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Gender Differences in Relative Risk Aversion with Data from the U.S. Federal Reserve Board's Survey of Consumer Finances

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Abstract

Earlier research has presented a pattern of decreasing financial relative risk aversion to all types of households, yet greater financial relative risk aversion by women versus men. This current paper brings into light new important evidence about the relative risk aversion of female investors over time working with data from the U.S. Federal Reserve Board's Survey of Consumer Finances (SCF) for 1989 and 2013 with the latter year reflecting the after-effect of the 2007-2008 financial crisis period. Employing Repeated-Imputation Inference (RII) techniques, we replicate existing results from the 1989 SCF and seek new results from the 2013 SCF. The 1989 results are in large corroborated, while the new results from 2013 indicate a reverse path of increasing (for single-headed households) and constant (for married couples) relative risk aversion, where gender differences persist. Based on our 2013 results, we offer policy and practice improvements.

Key words: relative risk aversion; individual investors; gender differences; survey of consumer finances; replication; RII techniques; policymaking

JEL classifications: J16; D81; G11

1. Introduction

Individuals and households are called on a daily basis to take on a plethora of financial decisions related to consumption, savings, and investments. Such financial decision making is plagued by the existence of risk, "a complex, and multidimensional concept with no single measure" as Fredman (1996) comments, that is approached throughout this paper as the variance of returns. When faced with financial risk, individuals exhibit different levels of risk aversion - a renowned characteristic of

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human behavior manifested under uncertainty and "synonymous with the unwillingness to incur risk" as Palsson (1996) notes.

In terms of investment decisions, researchers have linked investors' risk aversion or risk tolerance, which is the inverse of risk aversion as Barsky et al. (1997) define it, to several individual characteristics like their age, their time horizon, their liquidity needs, their portfolio size, their income, their investment knowledge, as well as their attitude toward price fluctuations. Of course, every investor is a unique case, and hence the list of defining factors of risk tolerance or risk aversion can be a long one. In this spirit, Sung and Hanna (1996) call for the acknowledgment of both subjective and objective factors related to risk tolerance.

With more than twenty years of empirical research voicing and articulating concerns about women's inadequate risk taking in their investment strategies, we are inquisitive in the current paper about the risk aversion of today's women investors. More specifically, our interest lies in determining whether gender differences in financial risk aversion have been increasing or decreasing or have stayed the same over time. To that effect, we use as our canvas one of the seminal works in the field examining differences in risk aversion by gender - that of Jianakoplos and Bernasek (1998) (JB from now on) - and attempt to inquire what has happened over time.

With the help of data from the U.S. Federal Reserve Board's Survey of Consumer Finances (SCF) for 1989, JB examine household holdings on risky assets and test for gender differences by particularly emphasizing any differences in risky asset holdings between single women and single men. In terms of our paper's work, we do the following things. First, we replicate the JB work for the SCF of 1989. Subsequently, we test the JB model on the SCF of 2013. Furthermore, we pool together the two independent cross-sections from 1989 and 2013, and by adding time interactions we then study the model over time, repeating the tests of gender differences.

With regards to our results and our own contribution to the literature, we report that for the replication exercise we corroborate the original JB results, but when we run the JB model on the 2013 SCF, the new results bring to the surface a reverse trend in the pattern of financial decision making under uncertainty for all types of households. In particular, we observe a trend of either increasing relative risk aversion (for both single women and single men) or constant relative risk aversion for married couples, which is in contradiction to a pattern of decreasing relative risk aversion for all household types documented in the 1989 results. We yet again detect gender differences, and our 2013 results are also corroborated by pooling the data for 1989 and 2013 and adding a time interaction.

We believe that our 2013 results reflect the after-effect of the 2007-2008 financial crisis upon the behavior of individual investors. In particular, we consider it as plausible to presume that the 2007-2008 financial crisis may have made people more aware of their vulnerability from exposure to risk and more aware of the need to protect their financial asset holdings against the possibility of a large negative event. In any case, the new paths of increasing and constant relative risk aversion along with the persistence of gender differences are noteworthy and add value to existing policy recommendations. In particular, regarding the detected gender differences, the policy

issue of women's better financial awarement aimed at bolder risk taking in their investment strategies for the sake of adequate retirement wealth accumulation arises anew. Moreover, the generalized increase in relative risk aversion calls for further investigation of the motivation of all types of households in terms of their wealth allocation.

Our research also aspires to add value to the already published works of International Journal of Business and Economics (IJBE), a journal with a long tradition of presenting studies in the fields of financial risk management and modern economy. With regards to the concept of risk aversion, IJBE's readers might already be aware of the journal's existing high caliber theoretical approaches, such as the ones encountered in Jellal and Wolff (2002) and Lu et al. (2011). From our side, we wish to add a more practical approach on the measurement of risk aversion, keeping our effort close to deciphering the profile of modern individual investors monitoring financial decisions as well as risk attitudes based on characteristics such as marital status or gender. The latter pursuit could be considered as being in the spirit of other works encountered in IJBE such as that of Li and Peng (2011) and Hung and Huang (2013), which readers may easily seek and explore. Lastly, our study adds to IJBE's existing works of Tobit implementations in financial risk management, such as that done by Lantara (2012).

The rest of our paper runs as follows. Section 2 presents the econometric model employed herein covering both theoretical underpinnings and the motivation of the included variables, along with data information and econometric techniques. Section 3 proceeds with the empirical results and our findings. Section 4 suggests practices with regards to the policymaking process. Section 5 concludes with the outcomes, highlighting some possible caveats and sketching out future directions.

2. The Model

Our paper follows the econometric model suggested by Jianakoplos and Bernasek (1998), which in turn is based on the theoretical framework developed by Friend and Blume (1975), and their suggested measure of relative risk aversion. Below, for the sake of a more accurate presentation, we first briefly present some elements from the expected utility theory along with the Friend and Blume framework, and afterwards we move to the presentation of the Jianakoplos and Bernasek model and to the motivation of the variables included in their specification. The pivotal role in the presentation of the model is the database employed in the analysis - namely, the Survey of Consumer Finances (SCF). Thus, we subsequently refer to the survey and certain methodological concerns springing from the data. We close the presentation of the model with the description of the econometric techniques that we will be adopting in our analysis.

2.1 A Theoretical Framework to Measure Risk Aversion

Assuming that utility is a function of wealth (W), risk aversion can be further defined by resorting to two standard measures, or the ones independently developed

by Pratt (1964) and Arrow (1971): the coefficient of absolute risk aversion, $-[U''(W)/U'(W)]$, and the coefficient of relative risk aversion, $-[U''(W)W/U'(W)]$. Following Grossman and Shiller (1981), relative risk aversion can be thought of as a "measure of the concavity of the utility function or the disutility of consumption fluctuations", which may intuitively be translated, following Hanna and Chen (1997) into "the higher the relative risk aversion, the more rapidly marginal utility decreases as consumption or wealth increases".

The expected utility theory, the predominant "normative" model of rational choice under uncertainty (Schoemaker, 1982), predicts that absolute risk aversion decreases with wealth - that is, the wealthier the individual is, the higher the amount he or she is willing to put at risk, or a property known as decreasing absolute risk aversion (DARA). However, any prediction about the response of relative risk aversion to changes in wealth that is either increasing relative risk aversion (IRRA) or decreasing relative risk aversion (DRRA) or constant relative risk aversion (CRRA) has proved more challenging to formulate. One of the earliest and strongly influential empirical works studying the response of relative risk aversion to changes in wealth belongs to Friend and Blume (1975) who develop their own theoretical model of measuring relative risk aversion. More specifically, working on the grounds of the expected utility theory, Friend and Blume suggest a model in which the allocation of an individual's portfolio between risky and risk-free assets, in the absence of taxes, has the following relationship:

$$\alpha_k = \left[\frac{E\left(\gamma_m - \gamma_f\right)}{\sigma_m^2}\right] \times \left(\frac{1}{C_k}\right), \tag{1}$$

where α_k is the proportion of the net worth of investor k placed in the portfolio of risky assets, $E(\gamma_m - \gamma_f)$ is the expected difference between the return on the market portfolio of risky assets (γ_m) and the return on the risk-free asset (γ_f), σ_m^2 is the variance of the return on the market portfolio of risky assets, and the whole expression in the brackets, $[E(\gamma_m - \gamma_f)/\sigma_m^2]$, is defined as the market price of risk. Lastly, C_k is Pratt's measure of relative risk aversion; that is, $C_k = -[U''(W_k) \times W_k / U'(W_k)]$, where W_k is investor k's wealth. In terms of wealth, Friend and Blume (1975) originally refer to investors' liquid net worth, defining it as the net value of both risky and risk-free assets; by liquid, they mean that the assets (both risk-free and risky) can be purchased or sold, at no cost, in any quantity.

Given the estimates of α_k and the market price of risk, i.e. $[E(\gamma_m - \gamma_f)/\sigma_m^2]$, Friend and Blume posit that equation (1) could be used to estimate the coefficient of relative risk aversion. More specifically, assuming that all investors agree on the value of the market price of risk, "α_k provides an estimate of C_k^{-1} up to a multiplicative positive constant, so that α_k can be used to assess how C_k^{-1} and, thereby, how C_k varies with wealth", Friend and Blume (1975). Furthermore, since the coefficient of relative risk aversion, C_k is a function of wealth, inferences about the effect of changes in wealth on C_k can be made by regressing the proportion of risky assets α_k on wealth (and, more specifically, on the natural logarithm of wealth). The

original Friend and Blume definition of wealth as the net value of both risky and risk-free assets is justified given their assumed indivisibility and transactability of assets, as well as the investment purposes of the assets' acquisition, but it is a narrow approach that excludes two significant sources of investors' wealth: residential housing wealth and human capital wealth. Friend and Blume acknowledge the importance of these two kinds of wealth in the demand for risky assets and enhance their model to account for the non-marketability of human capital.

In the subsequent stream of works measuring financial relative risk aversion, a significant number of researchers employ the Friend and Blume framework. Among others, we refer to the exemplary works of Morin and Suarez (1983), Bellante and Saba (1986), Siegel and Hoban (1982), Riley Jr. and Chow (1992), and Schooley and Worden (1996) and note several extensions of the Friend and Blume framework, where a gamut of individual characteristics of investors affecting financial risk taking are controlled, with the characteristics varying from age and education to marital status and race. The reported empirical evidence regarding relative risk aversion once again depends on nuances of the definitions of wealth with regards to the inclusion or exclusion of housing wealth, as well as the inclusion or exclusion of human capital in the determination of wealth.

2.2 The JB Econometric Model

Jianakoplos and Bernasek (1998, JB) base their work on the Friend and Blume theoretical framework and are in accordance with subsequent researchers' approach that follow the same framework that they expanded, which controls for other economic and demographic variables anticipated to influence the portfolio allocation. Furthermore, they examine household holdings on risky assets and test for gender differences by particularly emphasizing any differences in risky asset holdings between single women and single men with the help of data from the U.S. Federal Reserve Board's Survey of Consumer Finances (SCF) for 1989. Among their findings, they report that as wealth increases, the proportion of wealth held as risky assets is estimated to increase by a smaller amount for single women than for single men, implying higher relative risk aversion for women. In particular, their empirical representation, for any investor k, which we also follow in our paper, has the following form:

$$\begin{aligned} RATIO_k = {} & \beta_0 + \beta_1 \ln WEALTH_k + \beta_2 RACE_k + \beta_3 KIDS_k \\ & + \beta_4 HOMEOWNER_k + \beta_5 HUMAN_k + \sum_{i=1}^{10} \gamma_i AGE_{ik} \\ & + \sum_{j=1}^{5} \delta_j WORK_{jk} + \sum_{m=1}^{5} \lambda_m EDUCATION_{mk} + u_k, \end{aligned} \tag{2}$$

where we note the following:

$RATIO$ is the ratio of risky assets to $WEALTH$ (or α_k from the Friend and Blume theoretical model).

$WEALTH$ is the liquid net worth of the investor, i.e. the sum of the net value of risky

and risk-free assets.

RACE is a dummy variable equal to one if the respondent is black and zero otherwise.

KIDS is the number of people 18 years or younger in the household, also allowing for the presence of grandchildren, younger brothers or sisters, nieces, nephews, as well as other young people who may be dependents in a household.

HOMEOWNER is a dummy variable indicating whether or not the respondent is a homeowner.

HUMAN is the ratio of human capital to *WEALTH*. Human capital is estimated by assuming that wage, salary, and self-employment earnings of the household, for the SCF year of consideration, continue until retirement. In terms of retirement, if the head of household is under 65, then retirement is assumed at age 65. If the head of household is working and aged 66 through 69, then retirement is assumed in four years; if aged 70 through 74, then retirement is assumed in three years; if aged 75 through 79, then retirement is assumed in two years; and if over 79, then retirement is assumed in one year. Earnings are calculated separately for each spouse and are summed for married couples, while the present discounted value of this earnings stream until retirement using a 2% discount rate (a rate closely following the long-run growth rate of real GDP) is used as an estimate of human capital.

AGE is a set of dummy variables indicating into which of ten age categories the household head falls. The constructed age categories are the following: Less than 25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60, 61-65, and Over 65.

WORK is a set of dummy variables indicating five categories of labor force status of the household head. Following the JB classifications, the household head can be categorized as Self-employed, as Employed by Others, as Retired, as Farmer, or finally as Unemployed or Not in the Labor Force.

EDUCATION is a set of dummy variables indicating which of five levels of educational attainment the household head has reached with the levels being related to years of schooling as well as the acquisition of a diploma or a college degree, namely: Grade School or less (6 years or less), Some High School (7 to 12 years), High School Degree, Some College, and College Graduate (more than 16 years).

We close the presentation of the JB model with a reference to the components of wealth. We note that JB adhere to the original definition of wealth by Friend and Blume; namely, excluding residential real estate and human capital. Nevertheless, JB also acknowledge that holdings of residential real estate and human capital influence the allocation of investors' remaining wealth between risky and risk-free assets. Thus, they include measures of these assets as the explanatory variables *HOMEOWNER* and *HUMAN* in the estimating equation. Lastly, in terms of the components of wealth (namely, risky and risk-free assets), a delicate issue arises in the available assets' split, since the boundaries between the two categories are not always sharply defined. Based on the 1989 SCF (the database version used by JB), the JB classifications are given below.

In the 1989 SCF, JB classify risk-free assets as: "dollar balances in checking accounts, savings, and money market accounts, certificates of deposit, U.S. savings bonds, Individual Retirement Accounts (IRAs) balances invested in certificates of

deposit or bank accounts, and the cash value of life insurance less policy loans outstanding" (Jianakoplos and Bernasek, 1998). They also classify risky assets as: "the sum of balances in IRAs not invested in bank deposits, stock holdings less margin loans outstanding, bonds, trust assets, the net value of real estate owned other than residential housing, the net value of business owned, and the net value of other miscellaneous assets (e.g. precious metal, futures contracts, art work) reported by the household" (Jianakoplos and Bernasek, 1998).

For the purposes of the current paper, we retain all the above JB definitions to the best possible extent not only for our replication exercise on the 1989 SCF, but also for our new exercise covering the 2013 SCF. All our computations for the construction of all the components of wealth with regards to both versions of the SCF are available upon request.

2.3 Data & Econometric Techniques

As already mentioned, for the purposes of our paper we rely on the Survey of Consumer Finances (SCF) and its versions for the years 1989 and 2013. We briefly state that SCF is a triennial interview survey of a nationally representative sample of U.S. families, sponsored by the Board of Governors of the Federal Reserve System with the cooperation of the U.S. Department of the Treasury. We further note that by "families", SCF also considers one-person families.

The SCF sample is not an equal-probability design, and thus all statistics reported in our work will be sample weighted. At the same time, of great interest in SCF is the way the survey handles missing or incomplete information. In particular, for the final releases of the SCF public use datasets, missing and incomplete data have been imputed using the multiple imputation technique (Rubin, 2004) as developed for SCF. In essence, this procedure yields five values for each missing value so as to approximate the distribution of the missing data. The imputations are stored as five successive replicates (or "implicates") of each data record, and thus the number of observations in the full public dataset is five times the actual number of respondents. The value of incorporating information from all five datasets of SCF for the sake of valid inferences in empirical analysis has been stressed by several researchers. Indicatively, here we refer to Montalto and Sung (1996), Montalto and Yuh (1998), and Lindamood et al. (2007), and below we explain how we are going to account for the effects of imputation error on the standard errors of the estimates in our own multivariate analyses.

In the econometric model of equation (2), $RATIO$ (the ratio of risky assets to wealth) can only take values between zero and one. To allow for both upper and lower bounds on the dependent variable and also following JB, we are going to use a maximum likelihood tobit regression procedure for the estimations, and despite the non-linear nature of the specification we shall employ the "repeated-imputation inference" (RII) technique to produce the estimates. More specifically, following the analysis by Montalto and Yuh (1998), we conduct the tobit regression analysis on each of the five implicates separately and combine the results obtained independently from the five separate implicates so as to get the RII estimates. In particular, the best

estimate of every non-linear regression coefficient is the average of the results from the five implicates, while following Maddala and Lahiri (1992), a Wald chi-squared statistic is used to test whether each estimated coefficient is significantly different from zero.

Of subsequent interest in our analysis is the way that SCF defines a household unit. More specifically, in SCF a household unit is divided into a primary economic unit (PEU) and everyone else in the household. PEU should be the economically dominant single individual or couple (whether married or living together as partners) and all other persons in the household who are financially interdependent with that economically dominant person or couple. Another important issue is that because financial information is collected at the PEU level, it is not possible to make direct separate estimates of the financial characteristics of the individuals in the households, e.g. compute separately the financial characteristics of the respondent or the respondent's spouse or partner. The only variables collected separately for the respondent and the spouse or partner of the respondent are those concerning employment, pension, and certain demographic characteristics. In most other cases, the format of the SCF questions relating to the ownership of assets or liabilities is generic.

Equally generic is the format of the available questions related to investment decisions in the survey. Thus, we do not really know the gender of the PEU's investment decision maker. Assuming the respondent is also the financial decision maker seems more natural in single-headed households, but things get more complicated in the cases of couples (either married or living together as partners). In particular, we do not really know if the two spouses or partners make joint investment decisions for their assets or if it is one of the two who overbears in financial decision making. If one of the two spouses or partners makes the decision, especially in mixed-sex couples, it becomes even more difficult to determine the gender of the investment decision maker.

Given this extra difficulty to deduce the nature (either joint or individual) of financial decision making in couples and subsequently the gender of the investment decision maker(s), JB's and other researchers' (e.g. Embrey and Fox, 1997) approach is shared here in that the most direct test of gender differences in portfolio allocation is between households headed by never married females and households headed by never married males.

Delving into the data, we note that the 1989 SCF surveyed 3,143 households, while the 2013 SCF surveyed 6,015 households. Below, Table 1 gives the sample frequencies of households by marital status in each of the two surveys. We mention that the marital status options encountered in both surveys are "married", "living with a partner", "separated", "divorced", "widowed", and "never married". Two options encountered only in the 1989 SCF - namely, the ones for "married but spouse in institution (nursing home/jail)" and "married but spouse not current resident of HU", where HU refers to the Household Unit - are denoted as "married" for comparison purposes between the two.

Table 1. Sample Frequencies of Households by Marital Status

Marital Status	1989 SCF		2013 SCF	
Married	2,067	65.77%	3,278	54.50%
Living with a partner	69	2.20%	491	8.16%
Separated	92	2.93%	180	2.99%
Divorced	332	10.56%	762	12.67%
Widowed	313	9.96%	431	7.17%
Never Married	262	8.34%	873	14.51%
Married but spouse in institution (nursing home/jail)	6	0.19%	n/a	n/a
Married but spouse not current resident of HU	2	0.06%	n/a	n/a
Total	3,143		6,015	

From Table 1, we observe for the 1989 SCF that the sample size of the never married subgroup is relatively small. JB react to this same observation by considering single people as not only never married but also widowed and divorced individuals. The concern over the extent to which widowed and divorced individuals could be dealt as singles is a legitimate one; nevertheless, given the considered single nature of the decision maker for these two categories, the assumption is considered a relatively safe one, and we adopt it, too. Although for the 2013 SCF the sample size of the subgroup of never married households is bigger, for the sake of direct comparison between the 1989 behavior and the 2013 behavior, we retain the same consideration of single people as never married, widowed and divorced individuals also in the new exercise for the 2013 SCF.

We now estimate equation (2) jointly for single women and single men, including a dummy variable FEMALE, which equals one for single women and interacts with each explanatory variable. We perform this exercise in order to ascertain which coefficients are statistically different between single women and single men. The coefficients found to be significantly different by gender in this manner are indicated in the results, and the same exercise is also conducted for single women and married couples. In these two joint specifications with the FEMALE dummy variable interacting with each explanatory variable, we also perform Wald tests adjusted so as to examine whether the estimated equations are significantly different; first, between single women and single men, and second, between single women and married couples.

We implement the above process initially for the 1989 SCF and then for the 2013 SCF, treating the two surveys as two independent cross sections. As a supplementary exercise, we examine the SCF surveys of 1989 and 2013 into one pooled cross section, and by adding a time interaction we repeat the process. In particular and with reference to equation (2), in order to reflect the fact that the U.S. population may have different distributions in 1989 and in 2013, we allow the intercept to differ across time by including a year dummy variable, variable $y13$, that is equal to one for the observations coming from the 2013 SCF and to zero for the observations coming from the 1989 SCF (1989 is the base year). We also interact the year dummy variable with $\ln WEALTH$ in the variable $y13 \times \ln WEALTH$ so as to explore whether the effect

of $\ln WEALTH$ has changed over time. More specifically, we transform the econometric model as:

$$\begin{aligned} RATIO_k = {} & \beta_0 + \delta_0 y13_k + \beta_1 \ln WEALTH_k + \delta_1 y13_k \times \ln WEALTH_k \\ & + \beta_2 RACE_k + \beta_3 KIDS_k + \beta_4 HOMEOWNER_k + \beta_5 HUMAN_k \\ & + \sum_{i=1}^{10} \gamma_i AGE_{ik} + \sum_{j=1}^{5} \delta_j WORK_{jk} + \sum_{m=1}^{5} \lambda_m EDUCATION_{mk} + u_k, \end{aligned} \tag{3}$$

In the above model, the intercept for 1989 is β_0, while the intercept for 2013 is $\beta_0 + \delta_0$. The effect of $\ln WEALTH$ for 1989 is β_1, while the effect for 2013 is $\beta_1 + \delta_1$. Since the focus is on relative risk aversion, the effect of the other explanatory variables is assumed to remain constant from 1989 to 2013. This is an admittedly testable assumption, which we investigate properly in the implementation part. Moreover, we note that since wealth is expressed in a logarithmic form, and a dummy variable accounts for time, we do not turn nominal wealth into real wealth, as suggested in Wooldridge (2015). Lastly, considering that the error variance might change over time, we employ heteroscedasticity-robust standard errors and test statistics.

3. Empirical Results

We proceed with the empirical results in two parts. In the first part, we present the results of the replication exercise of the JB work for the 1989 SCF, as well as the results of running the JB model on the 2013 SCF. We note again that in this part we are treating the two datasets as two independent cross sections. In the second part, we present the results of estimating the JB model after pooling the two independent cross sections from 1989 and 2013 and after adding a time interaction.

3.1 Empirical Results I: Replication and New Results Employing RII Techniques

Table 2 lists the results of the Tobit estimations for the replication exercise on the 1989 SCF and the new exercise on the 2013 SCF. For comparison purposes, we also include in the table the original JB results for the 1989 SCF.

In terms of the replication exercise for the 1989 SCF, the most noteworthy points are the following. First, our Wald tests corroborate that the estimated equations are significantly different between single women and single men, as well as between single women and married couples. With regards to the estimated coefficients, the observation of the replicated results indicates that to a great extent the signs and magnitudes of the coefficients are largely replicated for all household types, with most prominent here the replication of the results regarding the coefficient on the natural logarithm of net worth ($\ln WEALTH$). However, from Table 2 our derived standard errors are higher for most estimated coefficients, or something we in large attribute to the use of RII techniques.

Table 2. Weighted Tobit Regression Results with RII Techniques

	Single Women			Single Men			Married Couples		
	JB	EK	EK	JB	EK	EK	JB	EK	EK
	1989	1989	2013	1989	1989	2013	1989	1989	2013
ln*WEALTH*	0.117***	0.118***	-0.087***	0.170*** †	0.184***†	-0.045***†	0.128***	0.133***	-0.004†
	(0.009)	(0.028)	(0.011)	(0.010)	(0.029)	(0.011)	(0.003)	(0.011)	(0.004)
AGE 26-30	0.044	-0.141	-0.038*	-0.137***†	-0.052	-0.036†	0.004†	-0.090	-0.036*
	(0.079)	(0.342)	(0.027)	(0.047)	(0.175)	(0.029)	(0.033)	(0.150)	(0.023)
AGE 31-35	0.127**	0.013	-0.001	-0.342***†	-0.370**	0.022	-0.090***†	-0.174	-0.050**†
	(0.063)	(0.204)	(0.028)	(0.059)	(0.181)	(0.030)	(0.032)	(0.155)	(0.022)
AGE 36-40	0.381***	0.179	0.016	-0.263***†	-0.228†	0.062*	-0.014†	-0.100†	-0.063**†
	(0.066)	(0.223)	(0.025)	(0.049)	(0.163)	(0.037)	(0.032)	(0.151)	(0.024)
AGE 41-45	0.241***	0.163	0.002	-0.252***†	-0.248†	0.032	0.018†	-0.062	-0.050**†
	(0.062)	(0.220)	(0.026)	(0.059)	(0.190)	(0.035)	(0.032)	(0.152)	(0.023)
AGE 46-50	0.325***	0.269	-0.011	-0.295***†	-0.446***†	0.042	-0.055*†	-0.086y	-0.080***†
	(0.066)	(0.217)	(0.031)	(0.078)	(0.180)	(0.030)	(0.034)	(0.154)	(0.023)
AGE 51-55	0.130**	0.017	0.008	-0.350***†	-0.475***†	0.002	-0.059*†	-0.154	-0.019
	(0.064)	(0.221)	(0.029)	(0.074)	(0.177)	(0.037)	(0.033)	(0.146)	(0.023)
AGE 56-60	0.065	-0.020	-0.018	-0.322***†	-0.301	-0.018	-0.078**†	-0.131	-0.045**
	(0.065)	(0.216)	(0.030)	(0.065)	(0.216)	(0.041)	(0.035)	(0.151)	(0.024)
AGE 61-65	0.250***	-0.014	0.035	-0.540***†	-0.594**†	-0.012	0.015†	-0.060	-0.034†
	(0.066)	(0.223)	(0.031)	(0.077)	(0.254)	(0.048)	(0.036)	(0.157)	(0.026)
Over 65	-0.232***	-0.316*	-0.050*	-0.668***†	-0.545**	-0.023	-0.122***	-0.198	-0.049
	(0.061)	(0.208)	(0.033)	(0.069)	(0.252)	(0.048)	(0.035)	(0.156)	(0.029)
EmpByOth	-0.262***	-0.418***	-0.183***	-0.113***	-0.175†	-0.069*†	-0.069***†	-0.171***†	-0.127***†
	(0.044)	(0.118)	(0.033)	(0.043)	(0.125)	(0.041)	(0.013)	(0.040)	(0.014)
Retired	-0.181***	-0.212*	-0.182**	-0.040	-0.209	-0.136***	0.241***†	-0.312***	-0.158***
	(0.049)	(0.150)	(0.037)	(0.057)	(0.196)	(0.054)	(0.019)	(0.065)	(0.024)
Farmer	-0.431***	-0.251*	0.188*	0.120†	-0.020†	0.164***	0.065**†	0.108†	0.070**
	(0.165)	(0.199)	(0.117)	(0.108***)	(0.138)	(0.040)	(0.030)	(0.042)	(0.032)
Unemp/NotLF	-0.395***	-0.342**	-0.113*	-0.222***	-0.152	0.003†	-0.032†	-0.123	-0.031*†
	(0.051)	(0.149)	(0.035)	(0.053)	(0.164)	(0.044)	(0.023)	(0.103)	(0.020)
Some HS	-0.310***	-0.187	-0.030	-0.300***	0.040	-0.095	0.000†	0.039	-0.028
	(0.066)	(0.336)	(0.082)	(0.067)	(0.204)	(0.086)	(0.029)	(0.134)	(0.030)
HS Degree	-0.336***	-0.016	-0.055	-0.274***	0.041	-0.143*	-0.014†	0.023	-0.109***
	(0.064)	(0.326)	(0.081)	(0.067)	(0.220)	(0.082)	(0.029)	(0.133)	(0.027)
Some Col.	-0.254***	0.007	-0.080	0.325***†	-0.039	-0.155**	-0.037†	0.031	-0.152***
	(0.067)	(0.328)	(0.082)	(0.070)	(0.232)	(0.082)	(0.029)	(0.136)	(0.029)
Col. Grad	-0.339***	0.091	-0.091	-0.244***	-0.048	-0.221***	-0.002†	0.025	-0.199***
	(0.067)	(0.328)	(0.082)	(0.068)	(0.221)	(0.082)	(0.029)	(0.134)	(0.028)
RACE	0.154***	0.142*	0.027*	-0.024†	-0.078	0.042*	-0.065***†	-0.130*†	0.028**
	(0.035)	(0.118)	(0.015)	(0.066)	(0.145)	(0.024)	(0.019)	(0.076)	(0.016)
KIDS	-0.030*	-0.007	0.031***	0.034†	0.122	-0.001†	0.013***†	0.022	0.021***†
	(0.016)	(0.047)	(0.006)	(0.027)	(0.110)	(0.022)	(0.004)	(0.019)	(0.004)

Table 2. (Cont'd)

	Single Women			Single Men			Married Couples		
	JB 1989	EK 1989	EK 2013	JB 1989	EK 1989	EK 2013	JB 1989	EK 1989	EK 2013
HOMEOWN	-0.068***	-0.046	-0.066***	0.070**†	0.012	-0.048**	-0.037***†	-0.072	-0.086***
	(0.024)	(0.071)	(0.015)	(0.031)	(0.074)	(0.021)	(0.011)	(0.053)	(0.011)
HUMAN	-0.002***	-0.002	0.0001	-0.000†	0.0002	0.0001	-0.000***†	-0.0004**	0.0001
	(.000)	(0.001)	(0.0001)	(0.000)	(0.001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
constant	-0.244**	-0.507	2.021***	-0.668***†	-1.073	1.569	-0.704***†	-0.746***	1.158***
	(0.121)	(0.473)	(0.141)	(0.126)	(0.338)	(0.151)	(0.054)	(0.229)	(0.056)
Sigma Hat	0.415	0.463	0.217	0.401	0.398	0.225	0.398	0.438	0.242
Observations	384	376	1,251	230	228	813	1,980	1,902	3,762
LeftCensored	123	149	0	65	57	0	450	376	0
RightCensored	2	2	134	6	4	80	17	6	139

Omitted Categories for Dummy Variables: Less than 25 for *AGE*, Self-employed for *WORK*, Grade School or less for *EDUCATION*.
*** Significantly different from zero at the 1% significance level.
** Significantly different from zero at the 5% significance level.
* Significantly different from zero at the 10% significance level.
† Significantly different from the single-female coefficients at the 10% significance level or lower.

In an effort to investigate the quality of our replication with regards to the estimated equations, we present in Table 3 the predicted $RATIO$ of the Tobit model, $\widehat{RATIO}|x$, as computed by the mean values of all three household types. More specifically, employing separately the JB estimated equations and our own estimated equations, we calculate the conditional mean as given by the expression $\Phi(\bar{x}\hat{\beta}/\hat{\sigma})\bar{x}\hat{\beta}+\hat{\sigma}\phi(\bar{x}\hat{\beta}/\hat{\sigma})$ (Greene, 2003), at the mean values of the corresponding samples.

Table 3. Evaluation of $\widehat{RATIO}|x$ at the Means of the Corresponding Samples

Single Women		Single Men		Married Couples	
JB	EK	JB	EK	JB	EK
1989	1989	1989	1989	1989	1989
0.46	0.36	0.85	0.63	0.70	0.56

The results of Table 3 indicate numerical differences in the predicted results of the original and replication models, which we again attribute to the use of RII techniques in our replication exercise, as well as to certain discrepancies springing from our own calculation of wealth. Nevertheless, the qualitative pattern of the result of single women taking fewer financial risks than both single men, and married couples is corroborated in the computational derivations of our replication model.

Repeating from the Friend and Blume original model that the estimated coefficient on $\ln WEALTH$ shows "how C_k^{-1}, i.e. the inverse of the coefficient of relative risk aversion, and thereby C_k, i.e. the coefficient of relative risk aversion varies with wealth", we note that a positive coefficient indicates decreasing relative

risk aversion, while a negative coefficient indicates increasing relative risk aversion. Thus, from the results we replicate the 1989 SCF JB result that all types of households manifest decreasing relative risk aversion. Moreover, when it comes to the comparison between single women and single men, we replicate that relative risk aversion does not decrease as much for single women as for single men, corroborating the JB result that single women are relatively more risk averse than single men. From Table 2, we also replicate that there is no significant difference in relative risk aversion exhibited by married couples versus single females. It is important to note that in our approach, and with reference to the original Friend and Blume model, the comparison of the C_k of men and that of women is done on the assumption that men and women have the same positive multiplicative constant.

On an equally important note and again with reference to the estimated coefficient on $\ln WEALTH$, we refer to the JB work with the estimated coefficient $\hat{\beta}_1$. However, given the Tobit specification, we need to mention that if we wish to be more accurate, then the partial effect of $\ln WEALTH$ is not simply $\hat{\beta}_1$ but $\hat{\beta}_1 \Phi(\bar{x}\hat{\beta}/\hat{\sigma})$ (Greene, 2003). Nevertheless, this adjustment factor taking values between zero and one is assumed not to change the results qualitatively. To investigate this idea, we perform the following exercise. Taking into account the effects of AGE, $EDUCATION$, $RACE$, $KIDS$, $HOMEOWNERSHIP$, $HUMAN\,CAPITAL$, and $WORK$, we evaluate Tobit's adjustment factor $\Phi(\bar{x}\hat{\beta}/\hat{\sigma})$ at the mean values of the corresponding samples for all the aforementioned variables and then compute the adjusted coefficient on $\ln WEALTH$. The results corroborate that all types of households manifest decreasing relative risk aversion, and that when it comes to the comparison between single women and single men, relative risk aversion does not decrease as much for single women as for single men. Actually, multiplying all coefficients of Table 2 by the adjustment factor evaluated at the means of the corresponding samples does not change our results qualitatively.

Moving next to the 2013 results, we first note that our Wald tests indicate that the estimated equations are significantly different between single women and married couples, but not between single women and single men. However, although the estimated equations between single women and single men are not found to be significantly different, the coefficient on $\ln WEALTH$ is found to be statistically different between single women and single men. In particular, by isolating all household types and the results from Table 2 that refer to the coefficient on $\ln WEALTH$ and controlling for the effects of AGE, $EDUCATION$, $RACE$, $KIDS$, $HOMEOWNERSHIP$, $HUMAN\,CAPITAL$, and $WORK$, the analysis shows an interesting turn in the behavior of all types of households toward risk. More specifically, the negative coefficients on $\ln WEALTH$ indicate a pattern of increasing relative risk aversion, which is a reverse behavior from that of 1989. This is prominent in the case of single women, but in the case of single men and married couples, since the negative coefficients are not statistically significantly different from zero, one could infer constant relative risk aversion. Still though, the 2013 analysis indicates that in contrast to the 1989 behavior, holding all other factors constant, all types of households do not increase but rather decrease or keep constant their

proportion of wealth held in risky assets as their wealth increases.

The estimated coefficient on $\ln WEALTH$ for single women is significantly larger in absolute terms than that for single men, which indicates that single women are increasing their relative risk aversion by more than single men. Thus, while both single men and single women exhibit increasing relative risk aversion, single women do so to a higher degree. There is also a significant difference found in the relative risk aversion exhibited by married couples versus single women, although under the lack of information on the gender of the financial decision maker in married households, we infer no conclusive results.

3.2 Empirical Results II: Pooling data from 1989 & 2013

An observation of Table 2 reveals that the results from 1989 and 2013 are numerically different. A subsequent series of Wald tests further reveal that the results from 1989 are statistically significantly different from the 2013 results at least at the 10% level of significance.

In what follows we pool the surveys of 1989 and 2013 into an independent cross section. The motivation behind this set-up is to increase the sample size and to investigate the effect of $\ln WEALTH$ over time. We mentioned earlier that since the focus is on relative risk aversion, the effect of the other explanatory variables is assumed to remain constant from 1989 to 2013. This assumption is further tested in the specification by adding time interactions with all explanatory variables and performing Wald tests. The results reveal that this is indeed the case for the other explanatory variables with the exception of the *AGE* 51-55 group and the Unemployed or Not in the Labor Force work status variables. Thus, since most of the other slopes do not differ between the two years, pooling is deemed as a good strategy leading to efficient and more precise estimates. The results are presented in Table 4.

Table 4. Tobit Regression Results with RII Techniques on Pooled Data

	Single Women	Single Men	Married Couples
$\ln WEALTH$	0.107***	0.169***†	0.129***
	(0.018)	(0.022)	(0.008)
$y13$	2.486***	2.653***	1.914***†
	(0.258)	(0.256)	(0.094)
$y13 \times \ln WEALTH$	-0.191***	-0.213***	-0.143***†
	(0.025)	(0.024)	(0.008)
AGE 26-30	-0.052	-0.012	-0.040
	(0.048)	(0.062)	(0.044)
AGE 31-35	-0.013	-0.080	-0.078**†
	(0.049)	(0.062)	(0.045)
AGE 36-40	0.053	-0.014	-0.053y
	(0.050)	(0.064)	(0.043)
AGE 41-45	0.030	-0.032	-0.036y
	(0.053)	(0.060)	(0.044)

Table 4. (Cont'd)

	Single Women	Single Men	Married Couples
AGE 46-50	0.047	-0.051y	-0.071*†
	(0.052)	(0.052)	(0.042)
AGE 51-55	0.003	-0.093*†	-0.050y
	(0.049)	(0.055)	(0.040)
AGE 56-60	-0.028	-0.067	-0.063*
	(0.052)	(0.061)	(0.041)
AGE 61-65	0.006	-0.119**†	-0.036
	(0.050)	(0.065)	(0.044)
AGE Over 65	-0.140***	-0.137**	-0.086**
	(0.051)	(0.074)	(0.046)
EmpByOth	-0.235***	-0.115**†	-0.147***†
	(0.050)	(0.048)	(0.018)
Retired	-0.178***	-0.156**	-0.210***
	(0.050)	(0.067)	(0.027)
Farmer	-0.105	0.105*	0.115y
	(0.132)	(0.074)	(0.028)
Unemp/NotLF	-0.192***	-0.035y	-0.061***†
	(0.050)	(0.054)	(0.027)
Some HS	-0.068	-0.035	-0.020
	(0.118)	(0.090)	(0.048)
HS Degree	-0.040	-0.047	-0.051
	(0.113)	(0.086)	(0.045)
Some College	-0.053	-0.066	-0.076*
	(0.113)	(0.086)	(0.045)
College Grad	-0.058	-0.118*	-0.110***
	(0.113)	(0.086)	(0.045)
RACE	0.043**	0.016	-0.006y
	(0.021)	(0.030)	(0.019)
KIDS	0.025***	0.018	0.023***
	(0.009)	(0.024)	(0.007)
HOMEOWNER	-0.065***	-0.041*	-0.086***
	(0.021)	(0.026)	(0.016)
HUMAN	-0.001**	0.000y	0.000**
	(0.000)	(0.000)	(0.000)
constant	-0.446**	-1.098***	-0.673***†
	(0.231)	(0.244)	(0.117)
Sigma hat	0.289	0.289	0.309
Observations	1,632	1,042	5,669
Left-Censored	147	58	386
Right-Censored	136	84	151

*** Significantly different from zero at the 1% significance level.
** Significantly different from zero at the 5% significance level.
* Significantly different from zero at the 10% significance level.
† Significantly different from the single-female coefficients at the 10% significance level or lower.

We again note that the effect of $\ln WEALTH$ for 1989 and with reference to equation (3) is $\hat{\beta}_1$, while the effect of $\ln WEALTH$ for 2013 is $\hat{\beta}_1 + \hat{\delta}_1$. Hence, after isolating from Table 4 the results referring to $\ln WEALTH$ and the interacted variable, $y13 \times \ln WEALTH$, (that controls for the effects of AGE, $EDUCATION$, $RACE$, $KIDS$, $HOMEOWNERSHIP$, $HUMAN\,CAPITAL$, and $WORK$), the resulting effect of $\ln WEALTH$ for 2013 is estimated to be -0.084 for single women, -0.044 for single men, and -0.014 for married couples. All coefficients are statistically significantly different from zero, and furthermore they are significantly different between single women and single men, as well as between single women and married couples.

The resulting estimated coefficients with regards to $\ln WEALTH$ indicate increasing relative risk aversion for all household types, and the significant differences indicate that single women decrease their proportion of risky assets by significantly more than single men and married couples, implying persistent gender differences for 2013. Once again, we employ the assumption of the same positive multiplicative constant in the Friend and Blume model governing women and men here. This is an interesting finding, especially in light of the after-effect of the 2007-2008 financial crisis, suggesting a disinclination of all types of households towards investment, holding all other factors fixed.

4. Policy Implications

We next proceed with a series of policy recommendations. These recommendations are based on our analysis for 2013 and are given with our eye kept on specific demographic subgroups. In particular, we focus on single people, single parents, and single college graduates. This focus is dictated by our findings with regards to the financial risk taking profile of the aforementioned subgroups, their perceived vulnerability, and their financial risk aversion.

In this spirit we start based on our major finding that single women exhibit a trend of increasing relative risk aversion, while single men exhibit a pattern of constant relative risk aversion, with these two patterns in contrast to past patterns of decreasing relative risk aversion for all single-headed households. Thus, our first recommendation calls for a close monitoring of the financial decisions of single-headed households, especially in investment decisions related to retirement, such as those encountered for instance in 401(k)s plans or in other thrift saving accounts. In particular, we recommend an extra push in the portfolios of the aforementioned households towards risk taking, which could be implemented by opt-out default or automatic risk taking strategies in financial or retirement plans.

We next call for an extra monitoring effort on the risk taking pattern of single parents or singles with young dependents in their households. Our tests on the 2013 SCF offer evidence of increasing relative risk aversion manifested by single female parents and of constant relative risk aversion manifested by single male parents. Despite the optimistic turn in behavior of single women with one child who seem to take more financial risks in the presence of an additional young dependent, we still

deem single parents as more vulnerable, more risk averse, and in need of a systematic review of their financial risk taking profile. This review could be implemented through extra financial counseling and investment advisement.

Based on our finding related to single college graduates who seem to take significantly fewer financial risks than their peers with less than a sixth grade education, we lastly recommend, regardless of individuals' marital status, further investigation of the issue of their financial literacy or financial education. Here, we express our belief that we deem it is financial education and not education in general that might lead to higher financial risk taking. Thus, it is imperative for policy makers to employ methods from the early stages of education that help instill in individuals the necessity for higher financial risk taking so as to secure greater future financial returns.

5. Conclusions, Caveats, and Future Paths

Working within the expected utility theory framework, we investigate the empirical relationships over time between changes in wealth and relative risk aversion for several household types seeking out any gender differences in the manifestation of financial risk taking under uncertainty. The vehicle of financial risky choice for us is households' investment allocations in risky assets, and for our analysis we use data from the U.S. Federal Reserve Board's Survey of Consumer Finances (SCF) for 1989 and for 2013. More specifically, by employing the approach of Jianakoplos and Bernasek or JB for the 1989 SCF as our canvas, our own research is dedicated first to the replication of the JB results for the 1989 SCF and second to the application of the JB model on the 2013 SCF in order to derive new results.

The contribution of our work to the literature lies in the intertemporal feature of this study, the thorough use of available data, as well as the provision of important evidence for the policymaking process. More specifically, we bring into light new important evidence about the relative risk aversion of today's female investors working with data that also reflect the after-effect of the 2007-2008 financial crisis period. Furthermore, we exploit the richness of the data source available in the best possible way. The latter claim materializes first by meticulously studying the survey and extracting the respondents' risk-taking in terms of their investment strategies, and second by employing state-of-the-art Repeated-Imputation Inference (RII) techniques so as to make valid statistical inferences from the data. Lastly, based on the new results for the 2013 SCF, we offer informative policies and further suggest improved practices.

With regards to possible caveats in our analysis, we first refer to the one springing from the way SCF is conducted, which does not identify the gender of the investment decision maker. This is something most prominent in the cases of the survey's couples (either married or living together as partners) and something that limits our tests of gender differences to the comparison of single-headed households. Thus, we need to emphasize that both replication and new results pertain mostly to single women and single men and may not be generalized to all women and men.

As a further limitation meriting more investigation, we also point to the arbitrariness surrounding the selection of the wealth components - namely, the net value of risky and risk-free assets as encountered in SCF. More specifically, we stress here that upon reading and studying meticulously SCF and its codebook both for 1989 and for 2013, we conclude that it would be interesting to explore and suggest in the future some more elaborate definitions of risk-free and risky assets that could result in alternative definitions of wealth.

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