What Factors Portend Changes in Household Relative Risk Aversion?

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Abstract: Empirical research has examined economic and demographic factors related to risk aversion primarily using cross-sectional data. We add to this literature by investigating factors that are associated with changes in household relative risk aversion (RRA). Additionally, we evaluate changes in RRA during a time period that includes an economic shock loss. We use data from the 1983–1989 Survey of Consumer Finances panel study to calculate changes in RRA. Our results shed light on behavioral and attitudinal changes in household risk taking across time. Specifically, we find that household RRA is positively related to increases in assets, age, and education, and negatively related to increases in human capital. [Key words: risk aversion, education, human capital]

INTRODUCTION

The question of how human behavior is affected by risk has long been of interest to academics. Empirical studies related to individual risk aversion date back to the mid-1970s, and there is a broad literature that has identified a number of factors that are related to either risk aversion or

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Table 1. Percentage of Households "At Risk"[a] at Age 65, by Income Group

Income group	2004	2007	2010	2010 with 2013 asset prices
All	45%	44%	53%	50%
Low income	52%	54%	61%	60%
Middle income	44%	43%	54%	52%
High income	39%	35%	44%	40%

Source: Center for Retirement Research
[a]"At Risk" indicates a household that would see a lower standard of living after retirement.

changes in risk aversion across time. While the findings of these studies have furthered the understanding of individual behavior and decision-making related to the various categories of risk aversion, they have not been uniformly consistent across studies. This lack of agreement is due in part to the cross-sectional nature of these studies, which can be very different in terms of sampling data as well as methodologies.

Besides the economic and demographic factors that impact risk perceptions or tolerances, the economic cycle and the economic shock losses that occasionally are part of that cycle also impact perceptions of risk in the short term and, for some individuals, the long term. While the causes of significant economic shocks and crises may differ, the end result is likely to be an increase in uncertainty across a broad demographic and economic spectrum. For example, the 2008 financial crisis (and the subsequent "Great Recession") saw a substantial drop in the stock market, the collapse of some well-known financial institutions, and the saga of the government's efforts to address the potential systemic failure of the financial system. Including the bursting of the real estate bubble, the impact of the 2008 financial crisis sent ripples across virtually all sectors of the economy. Whether it was a flight to safety (e.g., reallocation to more cash holdings), a reduction in ongoing wealth accumulation funding (e.g., retirement plan funding), or a long-term change in retirement plan portfolios towards more secure, lower yield assets, these decisions have potential long-term consequences that can be devastating for the long-term financial wellbeing of consumers.

Table 1 provides information on the uneven impact of that financial crisis on income groups and the differential impact of pre- and post-crisis investment decisions for these income groups. With the recovery in stock prices through 2013, the percentage of high-income households at risk based on the Net Retirement Risk Index (NRRI) had almost returned to the

2004 level.[5] The same was not the case for the low- and middle-income groups, where the NRRI increased by 18 percent for the middle-income group from 2004 to 2013 and by 15 percent for the low-income group (Munnell, Webb, and Golub-Sass, 2012).

To further illustrate the implications of financial shock on the investment decisions for individuals with lower wealth levels, Cerulli Associates examined Federal Reserve data and reported that among consumers with less than $100,000 in investable assets, the average investable assets declined by 9 percent, from $19,732 in 2007 to $17,975 in 2011. In comparison, consumers with investable assets between $500,000 and $2 million saw a 7 percent increase during the same time period (Mincer and Johnson, 2012).

Prudential Financial surveyed investors in 2009 and reported that 29 percent of the respondents pulled some or all of their stock investments out of the market (Prudential, 2009). They also reported that 70 percent of the respondents agreed with the statement that being too aggressive with investments was riskier that being too conservative. This compared to 50 percent of the respondents in 2007. Gallup (2015) reported that the percent of U.S. households invested in equity increased from 53 percent in 2013 to 55 percent in 2015, but it was still below the 62 percent level of 2007 (Prudential, 2015). In line with Table 1 above, the $30,000 to $74,999 group actually showed a significant decline in stock market presence (72 percent in 2007 versus 56 percent in 2015).

Part of the group that liquidated stock investments arguably had too great an exposure to equity risk prior to the financial shock, with the unfortunate consequence of experiencing permanent wealth reductions for a group that likely felt the financial shock most keenly (e.g., lower wealth/income individuals, retirees). However, it is the larger part of this group that could or should include stocks in their investment portfolio that is of concern, as their ability to grow wealth for the long term is substantially reduced. Given the transition to defined contribution types of retirement plans where employees now make the investment allocation decisions, eliminating or reducing investments in equities below a prudent level increases the possibility of delayed retirement and/or a reduction in standard of living as a result of lower retirement wealth and income. As such, it is important to better understand the impact of economic shocks on consumer preferences for risk across time.

[5]The NRRI compares a projected income replacement rate with a targeted replacement rate that maintains standard of living. Households whose projected income rate is less than 10 percent of the target are categorized as at risk of seeing a decline in living standards after retirement.

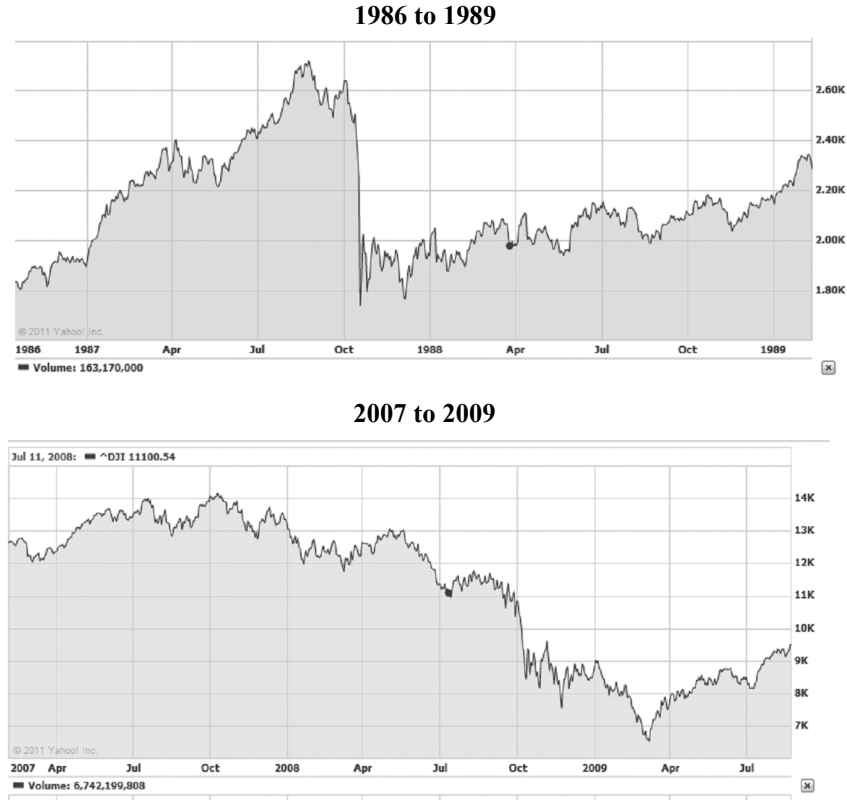

Fig. 1. A comparison of two financial shocks: 1987 and 2008 (Dow Jones Industrial Average).

The primary purpose of this paper is to investigate factors that may lead to a change in relative risk aversion across time. A secondary purpose is to examine whether there is a longer-term impact of an economic shock on relative risk aversion. The time period of the panel data used in this study (1983 and 1989 surveys of the same households) includes a financial shock in the form of the stock market collapse in October of 1987. As can be seen in Figure 1, this event and the 2008 financial crisis are similar in that both were major financial shock losses that followed a significant advance in the stock market. Two years after these events, neither market had recovered to the pre-collapse highs. In the case of the Black Monday market meltdown of October 19, 1987, a unique set of consumer-level data exists that allows for detailed analysis of the change in consumer risk aversion during a time period that includes an economic shock loss.

This study extends the prior literature on risk aversion by evaluating factors related to relative risk aversion on a dynamic basis. Unlike previous studies that relate risk aversion to individual factors in a cross-sectional setting (e.g., Halek and Eisenhauer, 2001), this study uses panel data from the Survey of Consumer Finances that captures financial and demographic data for the same family over two distinct time periods (1983 and 1989).

The next section of the paper reviews the prior research related to risk aversion. The hypotheses to be tested in this paper and a description of the data and methodology are provided in the following section. The article continues with a discussion of the empirical results and concludes with a summary of the important findings.

RELATED LITERATURE

Pratt (1964) and Arrow (1965) suggested the elasticity of marginal utility with respect to wealth, or $R(W) = -WU''(W)/U'(W)$, as an appropriate measure of relative risk aversion, where U is a concave utility function defined over wealth of W. Pratt showed that $R(W)$ is proportional to the insurance premium one is willing to pay to avoid a given risk. Arrow demonstrated that $R(W)$ is directly related to one's insistence on favorable odds when putting some fraction of wealth at risk. Both Pratt and Arrow hypothesized that $R(W)$ increases with W, implying that at higher levels of wealth, individuals become less willing to subject a given percentage of wealth to risk.[6] Empirical research on risk aversion may be categorized into three areas: the magnitude of $R(W)$, the increasing relative risk aversion (IRRA) hypothesis, and the relationship between risk aversion and demographic variables. Table 2 provides a summary of selected papers representing these three research strands.

Some of the earliest empirical estimates of relative risk aversion originated in the mid-1970s. Friend and Blume (1975) concluded that $R(W)$ generally exceeds unity and is probably greater than 2 after examining cross-sectional household demand for risky assets. In a time-series study of consumption, Hansen and Singleton (1982) found relative risk aversion parameters ranging from 0.35 to 1.0. A subsequent study of investments by Hansen and Singleton (1983) yielded relative risk aversion estimates as low as –0.359 and as high as 58.25, although most fell between 0.26 and 2.7. Mankiw (1985) obtained relative risk aversion estimates ranging from 2.44

[6]It is worth noting that since the seminal work of Pratt and Arrow on risk aversion, decision making concepts such as prudence and temperance have also been modeled using the same expected-utility framework (e.g., Eeckhoudt and Schlesinger (2006)).

Table 2. Summary of Related Literature

Panel A: Magnitude of Pratt-Arrow Relative Risk Aversion Measure

Authors	Methodology/Data	Main Results
Barsky et al. (1997)	Hypothetical question on speculative risk-taking	0.7 < RRA < 15.8
Cohen and Einav (2007)	Cross-sectional demand for auto insurance	Mean RRA > 100, Median RRA < 0.50
Friend and Blume (1975)	Cross-sectional household demand for risky assets	RRA > 1.0
Halek and Eisenhauer (2001)	Cross-sectional demand for term life insurance	Mean RRA 3.74, Median RRA 0.89
Hansen and Singleton (1982)	Time-series consumption and asset returns	0.35 < RRA < 1.0
Hansen and Singleton (1983)	Investments	0.26 < RRA < 2.7
Mankiw (1985)	Nondurable and durable consumption	2.44< RRA < 5.26 and 1.79 < RRA < 3.21
Sydnor (2010)	Cross-sectional demand for property insurance	RRA >>> 100
Szpiro (1986)	Time-series demand for property insurance	1.2 < RRA < 1.8

Panel B: Empirical Tests of Pratt-Arrow Increasing Relative Risk Aversion (IRRA)

Authors	Methodology/Data	Main Results
Barsky et al. (1997)	Hypothetical question on speculative risk-taking	DRRA (wealthy), IRRA (least wealthy)
Bellanti and Saba (1986)	Cross-sectional household data on assets & income	DRRA, DRRA (with decrease in age)
Cohn et al. (1975)	Cross-sectional individual investors' portfolios	DRRA
Friend and Blume (1975)	Cross-sectional household demand for risky assets	IRRA, CRRA
Halek and Eisenhauer (2001)	Cross-sectional demand for term life insurance	IRRA (assets), DRRA (income)
Jianakoplos and Bernasek (1998)	Cross-sectional data on household assets	DRRA
Levy (1994)	Experimental time-series investments and cross-sectional wealth data	DRRA
Meyer and Meyer (2005)	Variations in outcome variable of utility function	IRRA, DRRA, CRRA
Morin and Suarez (1983)	Cross-sectional household demand for risky assets	DRRA (wealthy), IRRA (least wealthy)
Ogaki and Zhang (2001)	Cross-sectional Pakistani and Indian household data on income & consumption	DRRA
Siegel and Hoban (1982)	Gross wealth excluding liabilities	CRRA, DRRA (wealthy), IRRA (least wealthy)
Szpiro (1983)	Cross-sectional demand for insured assets	IRRA
Szpiro (1986)	Time-series demand for property insurance	CRRA

Panel C: Demographics Associated with Relative Risk Aversion

Authors	Methodology/Data	Main Results
Barsky et al. (1997)	Hypothetical question on speculative risk-taking	Age, gender, nationality, race, religion, and behavior (smoking & drinking)
Cohen and Einav (2007)	Cross-sectional demand for auto insurance	Age, gender
Halek and Eisenhauer (2001)	Cross-sectional demand for term life insurance and hypothetical question on speculative risk-taking	Age, education, gender, race, marital status, religion, self-employment
Jianakoplos and Bernasek (1998)	Cross-sectional holdings of risky assets	Gender, children, marital status and race
Riley and Chow (1992)	Cross-sectional data on household investments	Age, education, gender, and race
Sunden and Surette (1998)	Cross-sectional investment choices in defined contribution retirement plans	Gender, marital status

to 5.26 for nondurable consumption and from 1.79 to 3.21 for durable goods consumption. Szpiro (1986) obtained a range of 1.2 to 1.8 using aggregate time-series data on property insurance. Meyer and Meyer (2005) discussed the impact different outcome variables, such as wealth or consumption, may have on relative risk aversion measurements. They concluded that once these differences are accounted for, the variation in reported relative risk aversion measures is reduced significantly.[7] More recently, Sydnor (2010) found relative risk aversion estimates in the triple and even quadruple digit range based on deductible choices on homeowners insurance. His findings illustrate the importance of considering alternative preference models to better explain these types of disparate results.

The IRRA hypothesis is another question investigated in much prior work, with little consensus in the findings. As Meyer and Meyer (2005) indicated, results appear sensitive to the outcome variable of the utility function (i.e., the measurement of wealth). For example, Cohn, Lewellen, Lease, and Schlarbaum (1975) examined a cross-section of individual investors' portfolio choices and found strong evidence of decreasing relative risk aversion (DRRA) when using a gross wealth measure that excluded liabilities. Siegel and Hoban (1982) replicated the Cohn et al. study using net worth and found that relative risk aversion was constant if wealth was defined to exclude housing. However, this result hid differences across subgroups: the wealthiest exhibited DRRA while the least wealthy exhibited IRRA. When broad, non-marketable assets were included, both subgroups displayed IRRA. Similar discrepancies are found throughout the literature, although theoretical applications usually assume either CRRA or IRRA.[8]

A growing area of research explores differences in risk preferences across demographic groups. This topic bridges the fields of psychology, sociobiology, demography, economics, and decision sciences. Both the natural and social sciences theorize that risk attitudes differ across demographic lines and that cultural factors influence individuals' attitudes.[9] Empirical studies have generally found women to be more risk averse than men. Results by Jianakoplos and Bernasek (1998) and Sunden and Surette

[7]Chetty (2006) clarifies that the appropriate measure of wealth should be related to permanent income, rather than measures such as physical wealth and monthly income that are often used in the literature.

[8]A non-exhaustive list of prior research that investigates the IRRA hypothesis includes the following: Friend and Blume (1975), Morin and Suarez (1983), Szpiro (1983, 1986), Bellanti and Saba (1986), Levy (1994), and Ogaki and Zhang (2001).

[9]For a sample of detailed discussions, see Geis (1993), Trimpop (1994), and Zuckerman (1994).

(1998) show that gender differences in risk aversion are further impacted by race, the presence of children, and marriage. Demographic variables outside of gender may also be associated with risk aversion. Riley and Chow (1992) examined individual asset allocation and found risk aversion to decline with wealth, education, and age, until age 65, at which point risk aversion increases.

Barsky, Juster, Kimball, and Shapiro (1997), Halek and Eisenhauer (2001), and Cohen and Einav (2007) addressed all three of the aforementioned research areas. Using answers to hypothetical survey questions on speculative risk-taking, Barsky et al. (1997) calculated upper and lower bounds on relative risk aversion and its inverse, risk tolerance. They obtained mean estimates of relative risk aversion for four groups (with different risk preferences) ranging from 0.7 to 15.8, with an infinite upper bound (assuming CRRA for each group). They also found significant differences in risk aversion by age, gender, race, religion, nationality, and behaviors such as smoking and drinking, as well as by cross-sections of wealth levels. Halek and Eisenhauer (2001) used household term life insurance data to estimate mean and median risk aversion levels of 3.74 and 0.89, respectively, across households, and found evidence of both IRRA and DRRA, contingent on wealth estimates. The relation between demographic variables and both risk aversion and speculative risk-taking was also examined. Cohen and Einav (2007) developed a structural econometric model to estimate risk preferences based on deductible choices of auto insurance in Israel. They found gender, age, and different proxies of wealth to be significantly related to their measures of relative risk aversion.

Finally, in a paper that closely relates to ours, Malmendier and Nagel (2011) utilized repeated cross-section data on households to construct risk attitude measures (e.g., "elicited risk tolerance") that allowed them to explore the relation between risk-taking behavior and past financial experiences. Their results suggest that individuals may have risk preferences that are evolving as personal economic experiences, notably recent ones, significantly influence risk taking.

The literature discussed above provides limited consensus and few generalizations regarding the magnitude of relative risk aversion, its behavior with respect to wealth, or its differences across demographic subgroups. This study examines risk aversion in a panel data setting that yields insights on the relations between events, financial decisions, and demographic characteristics. The hypotheses, model, and estimation below describe our approach to the estimation of individual risk aversion parameters that provide a comparison of objective risk preferences for the same set of individuals. Our approach allows us to potentially explain some of the inconsistent findings of previous research.

HYPOTHESES, DATA, METHODOLOGY, AND EMPIRICAL MODEL

Hypotheses

The literature provides testable hypotheses regarding demographic and financial variables. Based on the results of the majority of the prior cross-sectional studies, we might expect risk aversion related to certain individual characteristics to also change across time (e.g., age, education) and certain family, life-cycle events (e.g., marriage, divorce, new children, retirement) to lead to changes in risk tolerance regardless of inter-period economic events. The questions of particular interest in this paper include whether and how risk aversion changes following a widespread systematic financial shock to the economy, controlling for demographic and economic characteristics. We would expect that changes in risk aversion are more likely for consumers who have been directly impacted by the financial shock. We also would expect consumers who have been most affected by the financial shock to react most strongly to it by becoming even more risk averse. This logic motivates the following three hypotheses:

H1: Demographic characteristics that increase across time (e.g., age, education) will be associated with an increase in risk aversion.

H2: Financial characteristics that worsen across time (e.g., decrease in assets, decrease in human capital) will be associated with an increase in risk aversion.

H3: The life-cycle events of marriage, new children, divorce, and retirement will be associated with an increase in risk aversion.

We test the above hypotheses using an objective relative risk aversion measure.

Data

We investigate the factors that are related to changes in risk aversion by examining household survey data from the 1983–1989 Survey of Consumer Finances (SCF) panel study. The 1983–1989 panel study is one of two complete sources of panel data in the history of the SCF.[10] In the 1989 survey, 1,479 households that participated in the 1983 survey were re-interviewed. As noted above, the survey captures data from a variety of categories, including financial, demographic, and life-cycle. While there are other surveys that capture information on attitudes toward risk (e.g., University of Michigan Health and Retirement Study), the data in the SCF

survey is valuable to our study as it spans the 1987 stock market crash and therefore enables us to examine changes in household risk perceptions around a time period that includes a significant economic shock loss.

The SCF panel data have been used in a number of studies (e.g., Bertaut (1998), Dynan, Skinner, and Zeldes (2004), Malmendier and Nagel (2011)). Most recently, Liebenberg, Carson, and Hoyt (2010) and Liebenberg, Carson, and Dumm (2012) demonstrate the advantages of using rich household panel data (over the use of aggregate economic or cross-sectional household data) to capture dynamic relationships between events and financial solutions. Liebenberg et al. (2010) exploit panel information regarding life insurance policy loans to find some of the first evidence of the emergency fund hypothesis for life insurance policy loans. Liebenberg et al. (2012) use detailed life insurance, financial, and demographic data to provide a dynamic analysis of life insurance demand.

Methodology and Empirical Model

Table 2 provides a detailed examination of the factors that explain observed variation in levels of relative risk aversion. For example, Panel C of Table 2 shows that resulting demographics associated with relative risk aversion are not completely consistent even across studies that use similar cross-sectional data (e.g., demand for insurance or investment holdings). Our study differs in that we examine demographic, financial, and life-cycle factors associated with changes in risk aversion around a financial shock. Using the SCF panel data for the same households in 1983 and 1989, we are able to capture changes in risk aversion around the 1987 stock market crash. As stated above, we hypothesize that changes in risk aversion are related to demographic factors, financial factors, and life cycle events. More formally, we test the following general model:

$$\textit{Change in risk aversion} = f(\textit{demographic and financial factors, life cycle events})$$

For our study, the change in the risk aversion dependent variable, *RRAINC*, captures an increase in *relative risk aversion* between two time periods (1983 and 1989), as it is set equal to 1 if relative risk aversion increases between 1983 and 1989, and 0 otherwise. Relative risk aversion

[10]The other panel dataset is the 2007–2009 SCF Panel where the Federal Reserve Board conducted a follow-up survey to the families who participated in the 2007 survey (Bricker, Bucks, Kennickell, Mach, and Moore , 2011). We prefer the 1983–1989 study over the more recent data source because the timing of the re-interview (1989) is clearly after the 1987 stock market crash. By contrast, for the 2008–2009 financial crisis the stock market only reached its lowest point in 2009.

in each period is calculated utilizing the relative risk aversion measure derived by Halek and Eisenhauer (2001), which is based on a simple, single-period expected utility model.[11] This measure of relative risk aversion evaluated at average wealth is:

$$R(E[W]) = -E[W]U''(E[W])/U'(E[W]) = E[W]\theta/(Y - V^*),$$

where Y represents the present value of expected future earnings, conditional on survival, V^* is the optimum level of life insurance coverage, $(Y - V^*)$ represents the uninsured portion of potential loss, $E[W]$ is the breadwinner's expected wealth, and θ is a type of insurance pricing parameter that reflects the relationship between premium loading and the probability of survival. Specifically, $E[W]$ is calculated as:

$$E[W] = A + (1 - p)Y - mV^* + pV^*,$$

and θ is calculated as:

$$\theta = (\lambda - 1)/(1 - p) > 0 \quad \forall \quad \lambda > 1,$$

where A is the household's accumulated stock of assets excluding human capital, m is the premium rate for life insurance coverage V^* (i.e., the per-dollar cost of coverage for an amount of life insurance purchased), p is the probability of the breadwinner's death resulting in a loss of Y, $(1 - p)$ is the probability of survival during the period, and l is the premium loading factor.

Halek and Eisenhauer (2001) empirically estimate a household's relative risk aversion by using appropriate variables from the 1992 HRS data set. For example, they estimate Y by separating out the household head's contribution to gross household income, deducting income taxes using the IRS 1992 tax rate schedules, extending these net earnings over the reported number of years to retirement (or assuming a normal retirement age of 65), and discounting back to present value at an assumed rate of two percent.

We calculate the relative risk aversion measure for our SCF households for both years 1983 and 1989 in a similar manner using appropriate variables. The SCF panel data set contains non-contingent assets (A), term life insurance holdings (V^*), and individuals' gross income, which is used to estimate human capital (Y). Specifically, we estimate Y by separating out a household head's contribution to gross household income, deducting income taxes using the IRS 1983 (or 1989) tax rate schedules, extending these net earnings over the number of years to retirement (assuming a normal retirement age of 65), and discounting back to present value at an

[11]See pages 5–6 of Halek and Eisenhauer (2001) for the derivation of this relative risk aversion measure.

assumed rate of two percent. We also use mortality rates *(p)* for each primary respondent based on gender and age from actuarial tables in Bell, Wade, and Goss (1992). Finally, similar to Halek and Eisenhauer (2001), we compute a premium rate *(m)* for each policyholder as a function of mortality and reported insurance coverage based on average rate schedules reported by the Federal Trade Commission (1979). From this, we are able to estimate the associated premium loading factor *(l)* for each household (since $m = lp$), and thus we have an estimate of our insurance pricing parameter θ for each household as well.

Once we have our per household relative risk aversion measures for 1983 and 1989, *RRA83* and *RRA89*, respectively, we calculate the dependent variable, *RRAINC*, to be used in our econometric models described below. In these, we include two sets of independent variables. First in Model (1) we include financial variables such as the change in a household's level of assets from 1983 to 1989, as well as the household's primary wage earner's change in present value of income (until retirement) from 1983 to 1989. We take the natural log of these financial variables, labeled as *CHLNASSETS* and *CHLNHUMCAP*, respectively. We then also include variables that reflect life cycle changes between 1983 and 1989, such as having children (*NEWKIDS*), getting married (*NEWMARRIED*), getting divorced (*NEWDIVORCED*), or becoming retired (*NEWR*).[12] Then in Model (2) we also include demographic and financial variables that prior studies have found to relate to relative risk aversion. Demographic characteristics captured include age (*AGE83*), education (*EDUC83*), gender (*MALE83*), and race (*WHITEHH*). The ratio of stocks to assets (*PCTSTOCK*83) is included to control for the household's exposure to the shock loss.

The prior discussion leads to the following two regression models to test our hypotheses:

$$\begin{aligned} RRAINC_1 = {} & \beta_0 + \beta_1 CHLNASSET_i + \beta_2 CHLNHUMCAP_i \\ & + \beta_3 NEWKIDS_I + \beta_4 NEWMARRIED_i + \beta_5 NEWDIVORCED_i \\ & + \beta_6 NEWR_i + \beta_7 PCTSTOCK83_i + \varepsilon_i \end{aligned} \tag{1}$$

$$\begin{aligned} RRAINC_i = {} & \beta_0 + \beta_1 CHLNASSET_i + \beta_2 CHLNHUMCAP_i \\ & + \beta_3 NEWKIDS_i + \beta_4 NEWMARRIED_i + \beta_5 NEWDIVORCED_i \\ & + \beta_6 NEWR_i + \beta_8 AGE83_i + \beta_9 EDUC83_i + \beta_{10} MALE83_i \\ & + \beta_{11} WHITEHH_i + \beta_{12} PCTSTOCK83_i + \varepsilon_i \end{aligned} \tag{2}$$

[12]While the survey includes newly divorced, there were an insufficient number of newly divorced individuals in the sample to allow for the use of this variable.

Table 3. Description of Variables

Risk Aversion Measure	
RRA83	Relative risk aversion in 1983
RRA89	Relative risk aversion in 1989
CHRRA	Change in relative risk aversion between 1983 and 1989
RRAINC	Binary variable equal to 1 if RRA increased from 1983 to 1989, 0 otherwise
LNASSETS83	Natural log of assets in 1983
CHLNASSETS	Natural log of the percentage change in total assets from 1983 to 1989
LNHUMCAP83	Natural log of the present value of income in 1983
CHLNHUMCAP	Natural log of the percentage change in human capital from 1983 to 1989
NEWKIDS	Binary variable equal to 1 if new children after 1983, 0 otherwise
NEWMARRIED	Binary variable equal to 1 if newly married in 1989, 0 otherwise
NEWDIVORCED	Binary variable equal to 1 if newly divorced in 1989, 0 otherwise
NEWR	Binary variable equal to 1 if newly retired in 1989, 0 otherwise
AGE83	Primary wage earner's age in 1983
EDUC83	Primary wage earner's number of years of education in 1983
MALE83	Binary variable equal to 1 if primary wage earner in 1983 is male, 0 otherwise
WHITEHH	Binary variable equal to 1 if race is white, 0 otherwise
PCTSTOCK83	Ratio of stock holdings in 1983 to total financial assets in 1983

We use logistic regression to empirically analyze the above models where the dependent variable *RRAINC* is specified as 1 when relative risk aversion increased between 1983 and 1989 and 0 if relative risk aversion remained unchanged or decreased between the two time periods. The sample used in these models consists of 306 household observations. The initial sample of 1,479 household observations is reduced to this number due to the restrictions needed to construct the relative risk aversion measure for each household: Households must hold term life insurance in both 1983 and 1989, and the amount of term life insurance held by a household must not exceed the household's human capital estimate. Additionally, we removed nine observations due to missing data or unrealistic values. We next describe our empirical results.

EMPIRICAL RESULTS

Descriptive Statistics

Panel A of Table 4 provides summary statistics for the variables used in the logistic regression model (dependent variable = *RRAINC*). The median *CHRRA* of –0.191 indicates that this sample became slightly less risk averse between 1983 and 1989. The average age was approximately 43 in 1983, and the individuals included in this sample were predominantly male (83 percent) and white (93 percent). The mean education level was just over 14 years (i.e., 2 years of college). Twenty-four percent of the households had new children between 1983 and 1989 and almost 5 percent were newly married. The percent that were newly divorced or retired were much smaller (0.7 percent and 2 percent, respectively). The average total assets held by households in the sample were roughly $201,935 and the average human capital measure was approximately $438,000.[13]

Panels B and C provide additional insights into changes in relative risk aversion surrounding an economic shock. Here, we see differences in movement in relative risk aversion in terms of both direction and magnitude. First, risk attitude prior to the financial shock matters, as the average relative risk aversion position was substantially lower for the group that experienced an increase in relative risk aversion (1.502 versus 2.406). This suggests that consumers who were less risk averse prior to the shock were more likely to become more risk averse after the financial shock. There were significant differences in the magnitude of the changes as well, as the group who experienced an increase in relative risk aversion saw their relative risk aversion nearly triple (almost a 200 percent increase). In contrast, the group that had a decrease (or no change) in relative risk aversion experienced a 56 percent decrease in relative risk aversion. This finding also suggests the impact of the economic shock was far greater on the group that became more risk averse.

Regression Results

The results for the logistic regression model are provided in Table 5. Model (1) is the reduced form model, and here the results indicate that households that saw an increase in assets became more risk averse, which

[13]Figures are based on converting the natural log results reported in Table 3. The human capital measure reflects the present value of the future income stream for the primary wage earner.

Table 4. Descriptive Statistics

Variable	Mean	Median	Minimum	Maximum	Std Dev
			Panel A: All Observations (N = 306)		
RRA83	2.087	1.166	.319	24.117	3.001
RRA89	2.250	1.004	.253	51.254	4.777
CHRRA	.163	–.191	–19.822	36.047	4.747
RRAINC	.353	.000	.000	1.000	.479
LNASSET83	12.212	12.025	10.119	14.419	1.359
CHLNASSET	.438	.520	–2.972	2.615	.774
LNHUMCAP83	12.992	12.902	11.859	14.309	.759
CHLNHUMCAP	–.016	.035	–2.202	2.335	.563
NEWKIDS	.239	.000	.000	4.000	.594
NEWMARRIED	.049	.000	.000	1.000	.216
NEWR	.020	.000	.000	1.000	.139
AGEP83	42.667	43.000	31.000	55.000	8.117
EDUCP83	14.408	15.500	5.000	17.000	2.593
MALEP83	.837	1.000	.000	1.000	.370
WHITEHH	.931	1.000	.000	1.000	.253
PCTSTOCK83	.072	.000	.000	.279	.104
			Panel B: RRAINC = 0 (N = 198)		
RRA83	2.406	1.375	.481	21.580	3.234
RRA89	1.042	.843	.253	13.859	1.179
CHRRA	–1.365	–.436	–19.822	–.004	2.751
			Panel C: RRAINC = 1 (N = 108)		
RRA83	1.502	.983	.319	24.117	2.425
RRA89	4.465	2.155	.454	51.254	7.406
CHRRA	2.963	.935	.013	36.047	6.169

ASSETS (83 and 89), HUMCAP (83 and 89), Stock Holdings, Financial Assets and PCTSTOCK83 are winsorized at the 1% and 99% levels.

Table 5. Logistic Regression Results (Dependent Variable = RRAINC)[a] (N = 306)

Variable	Model (1) Estimate	Model (2) Estimate
INTERCEPT	–1.4255***	–5.8437***
	(.2219)	(1.4327)
CHLNASSET	1.0556***	1.1541***
	(.2236)	(.2400)
CHLNHUMCAP	–2.7743***	–2.6510***
	(.3968)	(.4212)
NEWKIDS	.0070	.1258
	(.2449)	(.2646)
NEWMARRIED	–.4804	–.2842
	(.7037)	(.7339)
NEWR	1.7289*	1.3747
	(.9228)	(.9376)
AGEP83		.0511**
		(.0220)
EDUCP83		.1247*
		(.0682)
MALEP83		.7256
		(.4583)
WHITEHH		–.0874
		(.5767)
PCTSTOCK83	1.5876	–.8866
	(1.4092)	(1.6487)
LR statistic (df)	102.45 (6)	114.79 (10)

[a]Modeled on RRAINC = 1
NEWDIVORCED dropped from model due to an insufficient number of observations
P-values are in parentheses below each coefficient.
***= significant at 1%, **= significant at 5%, *= significant at 10%

is inconsistent with Hypothesis 2, but supports the IRRA hypothesis if wealth is measured in terms of assets. Households that experienced a reduction in human capital between these two periods became more risk averse, which is consistent with Hypothesis 2 and shows support of either the CRRA or DRRA hypothesis. Additionally, households where the respondent had retired between 1983 and 1989 were more likely to increase their risk aversion, which is consistent with Hypothesis 3. The greater propensity to experience increased risk aversion for newly retired households may be explained by a shift towards a fixed income and a limited ability to supplement income following a loss. Alternatively, the

significantly positive effect of *NEWR* on *RRAINC* may be due to the advanced age of retiring households rather than the change in employment status.

In order to control for the effects of age, and other demographic variables, on *RRAINC* we estimate Model (2), which includes the variables from Model (1) as well as additional demographic control variables. As with Model (1), the *CHLNHUMCAP* measure is negative and significant, indicating an inverse relation between the change in human capital and relative risk aversion. Additionally, the coefficient on *CHLNASSETS* remains positive and significant, indicating that relative risk aversion increases as a function of assets. The coefficients on *AGEP83* and *EDUCP83* are both positive and significant, indicating that older households and those with higher levels of education are more likely to increase their relative risk aversion following an economic shock. These results are consistent with Hypothesis 1. The lack of significance on *NEWR* in Model (2) suggests that this variable was capturing the effect of age on *INCRRA* in Model (1) rather than the effect of a life cycle event. The overall implication of Models (1) and (2) is that increases in risk aversion are driven by both financial and demographic factors. The relation between the underlying variables and increased relative risk aversion is largely consistent with what has been observed in a static setting (that focuses on the level of RRA). The direction of the relation between *INCRRA* and *CHLNHUMCAP*, *CHLNASSETS*, and *EDUCP*83 is consistent with that found by Halek and Eisenhauer (2001). However, the direction of the relation between *INCRRA* and *AGEP*83 is the opposite of what they report.

SUMMARY

The question of how human behavior is affected by risk has long been of interest to academics. At the theoretical level, research has considered measures of risk aversion (e.g., Pratt, 1964) and the relation between these measures and changes in wealth positions. Empirical research related to risk aversion has focused primarily on the magnitude of risk aversion as it relates to wealth, increasing relative risk aversion, the relation between risk aversion and demographic variables and, most recently, the context by which risk-taking measures are constructed. This study adds to the literature by evaluating the relations between risk aversion and the economic and demographic factors that are expected to be related to risk aversion on a dynamic basis. We utilize panel data from the Survey of Consumer Finances to capture financial and demographic data for the same family over two distinct time periods (1983 and 1989). The panel data allows us

to calculate changes in risk aversion for the same households around the 1987 stock market crash.

Our results shed light on behavioral and attitudinal changes in household risk taking around a financial shock. We find support for two of our proposed hypotheses: Increases in relative risk aversion are associated with changes in both financial and demographic characteristics. However, in our most comprehensive model we do not find support for the hypothesis that increased risk aversion is related to life-cycle events. These results help us better understand the factors that portend changes in relative risk aversion and provide some insights into the longer-term impact of an economic shock. Here, we find that the group that became more risk averse were those that started from a lower risk aversion baseline. The results show that responses following an economic shock differ based both on risk perceptions prior to the economic shock and on the economic experiences that the households have during this period.

In considering consumer reactions more generally, it is important to investigate factors that allow for better decision-making under uncertainty. Our results indicate households that react most strongly following a financial shock are those who initially exhibited lower levels of risk aversion. While one possible explanation is that the shock loss simply serves as a corrective event for this group where post-loss decisions and behavior more accurately reflect a household's true risk aversion, we would argue that it is more likely not this case for a larger percentage of these respondents. Regardless, the reaction to a financial shock for this group impacts their short-term (and perhaps long-term) decisions and, as noted in the introductory section, these can have long-term financial consequences. Our results support the need for continued financial education efforts at all ages that will improve consumer decision making under uncertainty. While the strength of the panel data is that it allows for this type of examination, the size of the data set limits our ability to make additional conclusions from our results. However, our results clearly suggest avenues for additional research and, ultimately, it is hoped that these findings and subsequent research help consumers to make better financial decisions throughout their lives.

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