***	0.301***	0.322***	0.074
	(0.076)	(0.053)	(0.069)	(0.050)
Males's Medicare	0.231	-0.308	1.285**	-0.323
	(2.584)	(2.895)	(3.845)	(4.645)
Female's Medicare	1.513	1.052***	-0.551	-4.329
	(2.302)	(2.426)	(4.009)	(4.124)
Males's Medicaid	-1.233	-7.197*	-7.215*	-7.416
	(3.682)	(3.364)	(3.025)	(3.984)
Female's Medicaid	-13.144**	-8.991*	-15.309***	-12.359**
	(4.374)	(3.629)	(3.254)	(3.813)
Males's VA/CHAMPUS	-4.193	-1.179	0.693	1.342
	(2.456)	(1.884)	(1.833)	(1.987)
Female's VA/CHAMPUS	5.786	4.351	-4.527	-0.835
	(3.326)	(2.738)	(2.643)	(2.910)
Male's Private Insurance	6.108***	4.456***	2.747**	5.455***
	(1.182)	(0.974)	(1.058)	(1.092)
Female's Private Insurance	1.230	4.707***	4.284***	0.152
	(1.215)	(1.011)	(1.079)	(1.105)
Male's Out of Pocket Med Exp/(10^4)	-0.141	-1.075*	0.621	1.318*
	(0.887)	(0.487)	(0.705)	(0.624)
Female's Out of Pocket Med Exp/(10^4)	0.040	-0.714	-0.384	0.811
	(0.784)	(0.694)	(0.610)	(0.540)
N	9,533	13,731	10,864	9,589

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors in parenthesis. Source: waves 1994-2014 of the HRS. All specifications include year controls. The estimates of the xtprobit regression in Stata for all specifications are presented in the Appendix.

6.2 Share of wealth held in risky assets

Table 6 presents the estimates of the tobit model for the household's share of wealth held in risky assets. We are mostly interested in the correlation between negative health shocks and this share. Our results show that the effect of a negative health shock to the male is not statistically significant while a negative health shock to the female is statistically significantly correlated with the share of wealth held in risky assets at the 5 percent level, and corresponds to a decrease of approximately 2 percentage-points. The theoretical framework suggests that the household experiences a loss in consumption due to the monetary cost of the female facing a health shock. Moreover, if we assume that the spouses' health and household consumption are complements, a reduction in consumption will also follow after a negative health shock to the female. Hence, the household has an incentive to reduce the share of risky assets held in order to insure itself against the female facing a health shock. Finally, as discussed before, the results in this section also suggest that the household is better insured against a negative health shock facing the male, which implies that the household's consumption is less affected by this.

In all specifications, we estimate that the share of risky assets held increases by approximately 2.5 percentage-points with the male's age, by 0.3 percentage-points with household wealth, and by 1.4 percentage-points with household non-earned income. As in the previous section, these results may suggest that households become less risk averse when their wealth increases. The associations between the male's and female's private insurance, respectively, and the share of risky assets held are also statistically significant and imply an increase of approximately 4.5 and 2 percentage-points. Finally, only the estimate of the effect of the female's out-of-pocket medical expenditure is statistically significant and corresponds to a 0.8 percentage-point increase in the share of wealth held in risky assets. The latter could reflect the households' wealth characteristics, i.e., wealthier households can afford to cover medical expenditures and invest in the stock market at the same time. Finally, both the male's and female's MEDICAID are statistically significant and associated with a reduction in the share of risky assets

Table 6: Estimates of Share of Risky Assets Tobit Model.

	(1)	(2)	(3)	(4)	(5)
Male's Negative Health Shock	-0.218	-0.242	-0.287	-0.283	-0.321
	(0.748)	(0.748)	(0.748)	(0.750)	(0.751)
Female's Negative Health Shock	-1.892*	-2.057**	-2.142**	-1.896*	-1.977*
	(0.794)	(0.794)	(0.795)	(0.797)	(0.798)
Male's Age	2.517*	2.346	2.467*	2.104	2.213
	(1.215)	(1.217)	(1.218)	(1.224)	(1.224)
Female's Age	-2.035	-1.938	-1.914	-1.949	-1.921
	(1.291)	(1.296)	(1.296)	(1.303)	(1.303)
Male's Years of Education	5.329***	5.251***	5.248***	5.179***	5.176***
	(2.144)	(0.213)	(0.213)	(0.214)	(0.214)
Female's Years of Education	4.022***	3.904***	3.889***	3.746***	3.733***
	(0.261)	(0.261)	(0.261)	(0.261)	(0.261)
Number of children	-0.352	-0.295	-0.293	-0.232	-0.232
	(0.265)	(0.265)	(0.265)	(0.265)	(0.265)
Household Wealth/(10^5)	0.360**	0.361***	0.360***	0.359***	0.358***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Household Earned Income/(10^4)	-0.093	-0.105	-0.106	-0.101	-0.101
	(0.088)	(0.090)	(0.090)	(0.089)	(0.089)
Household Non Earned Income/(10^5)	0.146***	0.142***	0.139***	0.142***	0.139***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Males's Government Insurance		0.307	0.295		
		(2.485)	(2.484)		
Males's Medicare				1.183	1.178
				(2.408)	(2.408)
Males's Medicaid				-6.637*	-6.628*
				(2.654)	(2.655)
Males's VA/CHAMPUS				1.319	1.393
				(1.431)	(1.431)
Female's Government Insurance		3.010	3.006		
		(2.192)	(2.196)		
Female's Medicare				4.159	4.152
				(2.145)	(2.144)
Female's Medicaid				-22.935***	-22.874***
				(3.228)	(3.227)
Female's VA/CHAMPUS				-2.774	-2.609
				(2.208)	(2.208)
Males's Private Insurance		4.737***	4.737***	4.539***	4.541***
		(0.759)	(0.759)	(0.765)	(0.765)
Female's Private Insurance		2.494***	2.518***	2.043**	2.077**
		(0.769)	(0.769)	(0.776)	(0.776)
Males's Out of Pocket Med Exp/(10^4)			0.513		0.438
			(0.328)		(0.341)
Female's Out of Pocket Med Exp/(10^4)			0.815*		0.806*
			(0.394)		(0.399)
Constant	-1.951***	-1.993***	-2.043***	-1.879***	-1.925***
	(0.389)	(0.391)	(0.005)	(0.394)	(0.394)
N	44, 303	44, 143	44, 143	43, 717	43, 717

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors in parenthesis. Source: waves 1994-2014 of the HRS. The table shows the estimates of a random effects tobit regressions in Stata(xttobit command) for all specifications. All specifications include the square of the male's age, the square of the female's age, and year controls.

In Table 7, once again we divide the data into age groups conditional on the male's age. The results show that the correlation between the female's negative health shock and the share of wealth held in risky assets is statistically significant for the groups where the male is 65-70 and 71-75 years old, with it being larger for the first group. It could be the case that for households with younger females, the negative health shock is more unexpected, and thus, this type of household might be less insured against the female's poor health and face higher costs. If this is true, households with younger females might reduce their share of wealth held in risky assets more than households with older females.

Table 7: Estimates of Share of Risky Assets Tobit Model
Conditioned on Male Age Groups.

	Male's Age			
	65-70	**71-75**	**76-80**	**81 and older**
	(1)	**(2)**	**(3)**	**(4)**
Male's Negative Health Shock	-1.402	-0.983	1.342	-2.110
	(1.517)	(1.211)	(1.449)	(1.696)
Female's Negative Health Shock	-6.668***	-2.825*	0.729	-2.917
	(1.651)	(1.299)	(1.505)	(1.695)
Male's Age	26.818	-3.671	-20.989	-3.427
	(28.026)	(3.385)	(43.011)	(6.382)
Female's Age	-4.521	4.741	17.398***	-0.239
	(5.687)	(4.163)	(4.288)	(2.871)
Male's Years of Education	3.742***	4.632***	4.780***	5.201***
	(0.346)	(0.273)	(0.314)	(0.383)
Female's Years of Education	3.584***	2.714***	3.224***	4.054***
	(0.411)	(0.332)	(0.398)	(0.497)
Number of children	-1.477***	-0.588	-0.617	-0.158
	(0.449)	(0.345)	(0.401)	(0.513)
Household Wealth/(10^5)	0.245***	0.479***	0.846***	0.543***
	(0.026)	(0.033)	(0.051)	(0.045)
Household Earned Income/(10^4)	-0.078	-0.118	0.020	-0.890*
	(0.136)	(0.132)	(0.272)	(0.414)
Household Non Earned Income/(10^5)	0.289***	0.291***	0.037	0.165*
	(0.046)	(0.051)	(0.044)	(0.067)
Males's Medicare	-3.446	4.953	15.797*	5.159
	(3.591)	(4.092)	(6.262)	(7.471)
Female's Medicare	3.714	14.895***	0.536	-8.949
	(3.184)	(3.907)	(5.974)	(6.583)
Males's Medicaid	-2.113	-6.361	-1.932***	-9.101
	(5.303)	(4.934)	(5.232)	(7.377)
Female's Medicaid	-22.847**	-15.963*	-2.427***	-33.843***
	(7.481)	(5.639)	(6.362)	(7.766)
Males's VA/CHAMPUS	-3.927	1.322	0.917	4.517
	(3.757)	(2.624)	(2.696)	(3.073)
Female's VA/CHAMPUS	1.619	0.058	-9.216*	-3.331
	(4.685)	(3.710)	(4.233)	(4.726)
Male's Private Insurance	7.163***	4.352***	4.905**	7.744***
	(1.656)	(1.370)	(1.606)	(1.712)
Female's Private Insurance	1.516	7.571***	5.154**	0.155
	(1.719)	(1.395)	(1.634)	(1.715)
Male's Out of Pocket Med Exp/(10^4)	0.458	-0.778	0.132	1.336
	(1.155)	(0.572)	(0.781)	(0.716)
Female's Out of Pocket Med Exp/(10^4)	0.135	0.186	-0.487	0.903
	(1.055)	(0.891)	(0.831)	(0.717)
Constant	-8.868	-1.979	0.069	-0.029
	(9.671)	(12.333)	(16.731)	(2.742)
N	9,533	13,731	10,864	9,589

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors in parenthesis. Source: waves 1994-2014 of the HRS. The table shows the estimates of a random effects tobit regressions in Stata (xttobit command) for all specifications. All specifications include the square of the male's age, the square of the female's age, and year controls.

6.3 Sensitivity analysis

We estimated two more specifications: one with an "initial health" variable and a second with a lagged health shock variable. Initial health indicates whether the individual had experienced a health shock before their first observation in our data, while the lagged variable indicates whether the individual had a health shock in the previous wave. We also include interaction effects between these variables and the actual health shock. We included these variables and interaction effects since a recent health shock may be more expected for households that have already experienced a health shock in the past, thus they might have changed their share of risky assets in the past already. The results are in line with our previous specifications. The male's negative health shock is not statistically significant, while the female's is. Specifically, when we control for initial health, the estimates for the female's negative health shock are negative and statistically significant when the male is 65-70 years old and 71-75 years old (see Table 12 in the Appendix). When we control for the lagged health shock, the female negative health shock is significant when the male is 65-70 years old (see Table 13 in the Appendix). Finally, we find that the estimates of the interaction effects mentioned above and the estimates of the effects of the initial health and lagged health shock are not statistically significant.

7 Conclusions

In this paper, we examine the relationship between recent negative health shocks and the probability of owning risky assets and the risk exposure of household portfolios, respectively, among aging couples in the U.S. We define negative health shocks as one or more of the following diagnoses by a medical doctor: cancer or a malignant tumor of any kind except skin cancer, stroke or transient ischemic attack, and heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems.

More specifically, we observe that a major negative health shock to the female is associated with a decrease in the probability of owning risky assets. However, a similar health shock to the male does not seem to have an effect on the probability of owning risky assets.

Our results are in line with the previous studies of Rosen and Wu (2004) or Berkowitz and Qiu (2006), who find that a negative health shock to the female is negatively associated with the probability of owning risky assets, while a negative health shock to the male does not significantly affect this probability.

Furthermore, we find that a negative health shock to the female is associated with a decrease in the share of household wealth invested in risky assets, in particular when the male is 65-70 years old and 71-75 years old. We do not find a statistically significant correlation for the male facing a negative health shock.

The theoretical model suggests that the results could be explained by households being better insured against the male facing poor health, which implies that the household's consumption is less affected by a negative health shock to the male. In turn, the share of household wealth held in risky assets is less affected as well. Our theoretical analysis also suggests that households show prudence and prefer to reduce the share of wealth held in risky assets to insure themselves against the loss in consumption due to the cost of the female's negative health shock.

Future research will need to consider the household's intertemporal decisions regarding consumption and investment in risky assets. Theoretical analyses should take into account that households consists of two spouses who may have different preferences, and should therefore use collective household models. Finally, it is also important to incorporate more channels that may affect the investment in risky assets, i.e., life expectancy, mortality, and bequest motives, into both the theoretical and empirical analysis.

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Appendices

A Mathematical Appendix

By totally differentiating (3) with respect to α, p^f, and p^m, we obtain the following equation:

$$\begin{aligned}
&\big[p^f p^m E[u''^{gg}\delta^2] + p^f(1-p^m)E[u''^{gb}\delta^2] + (1-p^f)p^m E[u''^{bg}\delta^2] + (1-p^f)(1-p^m)E[u''^{bb}\delta^2]\big]d\alpha \\
&+\big[p^m E[u'^{gg}\delta] + (1-p^m)E[u'^{gb}\delta] - p^m E[u'^{bg}\delta] - (1-p^m)E[u'^{bb}\delta]\big]dp^f \\
&+\big[p^f E[u'^{gg}\delta] - p^f E[u'^{gb}\delta] + (1-p^f)E[u'^{bg}\delta] - (1-p^f)E[u'^{bb}\delta]\big]dp^m = 0. \qquad \text{(A1)}
\end{aligned}$$

If we assume that the female's probability of good health changes $dp^f \neq 0$ and the male's probability of good health does not change $dp^m = 0$, then from equation (A1) we obtain the change in the expression for the change in the amount invested in the risky asset due to a change in the female's probability of good health,

$$\frac{d\alpha}{dp^f} = -\frac{1}{D}\big\{p^m\big(E[u'^{bb}\delta] - E[u'^{bg}\delta]\big) + (1-p^m)\big(E[u'^{gb}\delta] - E[u'^{bb}\delta]\big)\big\}$$

If we decompose the expected value into the sum of the product of the expectations and the covariance, $E[XY] = E[X]E[Y] + cov[X,Y]$, we obtain the following equation:

$$\begin{aligned}
\frac{d\alpha}{dp^f} = -\frac{1}{D}\big\{&p^m\big(E[u'^{gg}]\hat{\delta} - E[u'^{bg}]\hat{\delta} + cov[u'^{gg},\delta] - cov[u'^{bg},\delta]\big) \\
&+ (1-p^m)\big(E[u'^{gb}]\hat{\delta} - E[u'^{bb}]\hat{\delta} + cov[u'^{gb},\delta] - cov[u'^{bb},\delta]\big)\big\},
\end{aligned}$$

where

$$D = p^f p^m E[u''^{gg}\delta^2] + p^f(1-p^m)E[u''^{gb}\delta^2] + (1-p^f)p^m E[u''^{bg}\delta^2] + (1-p^f)(1-p^m)E[u''^{bb}\delta^2],$$

and $\hat{\delta} = E[\delta]$. Similarly, the expression when the male's probability of good health changes, ceteris paribus, is

$$\frac{d\alpha}{dp^m} = -\frac{1}{D}\big\{p^f\big(E[u'^{gg}\delta] - E[u'^{gb}\delta]\big) + (1-p^f)\big(E[u'^{gb}\delta] - E[u'^{bb}\delta]\big)\big\}.$$

Again, by decomposing into expectations and covariances we obtain:

$$\begin{aligned}
\frac{d\alpha}{dp^m} = -\frac{1}{D}\big\{&p^f\big(E[u'^{gg}]\hat{\delta} - E[u'^{gb}]\hat{\delta} + cov[u'^{gg},\delta] - cov[u'^{gb},\delta]\big) \\
&+ (1-p^f)\big(E[u'^{bg}]\hat{\delta} - E[u'^{bb}]\hat{\delta} + cov[u'^{gb},\delta] - cov[u'^{bb},\delta]\big)\big\}.
\end{aligned}$$

B Notes and Tables

Note to Table 1.

Number of children is the number of the spouses' living children. The household's total wealth is the sum of the net value of real estate (including primary residence), vehicles, and businesses and the value of the household's financial assets and all other savings. The household's financial assets include: checking, savings and money market accounts, CDs (Certificates of Deposit), government savings and T-bills, corporate, municipal and foreign bonds and bond funds, stocks, mutual funds, and IRA and Keogh accounts. The spouses' health insurance variables are dummies that indicate if the spouses' health insurance plans incorporate coverage by any of the following federal government health insurance programs: Medicare, Medicaid, VA/CHAMPUS (Civilian Health and Medical Program of the Uniformed Services), CHAMP-VA (The Civilian Health and Medical Program of the Department of Veterans Affairs) or any Medicare, Medicaid, VA/CHAMPUS, CHAMP-VA or any other government-provided health insurance. Private insurance indicates whether the spouse is privately insured. The household's earned income is the sum of the spouses' wage/salary income, commissions/tips and earnings from professional trade or practice. The household's non-earned income is defined as the sum of the households' capital income and the income from employer pensions or annuities, social security, unemployment or workers compensation for injuries, and all other government transfers. The negative health shock takes the value one if the spouse has experienced cancer or a malignant tumor of any kind except skin cancer, heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems, or stroke or transient ischemic attack, and zero otherwise.

Table 8: Estimates of Asset Ownership Probit Model.

	(1)	(2)	(3)	(4)	(5)
Male's Negative Health Shock	-0.014	-0.018	-0.017	-0.018	-0.017
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Female's Negative Health Shock	-0.069*	-0.072*	-0.074*	-0.071*	-0.072*
	(0.030)	(0.030)	(0.030)	(0.031)	(0.031)
Male's Age	0.064	0.060	0.061	0.052	0.054
	(0.047)	(0.047)	(0.047)	(0.048)	(0.048)
Female's Age	-0.007	-0.012	-0.012	-0.012	-0.012
	(0.051)	(0.051)	(0.051)	(0.051)	(0.051)
Male's Age^2	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female's Age^2	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male's Years of Education	0.185***	0.182***	0.182***	0.180***	0.180***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Female's Years of Education	0.137***	0.131***	0.131***	0.127***	0.127***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Number of children	-0.027**	-0.024*	-0.024*	-0.021*	-0.022*
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Household Wealth/(10^5)	0.032***	0.032***	0.032***	0.031***	0.031***
	(0.001)	(0.001)	(0.001)	(0.012)	(0.001)
Household Earned Income/(10^4)	-0.006	-0.007	-0.007	-0.007	-0.007
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Household Non Earned Income/(10^4)	0.017***	0.017***	0.016***	0.016***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male's Government Insurance		0.073	0.074		
		(0.097)	(0.097)		
Males's Medicare				0.066	0.066
				(0.093)	(0.093)
Males's Medicaid				-0.214*	-0.214*
				(0.098)	(0.098)
Males's VA/CHAMPUS				-0.021	-0.020
				(0.055)	(0.055)
Female's Government Insurance		0.109	0.109		
		(0.085)	(0.085)		
Female's Medicare				0.163*	0.163*
				(0.083)	(0.083)
Female's Medicaid				-0.719***	-0.719***
				(0.119)	(0.119)
Female's VA/CHAMPUS				0.017	0.019
				(0.083)	(0.083)
Male's Private Insurance		0.214***	0.214***	0.211***	0.211***
		(0.029)	(0.029)	(0.029)	(0.029)
Female's Private Insurance		0.122***	0.123***	0.105***	0.106***
		(0.030)	(0.030)	(0.030)	(0.030)
Males's Out of Pocket Med Exp/(10^4)			-0.002		-0.006
			(0.001)		(0.014)
Female's Out of Pocket Med Exp/(10^4)			0.001		0.019
			(0.001)		(0.016)
Constant	-7.991***	-8.005***	-8.006***	-7.662***	-7.737***
	(1.573)	(1.577)	(1.577)	(1.596)	(1.597)
N	44, 303	44, 143	44, 143	43, 717	43, 717
rho	0.735	0.731	0.731	0.731	0.731
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors in parenthesis. Source: waves 1994-2014 of the HRS. The table shows the estimates of a random effects probit regression in Stata (xtprobit command) for all specifications. All specifications include year controls.

Table 9: Estimates of Asset Ownership Probit Model

Conditioned on Male Age Group.

	Male's Age			
	65-70	**71-75**	**76-80**	**81 and older**
	(1)	**(2)**	**(3)**	**(4)**
Male's Negative Health Shock	-0.054	0.001	0.006	-0.070
	(0.063)	(0.057)	(0.066)	(0.070)
Female's Negative Health Shock	-0.291***	-0.076	0.030	-0.103
	(0.069)	(0.061)	(0.068)	(0.068)
Male's Age	1.744	1.139	-0.797	-0.052
	(1.256)	(1.718)	(2.074)	(0.272)
Female's Age	-0.096	0.124	0.973***	-0.090
	(0.236)	(0.205)	(0.200)	(0.121)
Male's Age^2	-0.012	-0.007	0.004	0.000
	(0.009)	(0.011)	(0.013)	(0.001)
Female's Age^2	0.000	-0.001	-0.006***	0.000
	(0.001)	(0.001)	(0.001)	(0.000)
Male's Years of Education	0.153***	0.196***	0.195***	0.179***
	(0.014)	(0.013)	(0.015)	(0.015)
Female's Years of Education	0.137***	0.111***	0.133***	0.136***
	(0.017)	(0.015)	(0.018)	(0.019)
Number of children	-0.070***	-0.038*	-0.035*	-0.011
	(0.018)	(0.016)	(0.018)	(0.019)
Household Wealth/(10^5)	0.019***	0.067***	0.089***	0.073***
	(0.018)	(0.003)	(0.005)	(0.004)
Household Earned Income/(10^4)	-0.004	-0.021**	-0.009	-0.031
	(0.006)	(0.007)	(0.014)	(0.020)
Household Non Earned Income/(10^5)	0.039***	0.020***	0.022***	0.004
	(0.004)	(0.003)	(0.005)	(0.003)
Males's Medicare	0.013	-0.021	0.952**	-0.021
	(0.155)	(0.192)	(0.313)	(0.301)
Female's Medicare	0.091	0.743***	-0.037	-0.278
	(0.140)	(0.185)	(0.275)	(0.261)
Males's Medicaid	-0.074	-0.497*	-0.514*	-0.500
	(0.223)	(0.242)	(0.224)	(0.279)
Female's Medicaid	-0.853**	-0.628*	-1.155***	-0.860**
	(0.316)	(0.269)	(0.281)	(0.288)
Males's VA/CHAMPUS	-0.256	-0.079	0.047	0.087
	(0.152)	(0.126)	(0.126)	(0.128)
Female's VA/CHAMPUS	0.342	0.286	-0.318	-0.054
	(0.193)	(0.177)	(0.190)	(0.191)
Male's Private Insurance	0.368***	0.297***	0.189**	0.355***
	(0.072)	(0.065)	(0.073)	(0.071)
Female's Private Insurance	0.074	0.314***	0.296***	0.009
	(0.073)	(0.068)	(0.075)	(0.072)
Male's Out of Pocket Med Exp/(10^4)	-0.008	-0.071*	0.042	0.085*
	(0.053)	(0.032)	(0.048)	(0.041)
Female's Out of Pocket Med Exp/(10^4)	0.002	0.047	-0.026	0.052
	(0.047)	(0.046)	(0.042)	(0.035)
Constant	-60.956	-52.541	-11.642	0.367
	(43.299)	(62.684)	(80.677)	(11.752)
N	9,533	13,731	10,864	9,589
rho	0.753	0.789	0.794	0.779
	(0.015)	(0.011)	(0.012)	(0.013)

$^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors in parenthesis. Source: waves 1994-2014 of the HRS. The table shows the estimates of a random effects probit regressions in Stata (xtprobit command) for all specifications. All specifications include year controls.

Table 10: Sensitivity Analysis 1: Estimates of Risky Share Tobit Model Conditioned on Male Age Groups.

	Male's Age			
	65-70	**71-75**	**76-80**	**81 and older**
	(1)	**(2)**	**(3)**	**(4)**
Female's Negative Health Shock	-7.929***	-8.478**	-0.653	-4.008
	(2.249)	(1.934)	(2.591)	(4.246)
Female's Initial Health	14.274	5.533	-5.089	-31.384
	(13.017)	(12.964)	(15.892)	(18.496)
N	6,568	7,621	4,569	1,827

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors in parenthesis. Source: waves 1994-2014 of the HRS. Initial health indicates if the female has ever had a health shock before her first observation. All specifications include year controls, the same covariates as in Table 7, and an interaction effect between the negative health shock and initial health.

Table 11: Sensitivity Analysis 2: Estimates of Risky Share Tobit Model Conditioned on Male Age Groups.

	Male's Age			
	65-70	**71-75**	**76-80**	**81 and older**
	(1)	**(2)**	**(3)**	**(4)**
Female's Negative Health Shock	-9.285**	0.264	2.427	-3.217
	(2.725)	(2.064)	(2.296)	(2.418)
Female's Lagged Negative Health Shock	2.304	-5.384	-2.395	-10.184
	(10.484)	(6.664)	(5.794)	(5.244)
N	8,378	11,281	9,679	8,539

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors in parenthesis. Source: waves 1994-2014 of the HRS. Lagged negative health shock indicates if the female had a health shock in the previous wave. All specifications include year controls, the same covariates as in Table 7, and an interaction effect between the negative health shock and the lagged negative health shock.