Household Bargaining and Portfolio Choice*

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Abstract

Differences in risk preferences may lead to spouses having different preferences over the allocation of their household portfolio. This paper examines how their problem is resolved using a simple collective model of household portfolio choice. The model predicts that the risk aversion of the spouse with more bargaining power determines household portfolio allocation. The model also predicts that the share of risky assets in the household portfolio increases with wealth. Empirical support for the results is found using data from the Health and Retirement Study (HRS).

1 Introduction

Households make financial decisions along two main dimensions. They decide how to allocate their income between consumption and savings and how to allocate their savings between risky and risk-free assets. The literature often

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models such decisions using a unitary framework, which treats the household as a single decision-making unit with one utility function and pooled income. A limitation of this approach is that it cannot analyze the influence of individual household members with different preferences on household financial decisions. Papers that do allow household members to have separate preferences have shown that this is an important consideration. For example, Browning (2000) and Mazzocco (2004) find that the allocation of resources within the household affects the consumption-savings decision when spouses differ in their preferences. Empirical estimates show that a majority of spouses do indeed differ in risk preferences (Barsky, Juster, Kimball, and Shapiro, 1997; Kimball, Sahm, and Shapiro, 2008).

This paper focuses on the household's decision to allocate its savings between risky and risk-free assets (hereafter household portfolio choice or allocation). As economic changes place greater responsibility on households to manage their own portfolios, it has become increasingly important for economists and policy makers to understand how households make this decision.

The literature on household portfolio choice is vast. The benchmark model, which treats the household as a single agent with constant relative risk aversion, predicts that household portfolio choice is independent of wealth. Yet, empirical evidence suggests that the share of the household portfolio allocated to risky assets increases with wealth (Bertaut and Starr-McCluer, 2002) and that the risk preferences of individual members are a significant determinant of household portfolio choice (Charles and Hurst, 2003; Barsky, Juster, Kimball, and Shapiro, 1997; Kimball, Sahm, and Shapiro, 2008). This paper provides a model of household portfolio choice that is consistent with this evidence. The model illustrates how intra-household differences in risk aversion and bargaining power interact with wealth to determine household portfolio choice. The model predicts that the risk aversion of the spouse with more bargaining power determines household portfolio allocation. The model also predicts that the share of risky assets in the household portfolio increases with household wealth.

The predictions of the model are tested using data from the Health and Retirement Study (HRS). The HRS is a longitudinal study that has surveyed older Americans every other year since 1992.[1] The HRS includes detailed information on household portfolios and a series of questions that can be used to infer respondents' risk aversion.

Preliminary empirical evidence suggests that the predictions of the model are consistent with the data.

2 Literature Review

The basic premise of this study is that marriage adds an additional layer of complexity to household portfolio choice. In particular, household portfolio decisions may be the outcome of bargaining because spouses may differ in

[1]The HRS is sponsored by the National Institute of Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan.

risk aversion. Previous research supports the assumption that spouses differ in risk aversion. For example, recent theoretical research finds that matching among couples is negatively assortative on risk aversion (Legros and Newman, 2007; Chiappori and Reny, 2006). Empirical evidence supports the assumption as well. Respondents to the HRS were asked a series of questions about choosing between two jobs: one that paid their current income with certainty and the other that had a 50-50 chance of doubling their income or reducing it by a certain fraction. Based on their answers, respondents could be grouped into four risk tolerance categories in the 1992 HRS. Mazzocco (2004) finds that around 50% of respondents fall into a different risk tolerance category from their spouses.

Most previous research on bargaining power and household financial decisions has focused on the consumption-savings choice (Browning, 2000; Lundberg, Startz, and Stillman, 2003). The problem arises because wives, who are on average younger and expected to live longer than their husbands, prefer to save more than their husbands. Browning (2000) uses a noncooperative bargaining model to show that the share of savings in the household portfolio depends on the distribution of income between spouses. Lundberg, Startz, and Stillman (2003) provide empirical support for this argument, showing that household consumption falls after the husband retires (and presumably loses bargaining power).

Two studies that utilize the HRS to study bargaining power are Elder and Rudolph (2003) and Friedberg and Webb (2006). Elder and Rudolph

(2003) focus on the *sources* of bargaining power and find that decisions are more likely to be made by the household member with more financial knowledge, more education, and a higher wage, irrespective of gender. They do not explore how the distribution of bargaining power affects financial outcomes. Friedberg and Webb (2006), in addition to examining the sources of bargaining power, investigate the consequences of bargaining power on household portfolio choice. They find that households tend to invest more heavily in stocks as the husband's bargaining power increases.

Finally, largely absent in the literature is a link between household bargaining theory and empirical models of household portfolio choice. This study attempts to fill that gap.

3 Theoretical Framework

The theoretical framework is constructed under the assumption that household members cooperate and make efficient decisions. The economy consists of households with two agents, a and b, who live for two periods. In the first period, each member of the household is endowed with wealth w_0^i, $i = a, b$. The household can save using a risk-free asset, m, that earns a certain return, r^m, and a risky asset, s, that earns a stochastic return, $\tilde{r}^s(\theta)$, where θ denotes the state of nature. Agents derive utility from consuming out of wealth a public good in periods 0 and 1, c_0 and $\tilde{c}_1(\theta)$. The utility function of each agent, u^i, is increasing, concave, and twice continuously differentiable.

Since the solution to the household problem is efficient, it can then be obtained as the solution to the following Pareto problem. Given $w_0 = w_0^a + w_0^b$, $\tilde{r}^s$, and r^m, the household chooses consumption, c_0 and $\tilde{c}_1$, savings in the risk-free asset, m_0, and savings in the risky asset, s_0, to solve

$$\max_{c_0,\tilde{c}_1,m_0,s_0} \lambda \left[u^a(c_0) + \beta^a E u^a(\tilde{c}_1)\right] + (1-\lambda)\left[u^b(c_0) + \beta^b E u^b(\tilde{c}_1)\right]$$

subject to

$$\begin{aligned} c_0 + m_0 + s_0 &\leq w_0 \\ \tilde{c}_1 &\leq (1+\tilde{r}_1^s)s_0 + (1+r^m)m_0 \ \forall\theta. \end{aligned}$$

Here λ denotes the Pareto weight or relative bargaining power of spouse a and β^i the discount factor for each spouse.

Let $x_0 = m_0 + s_0$ denote total household savings and let $\rho = \frac{s_0}{x_0}$ be the share of household savings invested in the risky asset. We can rewrite the above problem as

$$\begin{aligned} \max_{x_0,\rho} \lambda &\left[u^a(w_0 - x_0) + \beta^a E u^a\left((1+\tilde{r}_1^s)\rho x_0 + (1+r^m)(1-\rho)x_0\right)\right] \\ &+ (1-\lambda)\left[u^b(w_0 - x_0) + \beta^b E u^b\left((1+\tilde{r}_1^s)\rho x_0 + (1+r^m)(1-\rho)x_0\right)\right]. \end{aligned}$$

Now assume that each agent has a constant relative risk aversion (CRRA) utility function of the form[2]

$$u^a(c_t) = \frac{c_t^{1-\gamma^a} - 1}{1-\gamma^a} \text{ and } u^b(c_t) = \frac{c_t^{1-\gamma^b} - 1}{\delta(1-\gamma^b)}.$$

The optimal choice of savings and portfolio allocation, $x_0^\star$ and $\rho^\star$, are the solution to the following first order conditions:

$$\frac{\lambda\delta\beta^a x_0^{\star\gamma^b-\gamma^a}}{\beta^b(1-\lambda)}\left\{-\frac{(w_0-x_0^\star)^{-\gamma^a}}{\beta^a x_0^{\star-\gamma^a}} + E\left[(1+\tilde{r}_1^s)\rho^\star + (1+r^m)(1-\rho^\star)\right]^{1-\gamma^a}\right\} + \left\{-\frac{(w_0-x_0^\star)^{-\gamma^b}}{\beta^b x_0^{\star-\gamma^b}} + E\left[(1+\tilde{r}_1^s)\rho^\star + (1+r^m)(1-\rho^\star)\right]^{1-\gamma^b}\right\} = 0 \quad (1)$$

$$\frac{\lambda\delta\beta^a x_0^{\star\gamma^b-\gamma^a}}{\beta^b(1-\lambda)} E\left\{\left[(1+\tilde{r}_1^s)\rho^\star + (1+r^m)(1-\rho^\star)\right]^{-\gamma^a}(\tilde{r}^s - r^m)\right\} + E\left\{\left[(1+\tilde{r}_1^s)\rho^\star + (1+r^m)(1-\rho^\star)\right]^{-\gamma^b}(\tilde{r}^s - r^m)\right\} = 0. \quad (2)$$

Note that if $\delta = 1$ and individual members of the household have equal Pareto weights, identical discount factors, β, and identical coefficients of relative risk aversion, γ, then (2) reduces to the following:

$$E\left\{\left[(1+\tilde{r}_1^s)\rho^\star + (1+r^m)(1-\rho^\star)\right]^{-\gamma}(\tilde{r}^s - r^m)\right\} = 0. \quad (3)$$

[2]The parameter δ is required for accurate numerical simulation. Assume that $\gamma^a < \gamma^b$. There is a threshold level of household wealth, $\bar{w}$, above which "household risk aversion" is closer to γ^a and below which it is closer to γ^b. The threshold can be set at an arbitrary value by changing the value of δ. The details are described later.

Equation 3 represents the classic Merton-Samuelson result that the household's choice of ρ is independent of its wealth.[3]

Before turning to the numerical solution to the problem, insights about household portfolio choice can be gained by deriving the expression for household risk aversion. Define the instantaneous utility function of the representative agent as:[4]

$$\begin{aligned} V(w) &= \max_c \lambda \frac{c^{1-\gamma^a}}{1-\gamma^a} + (1-\lambda)\frac{c^{1-\gamma^b}}{\delta(1-\gamma^b)} \\ &\quad \text{subject to} \\ &\quad c \leq w. \end{aligned}$$

Household relative risk aversion is thus given by

$$\gamma^{hh} \equiv -w\frac{V''(w)}{V'(w)} = \frac{\lambda\delta\gamma^a w^{-\gamma^a} + (1-\lambda)\gamma^b w^{-\gamma^b}}{\lambda\delta w^{-\gamma^a} + (1-\lambda)w^{-\gamma^b}}$$

The main result can now be proved with the help of two lemmas.

Lemma 1. *a) As the relative bargaining power of the more(less) risk-averse spouse increases, household risk aversion increases(decreases).*

b) An increase in wealth, w, reduces household relative risk aversion.

Lemma 2. *As household risk aversion increases (decreases), the solution to the household's problem approaches the solution preferred by the more(less)*

[3]Merton (1969); Samuelson (1969); also see Jagannathan and Kocherlakota (1996)

[4]This is common in the literature on heterogeneous risk preferences. See, for example, Dumas (1989) and Mazzocco (2003)

risk-averse spouse.

Proposition 1. *As the relative bargaining power of a spouse increases, the solution to the household's problem approaches the solution most preferred by that spouse.*

Proof. In the Appendix □

Finally, observe that if spouse i can dictate his or her preferences (i.e., if $\lambda = 0$ or 1), the optimal share of the risky asset in the household portfolio is the solution to

$$E\left\{\left[(1+\tilde{r}_1^s)\rho^\star + (1+r^m)(1-\rho^\star)\right]^{-\gamma^i}(\tilde{r}^s - r^m)\right\} = 0. \tag{4}$$

where $i = a$ if $\lambda = 1$ and $i = b$ if $\lambda = 0$. We know from the numerical solution to Equation (4) that as an individual's risk aversion decreases, they prefer to hold a greater share of their portfolio in the risky asset. Proposition 1 thus implies that a greater share of the household's portfolio will be invested in the risky asset as the bargaining power of the less risk averse spouse increases. This is shown in the numerical simulations below along with other properties of the model.

3.1 Numerical Simulation

Since the theoretical model cannot be solved analytically, we describe the properties of the model using numerical simulations. In particular, we are interested in how risk aversion, bargaining power, and wealth interact to determine optimal portfolio allocation, $\rho^\star$. To describe these relationships, we numerically solve Equations (1) and (2) to calculate $\rho^\star$ for various values of risk aversion, bargaining power, and wealth.

We assume throughout that the return on bonds, r^m, is 1 percent and the return on risky assets, r_1^s, is either 27.03 percent, 13 percent, or -15.25 percent with equal probability.[5] Numerically realistic simulations also require choosing an appropriate value for δ. As mentioned earlier, given a threshold level of household wealth, $\bar{w}$, δ can be chosen such that household risk tolerance lies exactly between γ^a and γ^b at that level of wealth. The value of δ for which this holds is $\delta = \frac{1-\lambda}{\lambda}\bar{w}^{\gamma^a-\gamma^b}$.[6] To focus on gender differences in risk preferences, we abstract from gender differences in time preferences for the moment and assume that $\beta^a = \beta^b = 0.95$. Finally, we let $\gamma^a = 4.8$ and $\gamma^b = 8.2$.[7]

3.1.1 Bargaining Power

To demonstrate the effect of bargaining power, we hold wealth constant and show how the portfolio allocation changes with relative bargaining power.

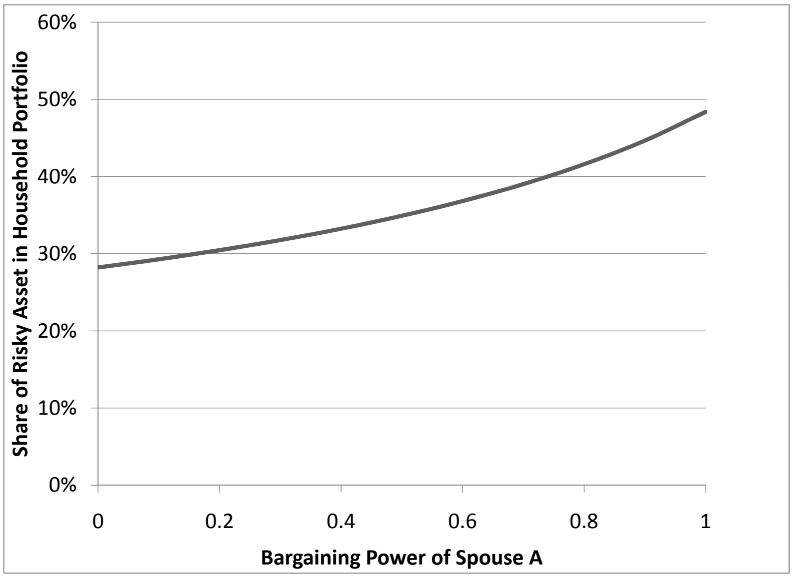
[5]This yields a mean return of 8.26 percent with a standard deviation of 17.58 percent, which corresponds to the S&P 500 for 1871-2004. The return data is taken from `http://www.econ.yale.edu/~shiller/data.htm`.

[6]This is obtained by solving $\gamma^{hh} = \frac{\gamma^a+\gamma^b}{2}$. Alternately, δ can be chosen so that the share of the household portfolio allocated to the risky asset lies exactly halfway between the most preferred allocations of spouse a and b.

[7]These are the values estimated for risk category I and III in the HRS; see Barsky, Juster, Kimball, and Shapiro (1997).

Let $w_0 = \$141,200$, which represents the mean financial assets of married couples in the 2000 HRS.[8] Let λ, which is spouse a's relative bargaining power within the household, vary from 0 to 1. Figure 1 shows the result. First, note that if the relative bargaining power of spouse a equalled 1, then the optimal portfolio allocation to the risky asset would be 48.4 percent. On the other hand, if the relative bargaining power of spouse b was 1, the optimal allocation would be 28.2 percent. The allocation lies somewhere between these two values depending on the distribution of bargaining power within the household.

Figure 1: Effect of relative bargaining power on portfolio allocation

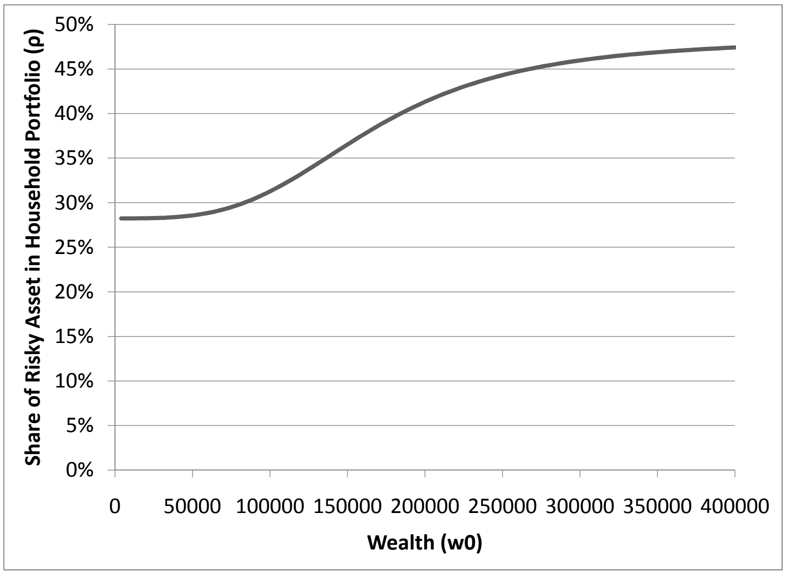


[8] Assets in Individual Retirement Accounts (IRAs) are excluded here and in the analysis because the HRS did not report what fraction of these were invested in risky assets.

3.1.2 Wealth

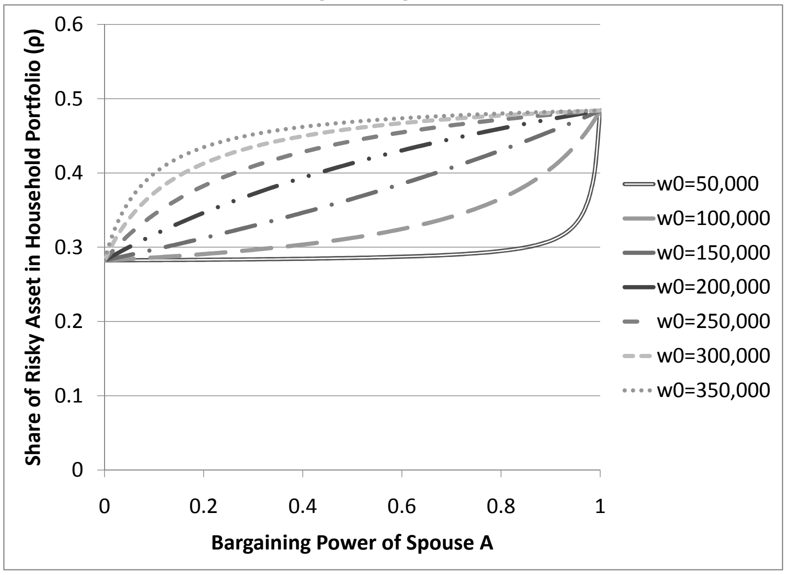
To demonstrate the effect of wealth, assume that the relative bargaining power of both spouses is equal, that is, $\lambda = 0.5$. Let w_0, wealth in period 1, vary from \$1,000 to \$400,000. Figure 2 shows that the share of the household portfolio allocated to the risky asset increases with wealth. When household wealth is low, the allocation is closer to what the more risk averse spouse prefers and when household wealth is high, the allocation is closer to what the less risk averse spouse prefers.

Figure 2: Effect of Wealth on Portfolio Allocation



Finally, in Figure 3, both bargaining power and wealth are allowed to vary. Each line represents a different level of wealth. The figure shows that bargaining power matters most in the middle of the wealth distribution. For low levels of wealth, the portfolio allocation remains close to the more risk

Figure 3: Interaction of Bargaining Power and Wealth



averse spouse's preferred choice while for high levels of wealth it remains close to the less risk averse spouse's preferred choice.

The theoretical model and simulations provide a number of empirically testable predictions. The next section describes the data used to test these predictions.

4 Data

The data comes from the 2000 wave of the HRS. The sample was restricted to married (or partnered) couples with both spouses in the data set, which yielded 6,279 married couples. Couples missing information about their years of education were dropped, after which 6,239 couples remained. A further 602 observations for whom financial wealth was zero were dropped. Finally, those for whom risk aversion data was missing were dropped, yielding a sample of 2,600 couples.

The risk tolerance data comes from Kimball, Sahm, and Shapiro (2008), who constructed a cardinal measure of risk aversion using responses to a series of questions in the HRS about choosing between two jobs: one that paid the respondent their current income with certainty and the other that had a 50-50 chance of doubling their income or reducing it by a certain fraction. [9]

Our variable of interest is the share of risky assets in household financial wealth. We define household financial wealth as the sum of the net value of assets in: 1) stocks, stock mutual funds, and investment trusts, 2) checking, savings, and money market accounts, 3) certificates of deposit (CDs), savings bonds, and Treasury bills, 4) bonds and bond funds and 5) other savings. The first category, hereafter referred to as "stocks," defines risky assets.

The characteristics of the sample are described in Table 1. Mean household financial wealth is $141,200. Over 42% of households hold some part of this wealth in stocks. The average share of stocks is nearly 25%. The data supports the premise of the paper that spouses differ in risk aversion; the table shows that this is true of nearly 80% of couples in the sample. We use years of education as our measure of bargaining power. The table shows that

[9] The data was downloaded from `http://www-personal.umich.edu/~shapiro/data/risk_preference/`.

over 70% of spouses differ in educational attainment and that husbands are slightly more likely to be more educated than wives. The characteristics of individual spouses are described in Table 2

Table 1: Descriptive Statistics for Couples (2000 HRS, N=2,600)

Variable	Percentage/Mean
Financial Profile	
Financial wealth ($1000)	141.2
Household income ($1000)	70.8
Own risky assets (%)	42.4
Value of risky assets ($1000)	79.8
Share of risky assets (%)	24.6
Risk aversion	
Ratio of wife's to husband's risk aversion	1.1
Husband is less risk averse (%)	40.5
Spouses are equally risk averse(%)	21.7
Wife is less risk averse (%)	37.8
Bargaining power	
Ratio of husband's to wife's education	1.0
Husband has more education (%)	38.4
Spouses have equal education (%)	29.7
Wife has more education (%)	31.9

Table 2: Descriptive Statistics for Spouses (2000 HRS, N=2,600)

Characteristics	Husband	Wife
Age	64.5	60.8
Education	12.7	12.6
Years worked	42.7	26.8
Earnings ($1000)	18.0	10.5
White (%)	88.3	88.8
Retired (%)	59.9	40.6

Table 3 shows the relationship between portfolio allocation and wealth quintiles. The data supports the predictions of the model that the share of risky assets in the household portfolio increases with wealth.

Table 3: Shares of Risky Assets by Financial Wealth Quintiles (2000 HRS, N=2,600)

Financial Wealth Quintile	Share of Risky Asset (%)
1	1.9
2	7.7
3	23.1
4	35.6
5	55.8

5 Empirical Evidence

To test the predictions of the theoretical model, we define a variable

$$z_i = \frac{\lambda}{1-\lambda}\frac{\gamma_a}{\gamma_b}$$

that is the product of relative bargaining power and relative risk aversion. The variable z increases with the relative bargaining power of spouse a and with his or her risk aversion. We hypothesize, controlling for wealth and levels of risk aversion in the household, that ρ_i as a function of z_i will have an inverted-U shape. The argument goes as follows. When z_i is small, it means that spouse b is more risk averse and has more bargaining power relative to spouse a. Thus the share of risky assets in the household portfolio, ρ_i, will be small. When z_i is large, it means that it means that spouse a is more risk averse and has more bargaining power relative to spouse b. Again, ρ_i will be small. The value of z_i will fall between these two extremes when spouse a has relatively more bargaining power and is less risk averse (λ large and γ_a small) or when spouse b has relatively more bargaining power and is less risk averse ($1 - \lambda$ large and γ_b small). In either case, the share of risky assets in the household portfolio will be large.

We test this hypothesis by running the following regression to control for levels of household wealth and risk aversion

$$\rho_i = \beta_0 + \beta_1 \gamma_i^a + \beta_2 \gamma_i^b + \beta_3 w_i + \epsilon_i \tag{5}$$

We then regress the residual on z_i using non-parametric techniques to see if the hypothesized functional form is observed in the data.

$$\epsilon_i = f(z_i)$$

We use years of education as our measure of bargaining power of each spouse. We designate the husband to be spouse a and the wife to be spouse b.

The results of the OLS regression in Equation 5 are reported in Table 5. The share of risky assets (stocks) in the household portfolio decreases with

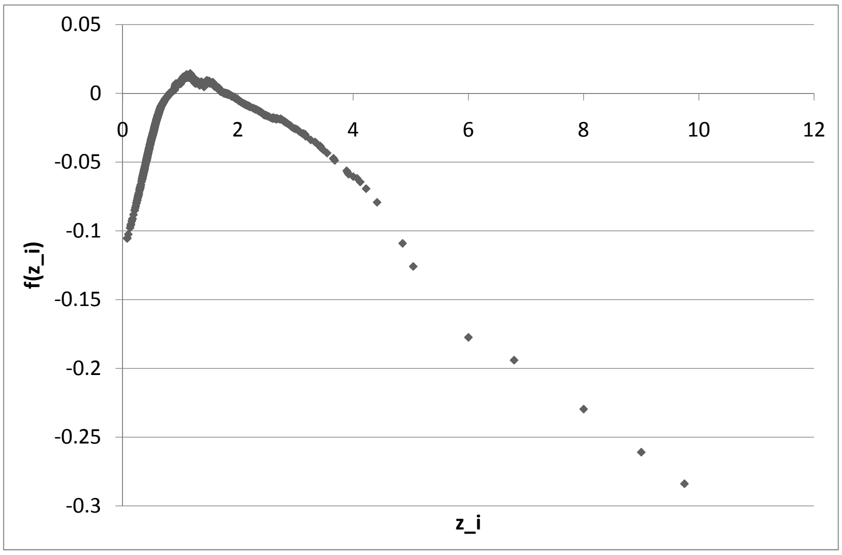
Table 4: OLS for Share of Risky Asset in Household Portfolio (2000 HRS)

Variable	Coefficient	Standard Error
Risk aversion of husband	-0.0031	(0.0028)
Risk aversion of wife	-0.0062	(0.0028)**
Total financial wealth ($10,000)	0.0027	(0.0002)***
Constant	0.2851	(0.0317)***

the risk aversion of both spouses and increases with wealth.

Next, the residuals are regressed on the variable z_i. Figure 4 plots the smoothed values of the residual as a function of z_i. As hypothesized, the function has an inverted-U shape.

Figure 4: Effect of relative bargaining power and risk aversion on portfolio allocation



5.1 Other Factors

Finally, we look beyond the predictions of the theoretical model and consider the effect of factors outside the model like gender and education on portfolio allocation. The estimation results are reported in Table 5. Note that, following Kimball, Sahm, and Shapiro (2008), we use risk tolerance, the reciprocal of risk aversion for the estimation. Ordinary least squares p-values based are based on robust standard errors. The estimates in columns (2) and (3) are exactly identified generalized method of moment (gmm) estimates proposed by Kimball, Sahm, and Shapiro (2008). The p-values are based on bootstrap standard errors because the risk tolerance variable is a generated regressor.

Table 5: OLS and GMM for Share of Risky Asset in Household Portfolio

	(1) ols	(2) gmm	(3) gmm
Wife's risk tolerance	-0.219794	0.000148	-0.001207
	(0.026)	(0.029)	(0.000)
Wealth ($100,000)	049041	0.049543	0.061610
	(0.000)	(0.000)	(0.000)
Wealth squared	-0.000530	-5.34e-08	-6.77e-08
	(0.000)	(0.262)	(0.234)
Ratio of husband's to wife's education	-0.124311	-0.0946	0.114603
	(0.000)	(0.000)	(0.000)
Husband's education	0.022560	0.019703	
	(0.000)	(0.000)	
Education ratio x wife's risk tolerance	0.353003	0.163986	0.242011
	(0.006)	(0.024)	(0.030)
N	2600	2600	2600

t-test p-values in parentheses

The gmm estimate in column (2) show that a $20,000 increase in financial wealth causes a 1% increase in the share of risky assets. There is a strong partial effect from the education of the husband. Moving from high school education to a college education causes a 7.7% increase in the share of risky assets. Overall, the empirical results indicate a first order effect of increasing exposure to risky assets as the husband becomes more educated, and household wealth increases. There is a second order effect of further increase in exposure to risky assets as the risk tolerance of the wife increases.

Comparing the estimates in column (2) and (3), we see that the coefficient on wealth, the square of wealth and the interaction term are consistent if husband's education is included or excluded. The coefficient on the education ratio changes sign from negative to positive when husband's eduction is dropped. This suggests that investment in risky assets increases with the education of the husband but the effect is weakened the larger the education difference between the husband and the wife.

The positive coefficients on the interaction term is consistent across specifications and implies that as the husband's relative eduction increases and the wife's risk tolerance increases more wealth is invested in risky assets.

6 Conclusion

This paper builds upon previous research by constructing a basic theoretical framework to describe household portfolio choice for married couples. The model predicts that household portfolio allocation is determined by the risk preference of the spouse with more bargaining power. It also predicts that the share of risky assets in the household portfolio increases with wealth. Empirical evidence from the 2000 HRS supports these predictions.

Policymakers can use the findings to evaluate the impact of policies that shift investment responsibilities to individuals, especially married couples.

As this study has shown, bargaining power and individual characteristics of couples can significantly affect household portfolio decisions.

For the purposes of this paper, we assumed a cooperative bargaining model in which the Pareto optimal solution for the couple is always attained. It might be interesting to consider a non-cooperative framework. It is also important to note that we only used data from the 2000 HRS. However, the HRS is a longitudinal data set that is rich in financial and demographic information for both husbands and wives. It would be of interest to look at the impact that a change in bargaining power (say as a result of retirement) has on household portfolio allocation. Finally, it is important to acknowledge that the HRS collects data from a representative sample of older Americans. Thus, it may not be possible to generalize our findings to the U.S. population as a whole. While the HRS has detailed information on household decision-making and household portfolio composition, it may be worth analyzing other data that is representative of the U.S. population as a whole. Research is currently underway to examine all these issues.

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A Proofs

A.1 Proof of Lemma 1

Proof. a) Assume without loss of generality that spouse a is less risk averse than spouse b, i.e., $\gamma^a < \gamma^b$. Then

$$\frac{\partial \gamma^{hh}}{\partial \lambda} = \frac{\delta w^{-\gamma^a - \gamma^b}(\gamma^a - \gamma^b)}{(\lambda \delta w^{-\gamma^a} + (1-\lambda) w^{-\gamma^b})^2} < 0$$

Thus an increase in λ, the relative bargaining power of the less risk averse spouse, leads to a decrease in household risk aversion. A decrease in λ, i.e., an increase in $(1-\lambda)$, the relative bargaining power of the more risk averse spouse, leads to an increase in household risk aversion.

b) The derivative of household risk aversion, γ^{hh}, with respect to wealth, w, is given by

$$\frac{\partial \gamma^{hh}}{\partial w} = \frac{-\lambda(1-\lambda)\delta(\gamma^a - \gamma^b)^2 w^{-(\gamma^a + \gamma^b + 1)}}{\left(\lambda \delta w^{-\gamma^a} + (1-\lambda) w^{-\gamma^b}\right)^2} < 0$$

Thus household relative risk aversion decreases as wealth increases. □

A.2 Proof of Lemma 2

Proof. After algebraic manipulation, we can rewrite the first order conditions for the solution to the household's problem as

$$ZX(a) + X(b) = 0$$

$$ZY(a) + Y(b) = 0.$$

where

$$\begin{aligned}
Z &= \frac{\beta^a}{\beta^b}\frac{\gamma^{hh} - \gamma^b}{\gamma^a - \gamma^{hh}} \\
X(i) &= \left\{ -\frac{(w_0 - x_0^\star)^{-\gamma^i}}{\beta^i x_0^{\star - \gamma^i}} + E\left[(1+\tilde{r}_1^s)\rho^\star + (1+r^m)(1-\rho^\star)\right]^{1-\gamma_i} \right\}, i = a, b \\
Y(i) &= E\left\{ \left[(1+\tilde{r}_1^s)\rho^\star + (1+r^m)(1-\rho^\star)\right]^{-\gamma^i} (\tilde{r}^s - r^m) \right\}, i = a, b
\end{aligned}$$

Spouse a's most preferred solution is chosen when $\lambda = 1$. If $\lambda = 1$, the first order conditions for the solution to the household's problem are $X(a) = 0$ and $Y(a) = 0$. Spouse b's most preferred solution is chosen when $\lambda = 0$. If $\lambda = 0$, the first order conditions for the solution to the household's problem are $X(b) = 0$ and $Y(b) = 0$.

Suppose $\gamma^a < \gamma^b$. Then

$$\frac{\partial Z}{\partial \gamma^{hh}} = \frac{\gamma^a - \gamma^b}{(\gamma^a - \gamma^{hh})^2} < 0$$

Thus as γ^{hh} increases, Z decreases, and the solution to the household problem gets closer to the preferred solution of spouse b, the more risk averse spouse.

Now suppose $\gamma^a > \gamma^b$. Then

$$\frac{\partial Z}{\partial \gamma^{hh}} = \frac{\gamma^b - \gamma^a}{(\gamma^a - \gamma^{hh})^2} > 0$$

Thus as γ^{hh} increases, Z decreases, and the solution to the household problem gets closer to the preferred solution of spouse a, the more risk averse spouse.

□

A.3 Proof of Proposition 1

Proof. The proof follows directly from Lemma 1a and Lemma 2. □