HOUSEHOLD LIFE CYCLE PROTECTION: LIFE INSURANCE HOLDINGS, FINANCIAL VULNERABILITY AND PORTFOLIO IMPLICATIONS

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ABSTRACT. Using the Survey of Consumer Finances we examine the life cycle demand for different types of life insurance. Specifically we test for the consumer's avoidance of income volatility as a result of the death of a wage-earning household member through the purchases of life insurance. We first develop a financial vulnerability index to control for the risk to a household. We then examine the demand for life insurance using several definitions of life insurance. We find, in contrast to previous research, that there is a relationship between financial vulnerability and the amount of term life or total life insurance purchases. In addition, we find older consumers use less life insurance to protect a certain level of financial vulnerability than the younger consumers. Finally, the proportion of life insurance in a household portfolio decreases as the household gets older.

1. INTRODUCTION

A household's demand for life insurance depends on its economic and demographic structures. Using the Survey of Consumer Finances (SCF), our study examines the life cycle demand for different types of life insurance. First, we test for the consumer's avoidance of volatility of household income through the purchases of life insurance. We define financial vulnerability as the household's sensitivity to the loss of income due to the death of a spouse and develop a financial vulnerability index to control for this household's risk. We then examine the demand for life insurance using several types of life insurance. Finally, we examine consumer portfolios to see the relationship between insurance and other assets.

Merton (1975) indicated that the usual sources of consumer uncertainty include uncertainty about future capital income, future labor income (human capital), age at death, investment opportunities, and relative prices of consumer goods. Holden et al. (1986) and Hurd and Wise (1989) document sharp declines in living standards and increases in poverty rates among women whose husbands passed away. Analyzing data gathered during the

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1960s from households in middle-age through early retirement, Auerbach and Kotlikoff (1987, 1991a,b) found that roughly one-third of wives and secondary earners would have seen their living standards decline by 25 percent or more had their spouses actually died. While we know that life insurance can be demanded for a number of reasons, we look in particular at the life cycle income protection rationale for demanding life insurance.

Our study captures the relationship between the spouses by including a household's total life insurance held on the life of both the husband and the wife. In this paper we focus explicitly on those households with a married couple. Those households are between 20 and 64 years of age and at least one of spouses has regular earnings as an employee. Our index measures the financial vulnerability by the volatility of a couple's living standard as a whole. In the case of the breadwinner, the key determinant of the demand for life insurance is the effect of the insured's death on the future consumption of the other household members. In addition, our index is based only on the total amount of life insurance held by each household, and not on the individual demand for life insurance by each spouse. Our income volatility index does a good job in explaining the financial vulnerability of a household. In contrast to previous research, e.g. Bernheim et al. (2001), we find relationships between financial vulnerability and purchases of term life insurance and a relationship between vulnerability and total (sum of term life and whole life) purchases. Moreover, our life cycle empirical results show that the sensitivity of total life insurance to financial vulnerability decreases for older households. It suggests younger households are likely to use more life insurance to manage its financial vulnerability but the household substitutes the price-increasing life insurance for other protection methods as it gets older.

Our empirical examination of the consumer portfolios suggests that mutual funds are complements to total life insurance for the young-aged and bonds are complements to total life insurance for all ages. However, the real estate is a substitute for total life insurance. Moreover, the proportion of total life insurance in a household's portfolio decreases as the household gets older.

The paper is organized as follows. Section 2 provides our method for measuring financial vulnerability, and section 3 describes the data, variables and hypotheses. Section 4 discusses our estimation methodology. Section 5 shows the results of the relationship between households' life insurance holdings and financial vulnerability with pooled and life cycle data respectively. We then examine the household's portfolio to see the relationship between life insurance and other assets. The final section summarizes the study.

2. A Different Strategy for Measuring Financial Vulnerability

2.1. **Concept.** Bernheim et al. (2001) adopted a yardstick for quantifying financial vulnerability: the percentage decline in an individual's sustainable living standard that would result from a spouse's death. To calculate this decline, they made use of a life cycle model embodied in the financial planning software, Economic Security Planner (or ESPlanner).[1] The model underlying ESPlanner is a dynamic life cycle consumption model and uses the household's highest sustainable living standard to obtain the benchmark life insurance holding. Bernheim et al. (2001) use this benchmark life insurance holding to determine the vulnerability which is the difference between current life insurance holdings and the benchmark. Our first concern is whether it is appropriate to use the highest sustainable living standard to obtain the benchmark. In reality, people normally lead a life style below their highest living standard. If consumers are prudent, they will set aside some money to for a "rainy day" (Kimball, 1990). Our second concern is that if the benchmark from ESPlanner does not accurately reflect a households' financial vulnerability, it is likely that Bernheim et al. (2001) would conclude there is no significant correlation between life insurance and financial vulnerability.

Bernheim et al. (2001) also failed to make distinctions between term life insurance and whole life insurance demand in their analysis. There are differences between term life insurance and whole life insurance. First, whole life insurance has a cash value while term life insurance has no cash value. Second, the duration of whole life insurance is generally much longer than term insurance. Third, term life insurance is naturally suited for ensuring that mortgages and other loans are paid on the debtor/insured's death and as a vehicle for ensuring that education or other needs are available if death were to cut short the period needed for the provider/insured to earn the needed funds. Finally, whole life insurance can serve as a quasi-forced savings plan (Black and Skipper, 2000). The differences between the two types of insurance may lead to differences in the household's insurance purchasing behavior. Since income is the most important factor influencing a couple's living standard and we assume people like to maintain their living standard for the long run, our assumption is that current whole life and term life insurance holdings reflect a household's current perception of overall future potential financial vulnerability.

[1]Economic Security Planner, Inc. provides free copies of the software for academic research: www.ESPlanner.com.

2.2. **Financial Vulnerability Index.** One of the primary assumptions regarding a couple's standard of living involves determining the relative cost savings from living together versus separately. There are fixed costs of operating a household which can be "shared" between spouses. For example, an expenditure of $\widehat{C}$, when there are two adults in the household provides the same standard of living for each household member as does an expenditure of C when there is only one adult in the household.We use the value 0.678 which was suggested by Bernheim et al. (2001) to indicate the household scale economies.[2] It implies that a two-adult household must spend 1.5999 (=$2^{0.678}$) times as much as a one-adult household to achieve the same living standard. Bernheim et al. (2001) further considered the effects of the number of the children and use OECD child-adult equivalency factor 0.5. We also use this equivalent factor. Furthermore, we make the following assumption: the ratio of consumption (C_i) to labor earnings (Y_i) is constant for each household i. That is,

$$C_i = \alpha_i * Y_i. \tag{1}$$

The reason why we use labor earnings instead of the sum of household salaries and non-salary income to capture a household's financial vulnerability is that the non-salary income, e.g. income of investment assets can be earned by an individual even if his/her spouse dies. The term α_i absorbs the effects of taxation, future obligations, saving and income growth rate, inflation and other factors.

When both of spouses are alive, the living standard of the household i is

$$C_i = \alpha_i \frac{Y_{\text{hus,i}} + Y_{\text{wife,i}}}{(2 + \frac{N}{2})^{0.678}}. \tag{2}$$

The variable $Y_{\text{hus,i}}$ is the husband's main job and non-main job salary of the household i , $Y_{\text{wife,i}}$ is the wife's main job and non-main job salary of the household i and C_i is the living standard of household i when both of spouses are alive. N is the number of the dependent children. $2^{0.678}$ measures the household scale economies.

When the husband dies, the living standard of the wife $C_{\text{wife,i}}$ becomes

$$C_{\text{wife,i}} = \alpha_i \frac{Y_{\text{wife,i}}}{(1 + \frac{N}{2})^{0.678}}. \tag{3}$$

The impact on the wife of the household i if her husband dies $(\text{IMPACT}_{\text{wife,i}})$ can be expressed as the percentage decline in her living standard:

[2]The OECD uses a value of 0.7 for the exponent (see Ringen (1991)).

$$\text{(4)} \quad \text{IMPACT}_{\text{wife,i}} = \frac{C_{\text{wife,i}}}{C_i} - 1 = \frac{Y_{\text{wife,i}}(2+\frac{N}{2})^{0.678}}{(Y_{\text{hus,i}}+Y_{\text{wife,i}})(1+\frac{N}{2})^{0.678}} - 1.$$

Correspondingly, when the wife dies, the living standard of the husband $C_{\text{hus,i}}$ is

$$\text{(5)} \quad C_{\text{hus,i}} = \alpha_i \frac{Y_{\text{hus,i}}}{(1+\frac{N}{2})^{0.678}}.$$

The impact on the husband of the household i if his wife dies $(\text{IMPACT}_{\text{hus,i}})$ is given by

$$\text{(6)} \quad \text{IMPACT}_{\text{hus,i}} = \frac{C_{\text{hus,i}}}{C_i} - 1 = \frac{Y_{\text{hus,i}}(2+\frac{N}{2})^{0.678}}{(Y_{\text{hus,i}}+Y_{\text{wife,i}})(1+\frac{N}{2})^{0.678}} - 1.$$

Our index of financial vulnerability (IMPACT_i) of the household i can then be defined as

$$\text{(7)} \quad \text{IMPACT}_i = \sqrt{q_{x,i}^{\text{hus}} \bar{Y}_{\text{hus,i}} (\text{IMPACT}_{\text{wife,i}})^2 + q_{y,i}^{\text{wife}} \bar{Y}_{\text{wife,i}} (\text{IMPACT}_{\text{hus,i}})^2}.$$

The index we defined is similar to the definition of standard deviation. The variable $q_{x,i}^{\text{hus,i}}$ is the one-year death probability of the husband aged x of the household i in the survey year and $q_{y,i}^{\text{wife}}$ the one-year death probability of the wife aged y of the household i in the survey year. We use the 1990-1995 US SOA Life Insurance Basic Mortality Table to capture the mortality experience of the observed household. The reason why we use one-year death probability is that the current life insurance holding reflects the household's expectation of its potential risks if one of spouses dies in the foreseeable future, e.g. one year. The variables $\bar{Y}_{\text{hus,i}}$ and $\bar{Y}_{\text{wife,i}}$ are the scaled husband's labor income and the scaled wife's labor earnings respectively.[3] The reason why we include the scaled labor income in our financial vulnerability index is to capture two effects: on the one hand, it takes into account of the "absolute" consumption need of a surviving spouse (and other members of the family) since *ceteris paribus* the family with a higher level of income certainly needs more life insurance coverage upon its more important wage-earner's death because of its more expensive lifestyle given its higher family income; on the other hand, the scaled income may pick up the non-linear relationship between income and consumption. It may be that the low-income household needs to consume most of its income and

[3]We divide the husband's income $Y_{\text{hus,i}}$ and the wife's income $Y_{\text{wife,i}}$ by 10,000 respectively.

the high-income household is able to save.[4] Our index also solves one of the main problems to use this dataset: the Survey of Consumer Finances reports the results of the survey based on a household instead of an individual. Our index measures the financial vulnerability by the volatility of a couple's living standard as a whole. IMPACT_i thus captures the volatility of a household's financial situation if one of spouses dies.

3. DATA, VARIABLES, AND HYPOTHESIS

We now turn to an empirical examination of the effects of financial vulnerability on the household's demand for term life insurance, whole life insurance and total life insurance. Firstly, we exam the pooled data and then investigate the relationship with a life cycle analysis. In addition to the above approach of using household income volatility as a proxy of financial vulnerability, we will control for other influential factors to clarify the relationship between different types of life insurance demand and financial vulnerability in our regression models. Finally, we explore a household's asset portfolio.

3.1. **Data Description.** The sample for our study consists of the 1992, 1995, 1998 and 2001 years of the Survey of Consumer Finances. In each of these four years, the survey covered over 4,000 households. The data includes demographic, income, wealth, debt and credit, pensions, attitudes about financial matters, the nature of transactions with various types of financial institutions, housing, real estate, business, vehicles, health and life insurance, current and past employment, current social security benefits, inheritances, charitable contributions, education, and retirement plans. The architects of the SCF data files imputed missing information, supplying five "implicates" for each household.[5] Following Bernheim et al. (2001), we use the first implicate in this study.[6] Further, the SCF data is not a panel data since the respondents are different in these four surveys. We can treat each year's whole data set as a "representative" observation. More specifically, the same age group has different assets, debts, obligations, etc. Similarly, households with same obligations belong to different age groups, etc. So the total number of observations in a year can be treated as a dynamic process. Moreover, we use year indicator variables to capture the time effects.[7]

[4]We thank two anonymous referees' valuable comments on this issue.

[5]Kennickell (1994) provides a description of the imputation procedure.

[6]The main function of the first iteration is to create reliable starting values. Since after each imputation is made the resulting value is taken to be "real" in the succeeding imputations (Kennickell, 1994), we deem the first implication is more accurate and more appropriate for our analysis.

[7]We obtain similar results when we run the regressions on each year's survey separately.

Because we are looking at those who have the need for life insurance we restrict the ages of the respondents to a range from 20 to 64. Following Bernheim et al. (2001), we exclude the observations that neither spouse had regular earnings as an employee. Accurate measurement of life insurance coverage is, of course, particularly critical for our analysis. Our final sample consists of 7,533 married couples for the 1992, 1995, 1998 and 2001 years of the Survey of Consumer Finances. Variables in dollars are all in year 2001 dollars. Fortunately, the SCF data match up reasonably well with other sources of information concerning this variable.[8] Table 1 shows the descriptive statistics for our sample. "Net amount at risk" is the difference between face value of whole life insurance and whole life cash value. "Salary and wage" refers to the main job and non-main job salary and wage. "Cash" includes checking accounts, saving accounts, money market deposit accounts, money market mutual funds, call accounts at brokerages and certificates of deposit. "Mutual fund" includes stock mutual funds, tax-free bond mutual funds, government bond mutual funds, other bond mutual funds, combination and other mutual funds and total directly-held mutual funds, excluding market-money mutual funds. "Stock" refers to the publicly traded stock. "Bond" includes tax-exempt bonds (state and local bonds),mortgage-backed bonds, US government and government agency bonds and bills, corporate and foreign bonds and savings bonds. "A household's individual retirement account" includes individual retirement account, thrift accounts and future pensions. "Individual annuity not including job pension" refers to other managed assets such as trusts, annuities and managed investment accounts in which a household has equity interest. "Real estate" is the sum of the value of primary residence, other residential real estate and net equity in nonresidential real estate. If a household only owns a part of the property, the value reported should be only the household's share. "Other assets" are a household's total assets excluding whole life cash value, cash, mutual fund, stock, bond, individual annuity not including job pension, individual retirement account and real estate. The education level of respondents and spouses reflects the number of years of schooling. The baby boom indicator equals one if the respondent or the spouse was born between 1946 and 1964, and zero otherwise.

[8]Bernheim et al. (2001) made some comparisons between statistics on life insurance coverage (including all individual and group policies) drawn from the SCF and from a survey fielded by the life Insurance Marketing Research Organization (LIMRA). Furthermore, they computed the aggregate amount of in-force life insurance implied by the SCF survey responses, and compared this with total in-force life insurance reported by the industry (obtained from the ACLI (1999)). They concluded that there is no indication that the SCF understates life insurance coverage.

An important characteristic of the SCF is that it contains information only on the total amount of term life insurance and total amount of whole life insurance held by each household, and not on the division of this insurance between spouses. Bernheim et al. (2001) estimated a regression model explaining the fraction of a couple's total life insurance held on the life of husband as a function of the age of each spouse, the husband's earnings, the husband's share of the couple's total non-asset income, family size, and the husband's share of the couple's total benchmark life insurance. Due to the nature of the data, this type of estimation may be biased because they do not look at household purchases of insurance (Lewis, 1989). It could lead to the conclusion that there is no correlation between life insurance demand and financial vulnerability. Thus, we try to explore the relation between different types of life insurance demand and financial vulnerability directly based on the structure and characteristics of the household.

3.2. **Dependent Variables and Hypotheses.** From the perspective of consumers, we consider the policy face value and the "net amount at risk" of whole life insurance as proxies of whole life insurance quantity demanded and the face value of term life insurance as a proxy of term life insurance quantity demanded. The face value is the amount an insurer will pay to the beneficiary when the insured dies. The face value also reflects the amount a household perceives is appropriate to manage its financial vulnerability. However, there is a problem with face value of whole life insurance as policy reserves stated on a per-policy basis can be considered as "vanishing" or ending with the insured's death. Under this view of the reserve, the actual amount of pure whole life insurance protection at any point is the difference between the policy reserve at that point and the face amount. This difference is called the "net amount at risk" (Black and Skipper, 2000). Thus, the net amount at risk is also a good proxy of the quantity of whole life insurance demanded from the standpoint of the purchaser.

We consider our dependent variables to convey more information about life insurance demand and its relation with financial vulnerability than the previous research as these have typically used face amount. Because of the skewness of the face value or the net amount at risk, we use a logarithmic transformation. Since Bernheim et al. (2001) explored the relationship based on the total insurance demand, we also try to study this relationship by two different total life insurance demand definitions. The first total life insurance is defined as the sum of whole life insurance and term life insurance face values. The second total life insurance definition is the sum of term life insurance face value and the net amount at risk of whole life insurance.

According to Ando and Modigliani (1963)'s life cycle theory, an individual's income will be low in the beginning and end stages of life and high during the middle earning years of life. Term insurance can be useful for persons with low incomes and high insurance needs (Black and Skipper, 2000). Since younger families have lower income and less wealth accumulation, they may desire lower-cost insurance protection. On the other hand, while older families possibly have lower income, they have already accumulated a certain amount of wealth. It is possible that an annuity is a substitute for life insurance. In addition, Chen et al. (2001) state that baby boomers tend to purchase less life insurance than their earlier counterparts. Baby boomers are in the middle-age and older-age groups in our study. We predict that there will be a more significant relationship between younger household's life insurance holdings and its financial vulnerability.

Table 1: Summary Statistics for the Survey of Consumer Finances 1992, 1995, 1998 and 2001 Waves

Variable Description	Mean	Stan.Dev.	Minimum	25th	50th	75th	Maximum
Dependent Variables							
Face value of whole life insurance	$346,290	2,170,702	0	0	0	98,100	87,000,000
Cash value	$47,772	430,688	0	0	0	9,072	21,820,000
Net amount at risk	$308,627	2,038,791	0	0	0	68,672	86,786,560
Face value of term life insurance	$431,080	2,125,039	0	0	58,000	272,500	80,000,000
Term life + whole life face value	$777,370	3,204,973	0	25,000	147,150	450,000	93,960,000
Term life face value + whole life NAR	$739,707	3,099,074	0	19,620	133,400	436,000	93,746,560
Independent Variables							
Financial vulnerability index	0.1630	0.2257	0.0093	0.0548	0.0960	0.1818	5.9757
Salary and wage of the respondent	$121,258	603,505	0	22,620	43,000	81,750	24,476,000
Salary and wage of the spouse	$25,136	70,518	0	0	15,070	32,016	3,787,400
A household's total salary and wage	$146,393	607,666	5,000	37,976	65,000	113,000	24,476,000
Age of the respondent	43.6988	10.6959	20	35	44	52	64
Age of the spouse	41.7395	10.5537	16	34	42	50	82
Respondent's age-the spouse's age	3.4652	3.7452	0	1	2	5	45
Sizable inheritance expected	$132,029	1,626,872	0	0	0	0	112,140,000
Cash	$157,414	1,103,210	0	1,543	7,560	37,800	60,152,200
Mutual fund	$136,547	1,188,271	0	0	0	0	56,700,000
Stock	$680,546	8,319,873	0	0	0	10,000	394,700,000
Bond	$227,815	2,527,568	0	0	0	545	135,465,200
Individual annuity not including job pension	$257,354	3,994,620	0	0	0	0	163,500,000
A household's individual retirement account	$164,122	812,614	0	0	15,260	99,190	40,646,400
Real estate	$750,854	3,045,159	0	50,400	155,000	441,000	126,633,780
Other assets	$188,020	2,179,031	0	8,000	53,000	135,000	175,000,000
Total debt of the household	$3,271,103	22,595,167	0	11,300	26,378	173,637	698,060,160
Education level of the respondent	14.1649	2.6244	1	12	14	16	17
Education level of the spouse	13.8909	2.6375	0	12	14	16	17
Desire to leave a bequest	41.617%	49.296%	0	0	0	1	1
Foreseeable major financial obligations	59.087%	49.171%	0	0	1	1	1
Whole life annual premium/face value	0.677%	2.513%	0.001%	0.010%	0.010%	0.265%	46.765%
Year 1992 dummy	22.235%	41.583%	0	0	0	0	1
Year 1995 dummy	25.395%	43.530%	0	0	0	1	1

Table 1: Summary Statistics for the Survey of Consumer Finances 1992, 1995, 1998 and 2001 Waves (**Continued**)

Variable Description	Mean	Stan.Dev.	Minimum	25th	50th	75th	Maximum
Year 1998 dummy	25.687%	43.694%	0	0	0	1	1
Year 2001 dummy	26.683%	44.233%	0	0	0	1	1
Baby boom indicator of the respondent	55.648%	49.683%	0	0	1	1	1
Baby boom indicator of the spouse	58.688%	49.243%	0	0	1	1	1

Number of observations: 7,533.

3.3. **Other Explanatory Variables and Hypotheses.** In addition to independent variable IMPACT$_i$, other differences, such as demographic characteristics, financial situation and obligations, among couples are expected to affect life insurance demand. When we identify those factors, it will give us a clearer relationship between life insurance demand and financial vulnerability.

Assets. Intuitively, the wealth a person holds will influence his or her life insurance purchases. The relation between the demand for life insurance and wealth is ambiguous as it depends upon a consumer's risk tolerance. It is possible that an individual increases his life insurance demand with increasing wealth. It is also possible that a person will mainly put the increment of wealth into savings because he thinks he can handle risks with his improved economic strength. If so, life insurance can be an inferior good. Fortune (1973) found that per capita wealth was related negatively to "net" life insurance in force. This was attributed to the fact that increases in wealth lead to decrease in aversion to risk.

In order to identify the effect of different types of assets on the different types of life demand, we split the assets into several categories. We include cash and cash equivalents, mutual funds, stocks, bonds, annuities, individual retirement accounts, real estate and other assets. All of the above assets are all measured based on the unit of the household using the log value. In order to capture potential quadratic effects, we further include second-order terms.

Debts. Good risk management principles suggest the family unit should be protected against catastrophic losses. Life insurance can be a way to ensure that mortgages and other obligations are paid on the insured's death. Again, it is ambiguous whether there is a positive relationship between life insurance holdings and debts of a household.

Education. Education tends to be a good predictor of earning ability over the long term. It is also associated with wealth, financial vulnerability and life insurance demand. Burnett and Palmer (1984) show that higher education is associated with higher life insurance demand even allowing for the higher incomes. However, Goldsmith (1983) concludes that households with a more educated wife, *ceteris paribus*, have a lower likelihood of purchasing term insurance on the husband. Thus the overall effect of education on a household's insurance holdings is uncertain.

Inheritance, Obligations, Bequests and Emergencies. In the SCF data, there is a question concerning an expected inheritance. Thus, we are able to control for a potential substitute for the life insurance. Also the survey asked whether there are any foreseeable major financial obligations expected to

be met in the future such as educational expenses, health care costs and so forth. We control for these fixed obligations that life insurance may finance if one of spouses dies. Finally, we consider a household's desire to leave a bequest and also include it as one of independent variables.

Price. Price is a critically important determinant of insurance demand and supply. However, the fact remains that no completely satisfactory national measures of price exist and the price elasticity of life insurance is not well understood (Black and Skipper, 2000). Babbel (1985) examined the price elasticity of whole life insurance policies issued in the United States, using various price measures. Under his methodology, he found prices to be negatively related to new sales, with elasticity ranging from -0.32 to -0.92. We also predict a negative relation between the whole life insurance price and whole life insurance demand in the SCF. We use the premium per $1 face value as our price measure.[9]

Term Life Insurance. Term life insurance furnishes protection for a limited number of years at the end of which the policy expires, meaning that it terminates with no maturity value. The face amount of the policy is payable only if the insured's death occurs during the stipulated term, and nothing is paid in case of survival. Term insurance can be the basis for one's permanent insurance program through a so-called buy-term-and-invest-the-difference (BTID) arrangement. The difference between the higher-premium cash-value policy and the lower-premium term policy is to be invested separately, such as in a mutual fund, savings account, an annuity, or other investment media. The hope is that the term plus the separate investment will outperform the cash-value life insurance policy (Black and Skipper, 2000). Thus, we predict that the term life insurance is a substitute for the whole life insurance. So we use the log value of the term life face value in the whole life demand function.

Age. The relationship between age and life insurance is ambiguous. Burnett and Palmer (1984) do not find a significant relationship between age and life insurance holdings. For older people, they may have a greater desire to leave a bequest. However, they may have a binding budget constraint when approaching retirement. In our model, we further explore the impact of the absolute age difference between the husband and the wife on different types of life insurance demand.

[9]We come up with this price proxy based on the data we can get from the Survey of Consumer Finances.

Income. We include household labor income in our model. Income, like wealth, may have ambiguous term. If the consumer has decreasing absolute risk aversion, he will purchase less insurance at higher levels of income due to decreasing marginal utility of income. However, we know that as income increases new types of risks arise. For example, consumers may buy bigger houses and may incur more expensive obligation. Thus, one could hypothesize a positive relationship between income and insurance demand. Burnett and Palmer (1984) find a significant and positive relationship between income and life insurance holdings.

4. ESTIMATION METHODOLOGY

The regression equations were estimated initially using ordinary least squares (OLS). OLS is potentially problematical because there is about 35% zero term life face value, 58% zero whole life face value and 16% zero total life insurance face value. Tobit models under this situation will give us consistent estimates. Moreover, we suspect that there are endogeneity issues arising from the relationships between independent variables in the whole life insurance regression: log value of premium with age and log value of cash value. Thus, we account for endogeneity of price and a non-normally distributed dependant variable by employing a simultaneous Tobit estimation procedure. Our simultaneous-equation Tobit model is defined as:

$$premrate = \alpha_1 + \beta_1' X_1 + \varepsilon_1 \tag{8}$$

$$Log(\textbf{wlife}) = \alpha_2 + \beta_2 premrate + \beta_3 \text{IMPACT} + \phi' X_2 + \varepsilon_2$$

$$\text{where } Log(\textbf{wlife}) = 0 \text{ if } \textbf{wlife} \leq 0$$

$$\text{and cov}(\varepsilon_1, \varepsilon_2) \neq 0,$$

where $premrate$ is the premium per \$1 of whole life coverage, IMPACT is our vulnerability index, and **wlife** is the measure of whole life insurance face value, cash value and net amount at risk respectively.

After we estimated the simultaneous-equation Tobit model, we found the simultaneous structure is not appropriate.[10] The SCF does not include the information on the term life insurance premium. We also assume the regression on the term life insurance does not have the endogeneity problem. So we employ the ordinary Tobit estimation of the life insurance demand model. In addition to three different dependent variables to measure whole life insurance demanded (log of whole life face value, log of cash value of

[10]Since $\sigma_{12}/\sigma_2^2 = -1.3414$ and is insignificant (p-value = 1.0000), we cannot reject the hypothesis of no endogeneity.

whole life and log of net amount at risk of whole life), we estimate another three quantities: log of term life face value, log of sum of term life face value and whole life face value and log of sum of term life face value and whole life net amount at risk. Since there are many zero values in our dependent variables, we add a relatively small value (0.00001) to those with zero. We then test for the sensitivity with respect to adding this small value and find that the results are robust to size of the data transformation. We then estimate the following Tobit regression:

$$Log(\textbf{LifeIns}) = \alpha_3 + \gamma \text{IMPACT} + \beta' X + \varepsilon_3, \tag{9}$$

where **LifeIns** stands for six different dependent variables representing quantity of insurance demanded. IMPACT is our financial vulnerability index. We expect the coefficient γ is positive which means that a household increases its life insurance holdings with increasing financial vulnerability. The vector X stands for other explanatory variables.

5. Estimation Results

5.1. **Pooled Analysis.** This sub-section presents the results of the tests of the relationship between different life insurance holdings and a household's financial vulnerability with the pooled data. We also provide the robustness test.

5.1.1. *Pooled Analysis Results.* The regression models in Table 2 show that there is no significant relationship between a household's financial vulnerability and its whole life insurance holdings in all three Tobit regressions (face value, cash value and net amount at risk) as the marginal effects of the financial vulnerability index are all insignificant. An important conclusion to be drawn from Table 3 is that there is a positive and significant relationship between a household's term life insurance and the sum of term life and whole life insurance face value respectively and its financial vulnerability. The higher volatility of potential living standard implies more term or total life insurance purchases. The results suggest that households tend to use term life or a combination of term life and whole life insurance instead of solely whole life insurance to reduce their potential financial vulnerability. Our results are opposite to Bernheim et al. (2001)'s conclusion because they do not find this relationship specifically as they only look at total life purchases.

The education levels of the husband and the wife in the six Tobit models are almost all positive and statistically significant, consistent with Burnett and Palmer (1984). The effect that a more educated household has a greater

likelihood of understanding the need for insurance dominates the substitution effect of the wife's human capital (education) for "pure" insurance on the husband. The results also provide some evidence that life insurance demand is related to the bequest motive. If a couple desires to leave an estate, the evidence suggests a positive relationship between a bequest and the demand for total life insurance.

We also note the relationship between term and whole life insurance in the demand equation. Term life insurance is significantly and negatively related to whole life insurance which means that term life insurance is a substitute for the whole life insurance.

Our age and quadratic age explanatory variables are only marginally significant with the pooled data. However, the age difference between the spouses is significant and negative in the first-order term but significant and positive in the quadratic term in the term life model and total life model. After we explore the total marginal effect of age on the demand for life insurance, we see a negative relationship between age difference between spouses and life insurance demand. This suggests that when the age difference between spouses increases, the household tends to use other methods instead of life insurance to manage their risks because the price of life insurance may be too high for the elder spouse.[11]

Another finding is that labor income of both spouses is positively related to the whole life cash value, the term life and total insurance demand in our Tobit models. Foreseeable major financial obligations expected to be met in the near future such as educational expenses, health care costs and so forth are positively and significantly related to the term life and total life insurance demand but we do not find this relationship for the whole life net amount at risk. In this sense, people tend to use term life insurance instead of whole life net amount at risk to manage their current or short-term obligation.

[11]We also explore the impact of the baby boom cohort on the life insurance demand. The Baby Boom generation refers to the cohort born between 1946 and 1964. Contrary to the finding of Chen et al. (2001), we do not find a significant difference of the baby boom cohort's life insurance purchasing behavior from earlier or later counterparts. Since controlling for whether a householder belongs to the baby boom cohort does not improve our regression results, we do not include it in our regression model.

Table 2: Estimated Tobit Model to Investigate the Relationship between the Whole Life Insurance Holding and the Financial Vulnerability with Pooled Data

Variable	Log(Face Value+0.00001)		Log(Cash Value+0.00001)		Log(NAR+0.00001)	
	Estimate	M. E.[a]	Estimate	M. E. [a]	Estimate	M. E. [a]
Intercept	-0.8521	-0.8459	-62.2563	-29.0463***	-6.2555	-3.2584***
	(0.874)	(0.867)	(4.815)	(2.205)	(2.316)	(1.206)
Financial vulnerability index	0.3956	0.3927	1.6409	0.7656	0.6411	0.3339
	(0.255)	(0.253)	(1.421)	(0.663)	(0.662)	(0.345)
Whole life annual premium/face value	-3.4532	-3.4281**	170.9790	79.7721***	-11.1388	-5.8019***
	(1.349)	(1.339)	(8.866)	(4.151)	(3.431)	(1.797)
Year 1995 dummy	-0.9858	-0.9786***	-1.4609	-0.6816**	-2.4562	-1.2794***
	(0.125)	(0.124)	(0.718)	(0.335)	(0.326)	(0.170)
Year 1998 dummy	-1.1014	-1.0934***	-3.2065	-1.4960***	-2.3324	-1.2149***
	(0.128)	(0.127)	(0.727)	(0.339)	(0.333)	(0.174)
Year 2001 dummy	-1.5527	-1.5415***	-5.6048	-2.6150***	-3.5128	-1.8297***
	(0.134)	(0.132)	(0.739)	(0.344)	(0.349)	(0.182)
Log(sizable inheritance expected)	0.0072	0.0072	0.1127	0.0526**	0.0118	0.0061
	(0.010)	(0.010)	(0.056)	(0.026)	(0.026)	(0.013)
Log(total debt of the household)	0.0277	0.0275**	0.2009	0.0937***	0.1085	0.0565***
	(0.013)	(0.013)	(0.071)	(0.033)	(0.033)	(0.017)
Log(other assets)	0.0623	0.0619***	0.6416	0.2993***	0.1686	0.0878***
	(0.020)	(0.020)	(0.108)	(0.050)	(0.052)	(0.027)
Age of the respondent	-0.0054	-0.0054	0.0659	0.0307	-0.1564	-0.0815
	(0.057)	(0.057)	(0.310)	(0.144)	(0.151)	(0.078)
(Age of the respondent)^2	-0.0004	-0.0004	0.0018	0.0008	0.0007	0.0004
	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.001)
Age of the spouse	0.0100	0.0099	0.5841	0.2725**	0.1351	0.0704
	(0.054)	(0.053)	(0.294)	(0.137)	(0.142)	(0.074)
(Age of the spouse)^2	-0.0002	-0.0002	-0.0068	-0.0032**	-0.0015	-0.0008
	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.001)
Respondent's age-the spouse's age	-0.0260	-0.0258	-0.4922	-0.2296***	-0.0424	-0.0221

Table 2: Estimated Tobit Model to Investigate the Relationship between the Whole Life Insurance Holding and the Financial Vulnerability with Pooled Data (**Continued**)

Variable	Log(Face Value+0.00001)		Log(Cash Value+0.00001)		Log(NAR+0.00001)	
	Estimate	M. E.[a]	Estimate	M. E. [a]	Estimate	M. E. [a]
	(0.029)	(0.029)	(0.156)	(0.073)	(0.076)	(0.040)
(Respondent's age-spouse's age)^2	0.0002	0.0002	0.0111	0.0052	-0.0005	-0.0003
	(0.002)	(0.002)	(0.009)	(0.004)	(0.004)	(0.002)
Log(salary and wage of the respondent)	-0.0052	-0.0052	0.2498	0.1165***	0.0194	0.0101
	(0.013)	(0.013)	(0.074)	(0.034)	(0.035)	(0.018)
Log(salary and wage of the spouse)	-0.0030	-0.0029	0.1241	0.0579**	-0.0214	-0.0112
	(0.010)	(0.010)	(0.058)	(0.027)	(0.027)	(0.014)
Education level of the respondent	0.0214	0.0212	0.2301	0.1073*	0.1498	0.0780**
	(0.025)	(0.025)	(0.134)	(0.063)	(0.065)	(0.034)
Education level of the spouse	0.0208	0.0207	0.0065	0.0030	-0.0013	-0.0007
	(0.024)	(0.024)	(0.129)	(0.060)	(0.062)	(0.032)
Desire to leave a bequest	-0.1136	-0.1128	1.2590	0.5874**	-0.3641	-0.1897
	(0.103)	(0.102)	(0.572)	(0.267)	(0.269)	(0.140)
Log(cash+cash equivalent)	0.0418	0.0415	1.8356	0.8564***	-0.1691	-0.0881
	(0.062)	(0.062)	(0.336)	(0.156)	(0.166)	(0.086)
(Log(cash+cash equivalent))^2	-0.0056	-0.0056	-0.0685	-0.0320***	0.0026	0.0014
	(0.004)	(0.004)	(0.021)	(0.010)	(0.010)	(0.005)
Log(mutual fund)	0.0726	0.0721	0.5502	0.2567**	-0.0205	-0.0107
	(0.046)	(0.046)	(0.263)	(0.123)	(0.119)	(0.062)
(Log(mutual fund))^2	-0.0064	-0.0063*	-0.0379	-0.0177*	-0.0003	-0.0002
	(0.004)	(0.004)	(0.022)	(0.010)	(0.010)	(0.005)
Log(stock)	0.0282	0.0279	0.0080	0.0037	0.0175	0.0091
	(0.036)	(0.036)	(0.199)	(0.093)	(0.092)	(0.048)
(Log(stock))^2	-0.0029	-0.0028	0.0007	0.0003	-0.0005	-0.0003
	(0.003)	(0.003)	(0.016)	(0.008)	(0.008)	(0.004)
Log(bond)	0.0034	0.0034	1.0629	0.4959***	0.1071	0.0558
	(0.032)	(0.032)	(0.180)	(0.084)	(0.083)	(0.043)

Table 2: Estimated Tobit Model to Investigate the Relationship between the Whole Life Insurance Holding and the Financial Vulnerability with Pooled Data (**Continued**)

Variable	Log(Face Value+0.00001)		Log(Cash Value+0.00001)		Log(NAR+0.00001)	
	Estimate	M. E.[a]	Estimate	M. E. [a]	Estimate	M. E. [a]
$(\text{Log(bond)})^2$	0.0002	0.0002	-0.0699	-0.0326***	-0.0072	-0.0038
	(0.003)	(0.003)	(0.016)	(0.007)	(0.007)	(0.004)
Log(annuity)	-0.0370	-0.0367	0.5871	0.2739*	-0.0627	-0.0327
	(0.060)	(0.060)	(0.349)	(0.163)	(0.154)	(0.080)
$(\text{Log(annuity)})^2$	0.0030	0.0029	-0.0299	-0.0140	0.0077	0.0040
	(0.005)	(0.005)	(0.026)	(0.012)	(0.012)	(0.006)
Log(a household's individual retirement account)	0.0346	0.0344	0.6180	0.2883***	0.0641	0.0334
	(0.039)	(0.039)	(0.215)	(0.100)	(0.102)	(0.053)
$(\text{Log(a household's individual retirement account)})^2$	-0.0044	-0.0044	-0.0208	-0.0097	-0.0064	-0.0033
	(0.003)	(0.003)	(0.018)	(0.008)	(0.008)	(0.004)
Log(real estate)	0.0900	0.0894*	1.4070	0.6564***	0.3587	0.1868***
	(0.050)	(0.049)	(0.274)	(0.128)	(0.130)	(0.067)
$(\text{Log(real estate)})^2$	-0.0042	-0.0042	-0.0803	-0.0375***	-0.0231	-0.0120**
	(0.004)	(0.004)	(0.022)	(0.010)	(0.010)	(0.005)
Foreseeable major financial obligations	0.0617	0.0612	1.0905	0.5088**	0.2052	0.1069
	(0.096)	(0.096)	(0.535)	(0.249)	(0.251)	(0.131)
Log(cash value)	1.3458	1.3361***			1.7014	0.8862***
	(0.007)	(0.006)			(0.020)	(0.016)
Log(face value of term life insurance)	-0.0123	-0.0122***	-0.4701	-0.2193***	-0.0178	-0.0093*
	(0.004)	(0.004)	(0.023)	(0.011)	(0.010)	(0.005)
Log-likelihood	-8149.84		-16137.91		-10802.74	

Number of observations: 7,533;
Standard errors are presented below the estimated coefficients;
[a] Marginal effects (M. E.) of Tobit models are computed at the mean of Xs;
*** Significant at 1% level;
** Significant at 5% level;
* Significant at 10% level.

Table 3: Estimated Tobit Model to Investigate the Relationship between the Term Life and Total Life Insurance Holding respectively and the Financial Vulnerability with Pooled Data

Variable	Log(Term Life Face Value + 0.00001)		Log(Term Life + Whole Life Face Value + 0.00001)		Log(Term Life Face Value + Whole Life NAR + 0.00001)	
	Estimate	M. E.[a]	Estimate	M. E. [a]	Estimate	M. E. [a]
Intercept	-42.0603	-33.3480***	-18.2292	-17.9886***	-20.1606	-19.7429***
	(3.309)	(2.607)	(1.832)	(1.807)	(1.953)	(1.911)
Financial vulnerability index	5.3991	4.2808***	2.5862	2.5520***	2.9704	2.9088***
	(1.085)	(0.860)	(0.612)	(0.604)	(0.652)	(0.638)
Year 1995 dummy	-0.9452	-0.7494*	-0.3641	-0.3593	-0.7593	-0.7436**
	(0.532)	(0.422)	(0.298)	(0.294)	(0.317)	(0.311)
Year 1998 dummy	-3.1209	-2.4745***	-1.4401	-1.4211***	-1.6916	-1.6565***
	(0.536)	(0.425)	(0.300)	(0.296)	(0.319)	(0.312)
Year 2001 dummy	-3.0104	-2.3869***	-1.5204	-1.5003***	-1.9291	-1.8892***
	(0.537)	(0.426)	(0.300)	(0.296)	(0.320)	(0.313)
Log(sizable inheritance expected)	-0.0333	-0.0264	-0.0280	-0.0276	-0.0316	-0.0309
	(0.042)	(0.033)	(0.023)	(0.023)	(0.025)	(0.024)
Log(total debt of the household)	0.2848	0.2258***	0.1528	0.1508***	0.1772	0.1735***
	(0.053)	(0.042)	(0.029)	(0.029)	(0.031)	(0.031)
Log(other assets)	0.1924	0.1526**	0.2085	0.2057***	0.2107	0.2064***
	(0.076)	(0.060)	(0.042)	(0.042)	(0.045)	(0.044)
Age of the respondent	0.4216	0.3343**	0.1230	0.1214	0.1219	0.1194
	(0.214)	(0.170)	(0.119)	(0.117)	(0.127)	(0.124)
(Age of the respondent)^2	-0.0048	-0.0038**	-0.0015	-0.0015	-0.0015	-0.0015
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Age of the spouse	0.2353	0.1866	0.1947	0.1922*	0.2278	0.2231*
	(0.204)	(0.161)	(0.113)	(0.111)	(0.120)	(0.118)
(Age of the spouse)^2	-0.0026	-0.0021	-0.0019	-0.0019	-0.0023	-0.0023*
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Respondent's age-the spouse's age	-0.3904	-0.3095***	-0.2336	-0.2305***	-0.2594	-0.2541***
	(0.109)	(0.086)	(0.061)	(0.060)	(0.065)	(0.063)

Table 3: Estimated Tobit Model to Investigate the Relationship between the Term Life and Total Life Insurance Holding respectively and the Financial Vulnerability with Pooled Data (**Continued**)

Variable	Log(Term Life Face Value + 0.00001)		Log(Term Life + Whole Life Face Value + 0.00001)		Log(Term Life Face Value + Whole Life NAR + 0.00001)	
	Estimate	M. E.[a]	Estimate	M. E. [a]	Estimate	M. E. [a]
(Respondent's age-spouse's age)^2	0.0130	0.0103**	0.0098	0.0096***	0.0106	0.0104***
	(0.006)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)
Log(salary and wage of the respondent)	0.2007	0.1591***	0.1704	0.1682***	0.1720	0.1685***
	(0.054)	(0.043)	(0.030)	(0.030)	(0.032)	(0.031)
Log(salary and wage of the spouse)	0.1597	0.1266***	0.1158	0.1143***	0.1060	0.1038***
	(0.042)	(0.033)	(0.024)	(0.023)	(0.025)	(0.025)
Education level of the respondent	0.3745	0.2969***	0.2210	0.2181***	0.2555	0.2502***
	(0.096)	(0.076)	(0.054)	(0.053)	(0.057)	(0.056)
Education level of the spouse	0.2478	0.1964***	0.1457	0.1438***	0.1679	0.1645***
	(0.094)	(0.074)	(0.052)	(0.051)	(0.055)	(0.054)
Desire to leave a bequest	0.5587	0.4430	0.3857	0.3806	0.4442	0.4350*
	(0.417)	(0.331)	(0.235)	(0.232)	(0.250)	(0.245)
Log(cash+cash equivalent)	1.4826	1.1755***	1.1476	1.1324***	1.1138	1.0907***
	(0.219)	(0.174)	(0.120)	(0.119)	(0.128)	(0.126)
(Log(cash+cash equivalent))^2	-0.0709	-0.0562***	-0.0514	-0.0507***	-0.0493	-0.0483***
	(0.015)	(0.012)	(0.008)	(0.008)	(0.009)	(0.009)
Log(mutual fund)	0.1529	0.1212	0.1464	0.1444	0.1341	0.1313
	(0.200)	(0.158)	(0.112)	(0.111)	(0.119)	(0.117)
(Log(mutual fund))^2	-0.0059	-0.0046	-0.0100	-0.0099	-0.0103	-0.0101
	(0.017)	(0.013)	(0.009)	(0.009)	(0.010)	(0.010)
Log(stock)	0.4358	0.3456***	0.1569	0.1548*	0.1156	0.1133
	(0.150)	(0.119)	(0.084)	(0.083)	(0.090)	(0.088)
(Log(stock))^2	-0.0309	-0.0245**	-0.0126	-0.0125*	-0.0091	-0.0089
	(0.012)	(0.010)	(0.007)	(0.007)	(0.007)	(0.007)
Log(bond)	0.8123	0.6440***	0.3561	0.3514***	0.4089	0.4004***
	(0.136)	(0.108)	(0.076)	(0.075)	(0.081)	(0.079)

Table 3: Estimated Tobit Model to Investigate the Relationship between the Term Life and Total Life Insurance Holding respectively and the Financial Vulnerability with Pooled Data (**Continued**)

Variable	Log(Term Life Face Value + 0.00001)		Log(Term Life + Whole Life Face Value + 0.00001)		Log(Term Life Face Value + Whole Life NAR + 0.00001)	
	Estimate	M. E.[a]	Estimate	M. E. [a]	Estimate	M. E. [a]
$(\text{Log(bond)})^2$	-0.0777	-0.0616***	-0.0326	-0.0322***	-0.0373	-0.0365***
	(0.012)	(0.010)	(0.007)	(0.007)	(0.007)	(0.007)
Log(annuity)	-0.0819	-0.0649	-0.2499	-0.2466	-0.2112	-0.2069
	(0.275)	(0.218)	(0.153)	(0.151)	(0.163)	(0.160)
$(\text{Log(annuity)})^2$	0.0066	0.0052	0.0188	0.0186	0.0166	0.0162
	(0.021)	(0.017)	(0.012)	(0.011)	(0.012)	(0.012)
Log(a household's individual retirement account)	0.4079	0.3234***	0.4798	0.4735***	0.4615	0.4520***
	(0.157)	(0.124)	(0.088)	(0.087)	(0.094)	(0.092)
$(\text{Log(a household's individual retirement account)})^2$	-0.0025	-0.0020	-0.0212	-0.0209***	-0.0187	-0.0183**
	(0.013)	(0.011)	(0.008)	(0.007)	(0.008)	(0.008)
Log(real estate)	1.1048	0.8760***	0.7780	0.7678***	0.8228	0.8057***
	(0.201)	(0.159)	(0.112)	(0.111)	(0.119)	(0.117)
$(\text{Log(real estate)})^2$	-0.0740	-0.0587***	-0.0503	-0.0496***	-0.0535	-0.0524***
	(0.016)	(0.013)	(0.009)	(0.009)	(0.010)	(0.009)
Foreseeable major financial obligations	1.8355	1.4553***	0.5015	0.4948**	0.7438	0.7284***
	(0.390)	(0.309)	(0.218)	(0.215)	(0.233)	(0.228)
Log(cash value)	-0.3172	-0.2515***	0.2746	0.2710***	0.2293	0.2245***
	(0.047)	(0.037)	(0.010)	(0.010)	(0.011)	(0.011)
Log(Net Amount at Risk)	-0.0903	-0.0716**				
	(0.043)	(0.034)				
Log-likelihood	-22082.71		-23199.52		-23501.82	

Number of observations: 7,533;
Standard errors are presented below the estimated coefficients;
[a] Marginal effects (M. E.) of Tobit models are computed at the mean of Xs;
*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

5.1.2. *Robustness of the Results.* The households with the living standard below the US official poverty thresholds may not voluntarily purchase life insurance because they may receive governmental subsidiaries, e.g. social security— one kind of insurance. We exclude 333 households with the total income from all sources below the US official poverty thresholds by size of family and number of related children under 18 years to test the robustness of our results.[12] The estimated coefficients are close to those reported in Table 2 and Table 3. For example, The marginal effects of financial vulnerability index estimated from the dataset excluding the households with the living standard below the US official poverty thresholds shown in Table 4 are very close to those in Table 2 and Table 3.

Table 4: Marginal Effects of Financial Vulnerability Index Excluding the Households with the Living Standard below the US Official Poverty Thresholds

Variable	Log(Whole Life FV+0.00001)	Log(CV +0.00001)	Log(NAR +0.00001)
Financial vulnerability index	0.3807	0.7389	0.3323
	(0.251)	(0.688)	(0.366)

Variable	Log(Term Life FV+0.00001)	Log(Term+Whole Life FV+0.00001)	Log(Term+ NAR+0.00001)
Financial vulnerability index	4.2692***	2.4734***	2.8234***
	(0.867)	(0.587)	(0.623)

Total number of observations: 7,200; Standard errors are presented below the estimated coefficients;

[a] Marginal effects (M. E.) of Tobit models are computed at the mean of Xs and are derived from equations like those shown in Table 2 and Table 3;

*** Significant at 1% level;** Significant at 5% level;* Significant at 10% level.

Moreover, one may argue that the non-monetary contribution of a spouse who stays at home should be considered as income as a family will also suffer a financial loss if the spouse were to die.[13] To impute the value of household services we divide the sample into two parts. For those below the median household salary income ($54,520)[14] we assume the value of household service is the difference between $10,000 and the salary of the lower earning spouse. For those above the median we assume the value of household services is the difference between $20,000 and the salary of

[12]The poverty thresholds are obtained from *www.census.gov*. All poverty thresholds are translated to year 2001 dollars.

[13]Our thanks to a reviewer for making this point.

[14]It is the median salary income of all households which include those with no labor income.

the lower earning spouse. We attempt to refine this analysis but there does not seem to be a generally accepted methodology for valuing household services that also could be determined from our data set. Then we offer this crude adjustment as a robustness check on our original results.

We find that by adding the value of household services to household income, the sign and significance do not change. However, the magnitude of the estimates of financial vulnerability index is smaller than that without taking account of the value of non-salary housework services. One possible explanation is that imputing value of non-salary housework services increases the wealth of a household. So risk aversion decreases thus its sensitivity to the financial vulnerability also decreases.[15]

5.2. **Life Cycle Analysis.** We separate the sample into three age groups: Age 20–34; Age 35–49 and Age 50–64. They represent the young households, the middle–age households and the older households. Table 5 presents the results of the tests of the life cycle relationship between the different life insurance demand definitions and financial vulnerability. We still do not find a significant relationship between a household's net amount at risk and its financial vulnerability for any of these three age groups. These results are consistent with those results shown in Table 2. In contrast, we do see a positive relationship between term insurance and financial vulnerability for different age groups. For term life insurance, the relationship between term life and financial vulnerability is not significant for the age group 20–34. There are two possible explanations for this result. First, the number of observations for the younger ages is much smaller than that of the middle–age or the older–age groups (1,692 for young ages vs. 3,397 for middle ages and 2,444 for old ages). Second, it may imply that the young household does not value the protection of life insurance. When we combine the term life and whole life together, the relation between total life insurance and a household's financial vulnerability is also only significant for the middle–age households and the older households. An important conclusion to be drawn from this is that as a household gets older, it tends to use less total life insurance (sum of term life and whole life) to handle a certain level of financial vulnerability. The marginal effects of financial vulnerability decrease with age (from 4.7864 for the 35–49 age group to 2.2729 for the 50–64 age group in the sum of term life face value and whole life net amount at risk regression).

[15]The results are available upon request. However, we should treat the results with some skepticism as we do not estimate the true value of a spouse's household services. We merely attempt to discern how robust our original results are to a potential change in the value of household services.

5.3. **Life Insurance and Other Assets.** Headen and Lee (1974) explore the linkage between life insurance demand and household financial assets. They construct a four–component interrelated household asset estimated using primary securities, money, time deposits and ordinary life insurance sales. They use another four variables reflecting household expectations and current economic conditions in financial markets: net savings, the consumer sentiment index (reflecting household expectations of future prices, income, and general economic conditions), interest rates (on high grade bonds) and index of security prices. Given the low *t*-ratios for lagged alternative assets, they conclude that the evidence concerning the relation of life insurance demand and other alternative financial assets is not certain. The variables Headen and Lee (1974) define are macroeconomic oriented. For example, they use ordinary life insurance sales as life insurance demand and they investigate stocks and bonds quarterly flowing to household sector. However, they do not explore the life cycle effects and do not study the term insurance and whole life insurance separately.

We, on the other hand, investigate a household's life insurance purchasing behavior from a microeconomic perspective and treat each household as a unit. Although we have found a life cycle relationship between life insurance and financial vulnerability, it may be interesting to further determine the life cycle relationship between a household life insurance holding and other assets.

We focus on the relationship of a household's whole life or term life insurance holdings with its four kinds of investments: mutual funds, stocks, bonds and real estate. First, we explore the relationship between whole life insurance and these four investments in Table 6. We do not see a significant relationship between whole life face value or whole life net amount at risk respectively and different investments. It suggests that a household's ownership of other assets has no impact on its whole life purchasing decision. Second, we examine the term life and total life insurance. Table 7 shows that there is a significant and positive relationship between term life insurance and mutual funds for the young-aged households. There is also a significant and positive relationship between term life insurance and bonds for the middle- and upper-aged households. The elasticities of the term life insurance with respect to the real estate are negative for all ages. This implies that mutual funds, stocks and bonds are complements and real estate is a substitute to term life insurance. As for the total life insurance, we observe similar results. An interesting finding is that in most cases the elasticity of total life insurance decreases as people get older. It suggests the proportion of total life insurance in a household portfolio decreases as the household gets older.

Table 5: Marginal Effects of Financial Vulnerability Index for Different Age Groups

	Log(Whole Life Face Value +0.00001)		
Variable	Age 20-34	Age 35-49	Age 50-64
Financial vulnerability index	-0.5418	1.6838***	-0.0259
	(3.390)	(0.516)	(0.235)
Number of observations	1,692	3,397	2,444

	Log(Whole Life Cash Value +0.00001)		
Variable	Age 20-34	Age 35-49	Age 50-64
Financial vulnerability index	-14.1771**	1.7556	1.0864
	(6.871)	(1.520)	(0.900)
Number of observations	1,692	3,397	2,444

	Log(Whole Life NAR +0.00001)		
Variable	Age 20-34	Age 35-49	Age 50-64
Financial vulnerability index	0.7355	0.7966	0.2077
	(2.428)	(0.725)	(0.568)
Number of observations	1,692	3,397	2,444

	Log(Term Life Face Value +0.00001)		
Variable	Age 20-34	Age 35-49	Age 50-64
Financial vulnerability index	3.2922	7.6696***	3.4862***
	(9.519)	(1.893)	(1.021)
Number of observations	1,692	3,397	2,444

	Log(Term + Whole Face Value +0.00001)		
Variable	Age 20-34	Age 35-49	Age 50-64
Financial vulnerability index	1.5534	4.3764***	1.9203***
	(8.225)	(1.304)	(0.607)
Number of observations	1,692	3,397	2,444

	Log(Term FV+ Whole NAR +0.00001)		
Variable	Age 20-34	Age 35-49	Age 50-64
Financial vulnerability index	3.4276	4.7864***	2.2729***
	(8.371)	(1.366)	(0.678)
Number of observations	1,692	3,397	2,444

Total number of observations: 7,533; Standard errors are presented below the estimated coefficients;

[a] Marginal effects (M. E.) of Tobit models are computed at the mean of Xs and are derived from equations like those shown in Table 2 and Table 3;

*** Significant at 1% level;** Significant at 5% level;* Significant at 10% level.

Table 6: Elasticities of Whole Life Insurance Holdings with respect to Different Investments for Different Age Groups

	Whole Life Face Value +0.00001		
Variables	Age 20-34	Age 35-49	Age 50-64
Mutual fund	0.2351	0.0101	0.0050
	(0.204)	(0.040)	(0.023)
Stock	-0.0629	0.0375	-0.0051
	(0.132)	(0.025)	(0.013)
Bond	0.0291	-0.0032	-0.0033
	(0.137)	(0.025)	(0.020)
Real estate	0.0235	-0.0687	0.0490
	(0.050)	(0.062)	(0.051)
Number of observations	1,692	3,397	2,444

	Whole Life Cash Value +0.00001		
Variables	Age 20-34	Age 35-49	Age 50-64
Mutual fund	0.3875	0.2317	0.0571
	(0.954)	(0.229)	(0.151)
Stock	-0.2083	0.0045	0.0307
	(0.591)	(0.147)	(0.085)
Bond	0.1361	0.3034**	0.2776**
	(0.445)	(0.141)	(0.130)
Real estate	0.0799	-0.1750	-0.2165
	(0.215)	(0.352)	(0.342)
Number of observations	1,692	3,397	2,444

	Whole Life NAR +0.00001		
Variables	Age 20-34	Age 35-49	Age 50-64
Mutual fund	0.1763	-0.0673	-0.0045
	(0.385)	(0.097)	(0.077)
Stock	-0.0765	0.0246	0.0278
	(0.247)	(0.062)	(0.044)
Bond	0.0678	0.0437	-0.0214
	(0.181)	(0.060)	(0.067)
Real estate	0.0084	-0.1991	-0.0351
	(0.093)	(0.152)	(0.178)
Number of observations	1,692	3,397	2,444

Total number of observations: 7,533;

Standard errors of linear combination of first-order term and quadratic term are presented below the elasticities;

[a] Elasticities of Tobit models are computed at the mean of Xs;

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

Table 7: Elasticities of Term Life and Total Life Insurance Holdings with respect to Different Investments for Different Age Groups

	Term Life Face Value +0.00001		
Variables	Age 20-34	Age 35-49	Age 50-64
Mutual fund	1.3226**	0.0721	0.0718
	(0.577)	(0.159)	(0.140)
Stock	0.1552	0.1152	0.1200
	(0.343)	(0.100)	(0.078)
Bond	0.3177	0.2446**	0.2558**
	(0.268)	(0.096)	(0.120)
Real estate	-0.1035	-0.2085	-0.4765
	(0.120)	(0.241)	(0.318)
Number of observations	1,692	3,397	2,444

	Term + Whole FV +0.00001		
Variables	Age 20-34	Age 35-49	Age 50-64
Mutual fund	0.6361	0.1448	0.0219
	(0.397)	(0.091)	(0.064)
Stock	0.2324	-0.0421	0.0561
	(0.359)	(0.058)	(0.036)
Bond	0.2568	0.1608***	0.1016*
	(0.186)	(0.055)	(0.055)
Real estate	-0.1063	-0.2439*	-0.2180
	(0.084)	(0.138)	(0.144)
Number of observations	1,692	3,397	2,444

	Term FV + Whole NAR +0.00001		
Variables	Age 20-34	Age 35-49	Age 50-64
Mutual fund	0.8311**	0.1046	0.0187
	(0.409)	(0.096)	(0.072)
Stock	0.1630	-0.0564	0.0639
	(0.248)	(0.061)	(0.040)
Bond	0.3581*	0.1805***	0.1017
	(0.191)	(0.058)	(0.062)
Real estate	-0.1184	-0.2660*	-0.2395
	(0.086)	(0.145)	(0.162)
Number of observations	1,692	3,397	2,444

Total number of observations: 7,533;

Standard errors of linear combination of first-order term and quadratic term are presented below the elasticities;

[a] Elasticities of Tobit models are computed at the mean of Xs;

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

6. CONCLUSION

We find a relationship between financial vulnerability and the demand for life insurance. Unlike Bernheim et al. (2001), we decompose the demand for life insurance into the demand for term life and whole life insurance. Further, we employ an index of financial vulnerability that has two important features. First, it is transparent in the sense that we do not rely upon a proprietary model to construct it and, second, we take into account the vulnerability to loss of income to both spouses. Bernheim et al. (2001) found that the correlation between life insurance demand and financial vulnerability is essentially zero throughout the entire life cycle (they did not distinguish between whole life insurance and term life insurance and they based the ESPlanner to decide the benchmark life insurance). While our result also does not apply to whole life insurance, we do see a strong relationship between term and total insurance and financial vulnerability in our pooled and life cycle analysis. Our finding of a positive relationship between a household's financial vulnerability and the term life insurance and total life insurance holdings respectively seems reasonable in the light of the theory. Our empirical analysis shows that the more volatile the living standard a household will be, the more term or total life insurance it will purchase.

The final conclusion from our life cycle regression results is that older households tend to use less life insurance to protect a certain level of financial vulnerability than younger households. This may arise from the older's avoidance of the higher price of life insurance or decreasing absolute risk aversion since a household generally accumulate more wealth as it gets older. Finally, we also present evidence of how individual households change their portfolio over the life cycle and how this relates to the demand for life insurance.

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