

The importance of debt for household risky asset allocation and portfolio structure

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Abstract

When households decide on risky asset holdings, they do not make the decision in isolation from their debt structure and obligations, vice versa. We examine the joint behavior of debt and financial asset portfolio decisions, while existing empirical research on debt and asset portfolio choices has proceeded separately. In this paper, we first test the relationship between debt structure and asset allocation, then estimate the determinants of debt structure and asset allocation simultaneously. Using the 2016 Survey of Consumer Finances (SCF) data, we find robust evidence that debt structure affects households' risky asset allocation decisions and identify, in this simultaneous decision-making process, the demographic and financial factors that can contribute to the household overall financial portfolio structure. © 2018 Academy of Financial Services. All rights reserved.

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1. Introduction

There has been a massive increase in consumer assets and consumer debt over the last two decades. At the end of 2017, U.S. households' total financial assets exceeded \$80 trillion and total household debts rose to an all-time high of \$15.5 trillion, more than twice of what they were in 2000 (Board of Governors of the Federal Reserve System). Some striking effects

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observed include the broadening of the stockholder base (Bilias et al., 2010), the growth in mutual fund participation (Bailey et al., 2011), and consumer indebtedness accompanied by the fast growth in credit card use (Basnet and Donou-Adonsou, 2018). Empirical evidence shows that households do not follow the predictions by portfolio theories (cf. Campbell, 2006; Guiso et al., 2002). In addition, large variations across households in their portfolio structures are observed. For example, many households do not hold risky financial assets, while those do, many hold a large proportion of risky assets (Campbell, 2006). The portfolio allocation problems are gaining attention again in the academic circle. The renewed interest generally focuses on the key aspects of portfolio structure and understanding qualitatively as well as quantitatively the role of the determinants in the optimal investment decision of individuals and households (cf. Cardak and Wilkins, 2009). However, the approach taken by the existing literature typically focuses on specific aspects of household finance in isolation of other aspects of the balance sheet. Many studies focus on either the asset side (cf. Wang and Hanna, 2018) or the debt side of the household portfolio (cf. Yilmazer and DeVaney, 2005). In this paper, we examine the overall financial portfolio structure by considering both asset and debt allocation decisions. A household's asset structure is defined as the share of risky assets (stocks, corporate/foreign bond, mutual funds, and trust funds) in total financial assets. On the liability side, we classify the total debt as secured debt (mortgage and vehicle loans) and unsecured debt (credit card debt, education loan, and other consumer loans that are not backed by any underlying assets). A household's debt structure is represented by the ratio of outstanding secured debt balance to total debt.

There are many studies of household asset portfolio. Notable contributions include Bergstresser and Poterba (2004), Cardak and Wilkins (2009), Rosen and Wu (2004). They find that asset allocation decisions are affected by households' demographics, educational attainment, wealth, labor income, and health risks. Therefore, the likelihood of participating in risky asset investment should be related to issues affecting access and awareness of stocks if one had some level of financial assets. Drawing from both the frameworks of investment decision making and previous studies, we apply a two-stage sample selection model to examine risky asset shares conditional on participation (i.e., the decision to hold risky assets). The two-stage model allows for the individual determination of differences in the participation decision and the allocation decision, because unconditional shares cannot distinguish the effects of relevant variables on the participation decision from those on the portfolio share given that the asset is held. Stage one examines the likelihood of risky asset ownership and can be indicative of access barriers. Stage two examines risky asset allocation and can be reflective of attitude and preferences. Our methodology improves on many of the theoretical predictions of the classical portfolio theory that refer to asset shares, not to participation decisions (cf. Campbell et al., 2003). Our results show that the participation and allocation decisions are determined by distinct factors.

We also incorporate household debt structure in the analysis. While households' decision to invest in risky asset may well be influenced by demographic factors, income, and risk attitude, the decision is also likely to be affected by the households' debt holding. For example, households with large portion of mortgage debt may hold safer assets to plan for expenses with fixed payment schedule (Faig and Shum, 2002). Furthermore, optimal household portfolio may require the households to make asset allocation and debt allocation

decisions together. Policy-makers also noted the importance of analyzing household financial assets and liabilities together (Brown et al., 2015). However, the interactions between the liability and asset of household finances are largely unknown and often lack theoretical modeling. Given that assets and debt each display only one side of the household's balance sheet and the decision of asset and debt allocations cannot be separated, we look at both sides of the balance sheet simultaneously via a bivariate model. Our findings strongly support the hypothesis that both simultaneity and cross-causality effects affect the portfolio composition of households.

This study provides several new findings. First, the ratio of secured debt does not significantly affect the household's participation in risky asset investment, but it does have a significant impact on the portfolio share of risky assets, conditional on holding them. Second, we find higher secured debt ratio is positively correlated with conditional risky asset shares. Because a large proportion of household secured debt is mortgage debt, this result seems to contradict the well-known crowding-out effect of home ownership. Third, we identify a set of factors (such as age and education of household head, income, and liquidity constraints) that significantly influence the debt structure and risky asset allocation simultaneously.

The remainder of this paper proceeds as follows. Section 2 provides theoretical background of the joint decision of asset and debt allocations and reviews the strand of literature related to both asset and liability of the household's portfolio. Section 3 describes methodologies and the econometric models. Section 4 presents data selection and variable construction. In Section 5, we report and analyze the empirical results. Section 6 concludes the paper and provides policy recommendations.

2. Joint decision of asset and debt allocations

In theory, the demand for any asset or liability can be derived from a portfolio choice model in which households maximize expected utility subject to their budget constraints. Consumers' asset allocation decision should depend on the existing liability structure. For instance, holding a mortgage leaves the household with less spendable income, and the mortgage payments require the household to maintain certain liquid and less risky assets. On the liability side of the household portfolio, debt structure is also interdependent on asset allocation decisions. Therefore, the allocation of debt and the allocation of assets must be considered jointly. However, empirical research on household portfolio structure often investigates a single choice at a time. Studies on household risky asset allocation do not specifically test the effects of debt structure, while the research on consumer liability often focuses on analyzing the effect of credit and liquidity constraints that households face without considering the asset structure of the households (cf. Brown et al., 2005; Cox and Jappelli, 1993). To our knowledge, Yilmazer and DeVaney (2005) is the only study that demonstrates significant effects of financial assets on household debt.

The cross-causality between debt and asset allocations can be reflected by the interactions between financial and real assets. Cheung and Miu (2015) demonstrate significant interaction effect between financial assets and home ownership. Beaubrun-Diant and Maury (2016) analyze the simultaneous decisions of the households to participate in the stock market and

own their homes. They provide evidence that home- and stock-ownership decisions are taken simultaneously, therefore, rejecting the common view that these decisions are made sequentially. Waggle and Johnson (2003) examine the impact of home ownership on portfolio decisions relating to stocks and bonds. They find that young homeowners with high home value to net worth ratios should decrease the amount of stocks in their portfolios. With lower home to net worth ratios, investors can maximize utility by having their houses completely paid for and by holding more stocks. Hu (2005) shows that homeowners hold a higher proportion of equity in liquid financial assets than renters do.

Existing literature only indirectly test the effect of household debt on risky asset allocation. Most of these studies attempt to empirically identify factors explaining household financial asset allocation while adding mortgage debt as an explanatory variable (cf. Cardak and Wilkins, 2009; Cocco, 2005; Fratantoni, 1998). Secured debt, particularly mortgage, causes liquidity constraint on the household that influences the household's asset allocation choice. Faig and Shum (2002) identify real estate as both a risky investment and a personal illiquid project, which incurs penalties if discontinued. Mortgage, property tax, and utility payments regularly generate liquidity needs. Their results suggest that individuals who save to invest in their homes hold safer financial portfolios. Recent studies on the effects of background risks on household portfolio allocation often consider mortgage payments as part of the "committed expenses." Research in this area has identified background risks as associated with a number of factors, including labor income risks, committed expenditure, proprietary business income risks, and health risks. Background risks lead households to increase precautionary savings and reduce risky asset holdings. Fratantoni (2001) finds that mortgage commitments and labor income risk reduce household risky assets holdings. It is worth noting that this strand of literature does not consider the household's debt structure, which is defined as the ratio of outstanding secured debt balance to total household debt in this research.

Few studies incorporate both assets and debt in the analysis. Brown and Taylor (2008) attempt to identify the characteristics of the households that accumulate debt and/or financial assets and the determinants of net worth (i.e., the difference between household assets and debt). Although this research considers both sides of the household balance sheet, it does not inform on the structure of assets and debt. Cardak and Wilkins (2009) acknowledge that risky asset holdings and committed expenses are jointly determined by the household, but they proceed without estimating the two quantities simultaneously. In this paper, we add to the literature by investigating the determinants of household risky asset holdings controlling for the debt structure and by examining the determinants of households' financial portfolio incorporating financial asset and debt structures simultaneously.

3. The empirical models

3.1. A sample selection model

Our dependent variable is the share of risky assets, which is defined as the proportion of financial assets held in risky assets including equity and bonds. The dependent variable is not continuous and unbounded, so OLS estimates would be biased. Moreover, many households

in the sample have no risky asset investment at all. The Tobit model (Tobin, 1958) takes into consideration the concentration of observations at zero. It also accounts for the fact that the explanatory variables may influence the probability of whether a household invest zero dollar in risky assets, and how much they actually invest, given that they invest something. Tobit models are commonly used in the literature. For example, Basnet and Donou-Adonsou (2016) apply a Tobit model to analyze credit card balance which is either positive or equal to zero. Brown and Taylor (2008) treat household total assets and total debt as censored variables. They apply a univariate Tobit specification to model total assets and total debt independently, and a bivariate Tobit model to estimate the two quantities at the household level jointly. Cox and Jappelli (1993) take into account the selection bias caused by borrowing constraints and the household’s decision to hold positive debt, and apply a Tobit model to estimate the optimal level of household debt.

Based on the prototypical Tobit model (Tobin, 1958) censoring from below at zero, where the latent variable y^* is linear in regressors with additive error that is normally distributed and homoscedastic, y^* can be expressed as

$$y^* = x' \beta + \varepsilon \tag{1}$$

where the error term $\varepsilon \sim N [0, \sigma^2]$ has variance σ^2 , which is assumed to be constant across observations. In our model, the latent variable y^* is a household’s desired holding of risky assets. The observed y is the household’s actual risky assets holding. y can be expressed as

$$y = \begin{cases} y^* & \text{if } y^* > 0, \\ 0 & \text{if } y^* \leq 0. \end{cases} \tag{2}$$

Our interest is to derive the marginal effect in correspond to the effect of a change in a regressor on the desired risky asset holding (i.e., the latent variable),

$$\frac{\partial E[y^*|x]}{\partial x} = \beta. \tag{3}$$

However, the latent variable is not observable. To derive the marginal effect of observed data y , first, we introduce an indicator variable, d , and

$$d = \begin{cases} 1 & \text{if } y^* > 0, \\ 0 & \text{otherwise.} \end{cases} \tag{4}$$

Following Cameron and Trivedi (2005), we can derive the censored mean by first conditioning the observable y on the binary indicator d and then unconditioning. The left-censored mean is

$$\begin{aligned} E[y] &= E_d[E_{y|d}[y|d]] \\ &= Pr[d = 0] \times E[y|d = 0] + Pr[d = 1] \times E[y|d = 1] \\ &= 0 \times Pr[y^* \leq 0] + Pr[y^* > 0] \times E[y^*|y^* > 0] \\ &= Pr[y^* > 0] \times E[y^*|y^* > 0] \end{aligned} \tag{5}$$

where $\Pr[y^* > 0] = 1 - \Pr[y^* \leq 0] = \Pr[\varepsilon > -x'\beta]$. The conditional means are given by

$$\begin{aligned} E[y|x] &= \Pr[\varepsilon > -x'\beta]x'\beta + E[\varepsilon|\varepsilon > -x'\beta] \\ &= \Phi(x'\beta/\sigma)x'\beta + \sigma\phi(x'\beta/\sigma) \end{aligned} \quad (6)$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are the standard normal distribution pdf and cdf, respectively. The marginal effect derived from observed censored data are given by

$$\frac{\partial E[y|x]}{\partial x} = \beta \times \Pr[y^* > 0] = \beta\Phi\left(\frac{\beta'x}{\sigma}\right) \quad (7)$$

The above Tobit model restricts the censoring mechanism to be from the same model as that generating the outcome variable. In other words, the same set of variables and coefficients determine both the probability that an observation will be censored and the value of the dependent variable. This limitation can be remedied with the use of a sample selection model. We turn to a bivariate sample selection model that is defined in Cameron and Trivedi (2005),¹ which comprises a participation equation that

$$d = \begin{cases} 1 & \text{if } y_1^* > 0, \\ 0 & \text{otherwise,} \end{cases} \quad (8)$$

and an outcome equation that

$$y = \begin{cases} y_2^* & \text{if } y_1^* > 0, \\ \text{not observed} & \text{otherwise.} \end{cases} \quad (9)$$

The latent variable y_1^* determines whether or not the household invests in risky assets at all. y is observed if and only if $y_1^* > 0$. The latent variable y_2^* determines how much to invest, and $y_1^* \neq y_2^*$. The standard model specifies a linear model with additive errors for the latent variables,

$$y_1^* = x_1'\beta_1 + \varepsilon_1 \quad (10)$$

$$y_2^* = x_2'\beta_2 + \varepsilon_2 \quad (11)$$

while in Eq. (1), it is assumed that $y_1^* = y_2^*$.

The allocation of risky asset is estimated using observations on only those households with positive holdings of risky asset. The sample selection bias induced by using only observations with positive values of risky asset holding can be corrected by a standard two-step procedure (Heckman, 1979). We first estimate reduced-form Probit equation for the participation probabilities of risky asset investment (Eq. 8) and then include the estimated hazard as an additional regressor in the outcome equation (Eq. 9).²

Following the same derivation as Eq. (6), the expected investment in risky asset, conditional on that the household invests is given by

$$\begin{aligned} E[y|x, y_1^* > 0] &= E[x_2'\beta_2 + \varepsilon_2 | x_2'\beta_2 + \varepsilon_2 > 0] \\ &= x_2'\beta_2 + E[\varepsilon_2 | \varepsilon_1 > -x_1'\beta_1] \end{aligned}$$

$$= x_2' \beta_2 + \sigma_{12} \lambda(x_1' \beta_1), \quad (12)$$

where $\lambda(z) = \frac{\phi(z)}{\Phi(z)}$ is the inverse Mill's ratio term (Heckman, 1979). Heckman's two-step procedure is applied to estimate the positive values of y by an OLS,

$$y_i = x_{2i}' \beta_2 + \sigma_{12} \lambda(x_{1i}' \hat{\beta}_1) + v_i \quad (13)$$

where $\hat{\beta}_1$ is obtained by first-step Probit regression of y_1 on x_1 , and $\lambda(x_{1i}' \hat{\beta}_1)$ is the estimated inverse Mill's ratio.

If the independent variable only appears in the participation equation, we can use Probit model marginal effect. Define $p(x)$ as the probability of participating in risky asset investment given x . The marginal effect of variable x_j is given by

$$\frac{\partial p(x)}{\partial x_j} = \beta_j \phi(x' \beta) \quad (14)$$

The marginal effect $\delta E[y|x]/\delta x$ is β_2 if the independent variable only appears in the outcome equation. If the independent variable appears in both equations, the marginal effect is given by taking the partial derivatives of Eq. 12 (derivation omitted).

With the above sample selection model, we test how debt structure affects risky asset allocation. Our key independent variable is the proportion of secured debt in total debt. As defined in the previous section, the secured debt includes the outstanding balance of the household's mortgage and vehicle loans. We distinguish between secured and unsecured debt given the fact that unsecured debt is typically more expensive (higher interest rates) than secured debt. However, the adverse financial shock is less likely to cause immediate financial pressure on unsecured debt than secured debt (Brown and Taylor, 2008). In addition, the monthly payments of secured debt can be considered as part of the household's committed expenses, which affect the household's liquidity needs.

3.2. The bivariate model

The empirical question is whether there is a relationship between risky financial asset holding and debt structure. The causal effect is not meaningful because the two quantities are clearly jointly determined by the household. Households' asset allocation choices are obviously bound by how much debt they have; when consumers borrow they need to consider how much assets they have. Cardak and Wilkins (2009) express concerns on the potential endogeneity problem because asset and debt allocations are often determined simultaneously, but they proceed to estimate reduced-form regressions with the risky asset ratio on the left hand side and measures of committed expenses on the right hand side. To examine the joint decision of asset and debt allocations, we apply a bivariate model, which is developed in the context of the joint distribution, assuming a bivariate normal distribution.³ The bivariate model allows for the possibility of interdependent decision making with respect to the share of risky assets (y_a) and the share of secured debts (y_d), both of which are

censored. Each variable can be expressed by Eqs. (1) and (2). The bivariate Tobit model can be specified as follows,

$$y_a = \begin{cases} y_a^* & \text{if } y_a^* > 0, \\ 0 & \text{otherwise.} \end{cases} \quad (15)$$

$$y_d = \begin{cases} y_d^* & \text{if } y_d^* > 0, \\ 0 & \text{otherwise.} \end{cases} \quad (16)$$

Both latent variable y_a^* and y_d^* are linear model with additive errors,

$$y_a^* = x_h' \beta_1 + \varepsilon_{h1} \quad (17)$$

$$y_d^* = x_h' \beta_2 + \varepsilon_{h2} \quad (18)$$

where x_h is a vector of independent variables that affect household portfolio choices; ε_{h1} and ε_{h2} are the error terms which are jointly normally distributed with variances σ_{h1}^2 and σ_{h2}^2 , respectively, that is:

$$\varepsilon_{h1}, \varepsilon_{h2} \sim N[0, 0, \sigma_{h1}^2, \sigma_{h2}^2, \rho] \quad (19)$$

where the covariance is given by

$$\sigma_{h1h2} = \rho \sigma_{h1} \sigma_{h2} \quad (20)$$

where ρ is the correlation coefficient of ε_{h1} and ε_{h2} , which measures the degree of interdependence between y_a^* and y_b^* . A maximum-likelihood estimation is carried out to derive the coefficients for each equation, the cross-equation error correlations, and the variance of the error terms. If ρ is zero, the joint normal density function would collapse to the product of two independent normal density functions and a univariate approach of separating Eqs. (17) and (18) would be appropriate.

4. Data

The data used in this paper comes from the 2016 Survey of Consumer Finances (SCF). The SCF are sponsored by the Federal Reserve Board in cooperation with the Department of the Treasury. SCF has been conducted by the National Opinion Research Center and the University of Michigan since 1983. The SCF is the most comprehensive data source on household financial information in the United States. The survey data in the SCF include much information on households' balance sheet, pensions, income, as well as detailed data on demographic characteristics.

The SCF data are not a panel data. Some of the survey interviewees were selected from a standard multistage area-probability design, and the remaining were selected from a list sample derived from tax records by Internal Revenue Service. The SCF is conducted every three years. We choose the 2016 wave because it is the most recent data available and it made many changes from the previous 2013 wave. For example, there is a major update on the education loan section, the credit card section is reworked, and a new set of risk attitude

variables is added. In addition, by the time of the 2016 survey the economy was out of the 2008 financial crisis, the impact of the subprime mortgage crisis has been fading out the economy, consumers face fewer credit constraints, and the unemployment rate is getting down from the peak.

The 2016 SCF data consists of the asset and debt holdings of 6,248 households. The data are imputed to account for the variability in the data because of missing information. In our empirical estimations, Rubin's combination rule (Rubin, 1987) is applied to the estimated coefficients. The standard errors are also adjusted accordingly to generate the correct inference.

Because we are trying to analyze asset and debt choices, we exclude the households that do not have any financial assets or debt. It is also because these two variables appear in the denominator of two key variables. We screen out the observations with an extremely high value of net worth to control the impact of outliers. Because of the survey design, the list of sample from IRS tax records is likely to be relatively wealthy.⁴ Therefore, we drop out the families in the top 5 percentile of assets, in the top 5 percentile of net worth, or in the top 5 percentile of annual income. We exclude households that reported labor income in the bottom 5 percentile as the low-income families may behave quite differently in investing or acquiring debt. The final sample contains 4,049 out of the original 6,248 observations.

We include demographic variables that are commonly used in the literature as controls. They include the gender, age, race, and education of the household head, and number of children in the family. Previous studies suggest that demographic characteristics contribute to the portfolio decision. Moreover, the age pattern of risky portfolio shares is crucial to understanding portfolio behavior over the life cycle. Therefore, we use dummy variables to represent each age category instead of the continuous age variable. Addoum (2017) shows that couples significantly decrease their stock allocations after retirement, whereas singles' allocations remain relatively unchanged. In addition, family size (Browning, 1992), gender (Bogan 2013), bequest motives (Bertaut and Haliassos, 1997), ethnicity (Choudhury, 2001), and education (Dimmock et al., 2016) are all proven to affect household financial asset allocations.

We include the household's income in the past year and net worth as independent variables. Households with more income may be less vulnerable to the risk of their financial portfolios. Perraudin and Sørensen (2000)'s results suggest that a 10% proportional rise in wealth leads to a 24% and a 25% increase in stock and bond demand respectively. We take the natural log of total income to minimize the effect of outliers.

Many previous studies analyze how risk attitude affects household financial portfolio. Riley and Chow (1992) explore the relationships between asset allocation and individual risk aversion. They conclude that relative risk aversion decreases as one rises above the poverty level and decreases significantly for the wealthy households. Hariharan et al. (2000) confirm the CAPM prediction that risk-tolerant investors hold a smaller fraction of their investments in the risk-free asset. We control for risk attitude by including an ordered categorical variable ("Risk Averse") with values ranging from one to four. The household chooses one if it is willing to take substantial financial risks expecting to earn substantial returns. The value 2 means that the household is willing to take above average financial risks expecting to earn above average returns. Value 3 means the household is willing to take average financial risks

expecting to earn average returns. Value 4 means the household is not willing to take any financial risks. Therefore, the higher the value for this variable, the more risk-averse the household is.

We control for background risks by including measures of health risk and labor income risk.⁵ Rosen and Wu (2004) show that health is a significant predictor of both the probability of owning different types of financial assets and the share of financial wealth held in each asset category. Fan and Zhao (2009) provide the evidence that health shocks shift investment from risky assets toward other financial assets. Therefore, we expect that poor health has a negative impact on risky asset holding. We create a binary variable for the household's health status. The binary variable-“Health Risk” equals to one if either the head or his or her spouse expressed to have fair or poor health condition. To control for the labor income risk, we consider whether the head is self-employed, or own/share ownership in any privately-held businesses (“Private Business”). The rich who own private businesses are bound to consider business returns in selecting their financial portfolios. Owning or investing in a private business may suggest that the household substitutes for investment in the stock market. Moreover, private business may constantly generate liquidity needs (Faig and Shum, 2002) and being self-employed may expose the household to proprietary business risks (Heaton and Lucas, 2000). Therefore, this variable may also measure the household's liquid constraints.

“Committed Expense” is defined as monthly mortgage payments and car loan payments divided by monthly income. It measures both background risks and liquidity constraints. Additional controls for households' liquidity constraints include the checking and saving account balances (again, we use the natural log form to dampen the effects of extreme values), a binary variable-“High Expense” that takes on the value of one if the household had unusually high overall expenses in the past 12 months, the household's total line of credit (LOC), and total liquid assets that include the balance of all types of transaction accounts (LIQ). In the SCF, families were asked “If you experienced a financial emergency, how would you deal with it?” The respondents choose from four options: 1 = borrow from others; 2 = spend from own savings; 3 = postpone payment; 4 = cut back spending. We use this variable (labeled “LIQ CON”) as a proxy for the household's liquidity constraint. The higher the value, the more liquidity constraints the household faces.

To control for the credit constraints that the households face, we include two binary variables. The dummy variable “Turned Down” equals to one if the household applied for any type of credit in the past 12 months and feared denial or was turned down. Variable “Late Payment” equals to one if the household had a late payment in the past 12 months. Both of these variables represent the easiness that the household can raise money to invest. We do not control for interest rates. Although a household's debt and asset allocation decisions are likely to be affected by interest rates and expected rate of returns, the SCF data does not provide this information. Furthermore, we use cross-sectional data, so we assume that all of the households are subject to the same interest rate on debt (mortgage). An Austrian survey finds that interest rates only have small effects on saving, portfolio and loan decisions (Beer et al., 2016). Moreover, the effect of loan interest rate differentials across households because of households' credit worthiness should be captured by the credit constraint measures.

Personality factors such as impulsiveness, self-esteem, self-control, sensitivity, and so forth, may play an important role in consumer financial behaviors. Compulsive shoppers

often overspent when they use credit cards (Basnet and Donou-Adonsou, 2016). Norvilitis et al. (2006) and Wang et al. (2011) find that impulsiveness is significantly correlated with revolving credit card debt. Hira et al. (1993) report that internal locus of control is associated with optimism about one's financial future, but Norvilitis et al. (2006) find no relationship between locus of control and amount of debt in college students. Because of the limited availability of data in SCF and the consideration that this study targets on the household units instead of the individual consumers, such personality factors are not included.

Table 1 shows the summary statistics of all the variables. Risky asset ratio has a mean of 28.3% and a median of 20.8%, which is consistent with the evidence provided in the literature that many households hold few or no risky assets in their portfolio (Campbell, 2006). Fig. 1 is a histogram showing the distribution of our dependent variable-the share of risky assets in the household's financial assets.

On average the households in our sample hold 62.5% of total debt as secured debt and the median is higher at 84.2%. The demographic statistics summary shows 78% of household head are male, 66.5% are households with a married couple, 67.8% of household head are White and non-Hispanic, and, except for 5.5% of household heads who are over 75 years old, the sample data are evenly distributed among each age group. 16.4% of households are self-employed, while 21% of households own or share ownership in privately held businesses. Only 3.1% of households are unemployed.

One key observation in Table 1 is that, although the average households' total assets are \$1.1 million, 50% of the families have less than \$280,000 assets. The sample shows an average liquid assets of \$47,000 and an average net worth of \$0.9 million with a lower median at \$161,000. The households in our sample display an overall high degree of risk aversion (3.032 out of 4) and a medium level of liquidity constraint (1.8 out of 4); 20% of households feared denial or was turned down when applied for credit in the previous year, 15% had late payments in the last year, and 26.1% of families' head and/or spouse self-evaluated their health condition as poor or fair.

5. Results

5.1. Determinants of risky asset allocation

We first test the effect of debt structure on risky asset holdings by using a two-step Heckman estimation scheme on the Tobit model. This estimation scheme separates the decision to participate in investing risky assets from the decision on how much share of risky assets to hold. The same set of independent variables is included in both the participation equation and the outcome equation.⁶ This allows us to identify what factors prompt the household to enter the market for risky assets and what factors influence the portfolio share of risky assets, conditional on holding them. In addition, the inverse Mill's ratio is added in the outcome equation as an independent variable to avoid selection bias (King and Leape, 1998). The results show that the inverse Mill's ratio is significant, which suggests that there would be a possible selection bias in the analysis of risky asset holding if not considering the market participation decision. Table 2 presents the results.

Table 1 Summary statistics

| Variable name | Variable description | Mean | Median | Standard deviation | Min | Max |
|--------------------|---|--------|--------|--------------------|--------|--------|
| Risky ratio | Risky asset holdings as a % of financial assets | 28.336 | 20.816 | 29.854 | 0 | 100 |
| Secured debt ratio | Secured debt holdings as a % of total debt | 62.451 | 84.239 | 41.215 | 0 | 100 |
| HHSex | Household head gender (1 = male) | 0.781 | 1 | 0.413 | 0 | 1 |
| Age < 35 | Age less than 35 years | 0.173 | 0 | 0.378 | 0 | 1 |
| Age 35–44 | Age between 35 ~ 44 | 0.205 | 0 | 0.404 | 0 | 1 |
| Age 45–54 | Age between 45 ~ 54 | 0.227 | 0 | 0.419 | 0 | 1 |
| Age 55–64 | Age between 55 ~ 64 | 0.216 | 0 | 0.411 | 0 | 1 |
| Age 65–74 | Age between 65 ~ 74 | 0.124 | 0 | 0.330 | 0 | 1 |
| Age >75 | Age beyond 75 years (omitted in regressions) | 0.055 | 0 | 0.228 | 0 | 1 |
| Education | Education: 1 = no high school diploma/GED; 2 = high school diploma or GED; 3 = some college or associative degree; 4 = bachelor's degree or higher | 3.036 | 3 | 0.986 | 1 | 4 |
| Married | Marital status (1 = married; not included in regressions because of multicollinearity with HHSex) | 0.665 | 1 | 0.472 | 0 | 1 |
| Kids | Number of kids | 0.920 | 0 | 1.170 | 0 | 7 |
| Race | Race (1 = White and non-Hispanic) | 0.678 | 1 | 0.467 | 0 | 1 |
| Employed | Employed (1 = yes) (not included in regressions because of multicollinearity) | 0.784 | 1 | 0.412 | 0 | 1 |
| Self-employed | Self-employed (1 = yes) | 0.164 | 0 | 0.370 | 0 | 1 |
| Unemployed | Unemployed (1 = yes) (not included in regressions because of multicollinearity) | 0.031 | 0 | 0.174 | 0 | 1 |
| Retired | Retired (1 = yes) | 0.185 | 0 | 0.388 | 0 | 1 |
| Asset | Total assets ('000) | 1100 | 280 | 2500 | 0.001 | 23000 |
| Ln (income) | Annual income (log) | 11.281 | 11.205 | 0.928 | 9.485 | 14.422 |
| Ln (checking) | Checking account balance (log) | 7.244 | 7.784 | 2.804 | 0 | 14.078 |
| Ln (saving) | Saving account balance (log) | 4.737 | 5.602 | 4.474 | 0 | 15.464 |
| Net worth | Net worth ('000) | 914 | 161 | 2372 | -2000 | 23000 |
| Risk aversion | Risk Aversion (1 = take substantial financial risks expecting to earn substantial returns; 2 = take above average financial risks expecting to earn above average returns; 3 = take average financial risks expecting to earn average returns; 4 = not willing to take any financial risks) | 3.032 | 3 | 0.839 | 1 | 4 |
| Turned down | Applied for any type of credit in past 12 months, feared denial or was turned down (1 = yes) | 0.201 | 0 | 0.401 | 0 | 1 |
| Late Pay | Have any late payment last year (1 = yes) | 0.154 | 0 | 0.359 | 0 | 1 |
| High expense | Have unusually high expenses last year (1 = yes) | 0.260 | 0 | 0.439 | 0 | 1 |
| Committed expense | Ratio of committed expenses (monthly mortgage and car loan payments) to income (%) | 15.700 | 13 | 14.100 | 0 | 98.800 |
| Private business | Own or share ownership in any privately held businesses (1 = yes) | 0.210 | 0 | 0.408 | 0 | 1 |
| LIQ CON | If experience a financial emergency, 1 = borrow from others; 2 = spend from own savings; 3 = postpone payments; 4 = cut back spending | 1.800 | 2 | 1.038 | 0 | 4 |
| LOC | Total lines of credit ('000) | 18.742 | 0 | 154.067 | -0.002 | 7450 |
| LIQ | Liquid assets ('000)-balance of all types of transaction account | 47.069 | 6.592 | 182.790 | 0 | 5236.5 |
| Health risk | Health risk (1 = either head or spouse responded "poor" or "fair" health condition) | 0.261 | 0 | 0.439 | 0 | 1 |

Notes: This table reports the summary statistics for the outcome and control variables. Not all variables are included in the regressions because of multicollinearity problem. The number of observations = 4,049.

Our key independent variable, the ratio of secured debt to total debt, has a positive and significant coefficient only in the outcome equation. It implies that the share of debt in secured debt does not affect the household's decision on whether to invest in a risky asset, but households with relatively more secured debt are likely to invest relatively more in risky assets. The marginal

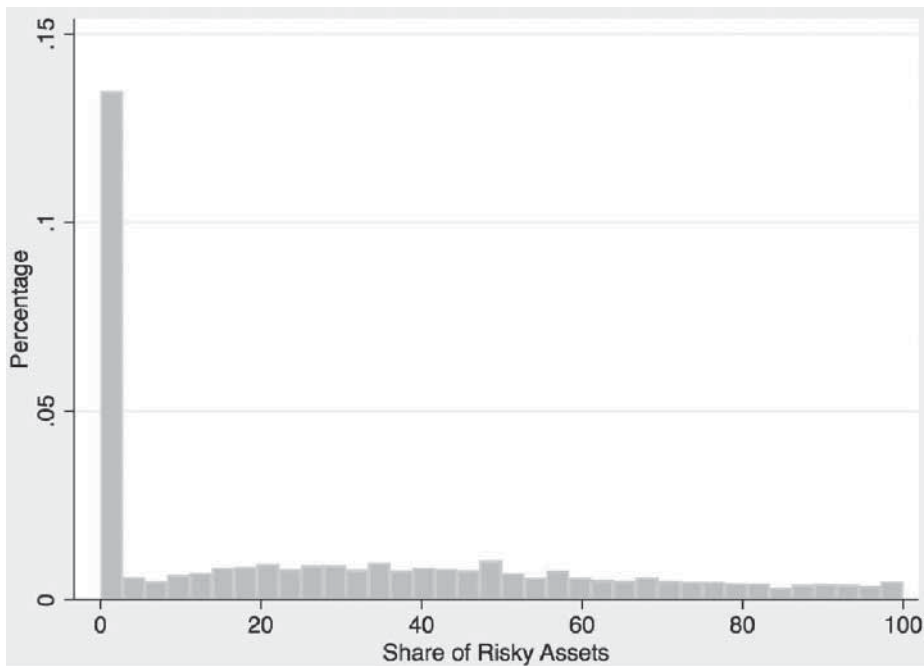


Fig. 1. Distribution of risky asset allocation.

effect shows an economic significance that if the secured debt share increases by 1%, the risky assets holding by an average household who already holds risky assets will increase by \$13,531.⁷ Because most of the secured debt is mortgage, this result seems to contradict the well-known crowding-out effect of home ownership. One of the explanations could be in line with the argument made by Brown and Tyler (2008) that households with relatively more secured debt need higher expected returns from risky asset to pay for the debt. These households may suffer more financial distress during economic down turns because financial shocks are more likely to cause immediate financial pressure on secured debt. On the other hand, these households could take advantage of the lower cost debt in exchange for relatively higher return assets. This result also partially supports Beaubrun-Dian and Maury (2016)'s finding that previous homeowners are more likely to become stockholders.

The variables that are significant in both the participation and the outcome equations include "Education," "Race," "Income," "Risk Averse," and "Private Business." Better educated household heads, or households with higher annual income are more likely to invest in risky assets, and are more likely to hold a larger proportion of risky assets in their financial portfolios. Whites are more likely to invest in risky assets and they tend to invest 5.131% more in risky assets than non-Whites. As expected, households that are more risk averse or own private businesses are less likely to invest in risky assets, and if they do invest in risky assets they tend to hold relatively less (approx. 5.781%) risky assets. Our result shows that a household owning a private business holds approximately 5.407% less in risky assets shares than the household without ownership in private business. This evidence supports the argument that private business is an investment substitute as private business owners are already exposed to market risks. This finding is consistent with part of the findings by Faig and Shum (2002) that households saving to invest in their own businesses have significantly safer financial portfolios.

Table 2 Heckman two-stage selection model

| Explanatory variables | (1) Prob[Y>0] | | (2) Y Y>0 | |
|-----------------------|---------------|----------------|-------------|----------------|
| | Coefficient | Standard error | Coefficient | Standard error |
| Secured debt ratio | 0.001 | 0.001 | 0.040** | 0.018 |
| HHSex | -0.099 | 0.061 | 3.984** | 1.926 |
| Age < 35 | -0.299** | 0.132 | -4.610 | 4.038 |
| Age 35-44 | -0.071 | 0.132 | 0.826 | 3.590 |
| Age 45-54 | 0.006 | 0.127 | 3.347 | 3.484 |
| Age 55-64 | 0.078 | 0.120 | 0.602 | 3.405 |
| Age 65-74 | 0.043 | 0.117 | -4.286 | 3.328 |
| Education | 0.165*** | 0.027 | 2.769*** | 0.941 |
| Kids | -0.023 | 0.023 | -0.710 | 0.619 |
| Race | 0.348*** | 0.051 | 5.131*** | 1.759 |
| Retired | -0.246*** | 0.081 | 0.482 | 2.260 |
| Ln(income) | 0.693*** | 0.048 | 6.613*** | 1.791 |
| Ln(checking) | 0.028*** | 0.006 | -0.609*** | 0.153 |
| Ln(saving) | 0.032*** | 0.010 | -0.447* | 0.258 |
| Net worth | 0.000 | 0.000 | 0.001*** | 0.000 |
| Risk aversion | -0.251*** | 0.030 | -5.781*** | 1.016 |
| Turned down | -0.142** | 0.062 | -3.023 | 1.974 |
| Late pay | -0.022 | 0.066 | -1.924 | 2.103 |
| High expense | -0.007 | 0.055 | 0.145 | 1.701 |
| Committed expense | 0.172 | 0.197 | 1.990 | 5.900 |
| Private business | -0.261*** | 0.069 | -5.407*** | 1.967 |
| LIQ CON | -0.016 | 0.022 | -0.813 | 0.744 |
| LOC | 0.000 | 0.000 | 0.000 | 0.003 |
| LIQ | 0.000 | 0.000 | -0.008** | 0.003 |
| Health risk | -0.154*** | 0.055 | -0.881 | 1.996 |
| Constant | -7.329*** | 0.509 | -31.277 | 23.287 |
| Inverse mills ratio | | | 14.787** | 6.056 |

Notes: ***, **, and * indicate significance at 1%, 5%, and 10% level, respectively. (1) This table shows the two-stage Heckman regression results. The Column 1 is the first-stage participation equation results, in which the dependent variable equals one if the respondent reports ownership of any risky financial assets. The Column 2 is the second-stage outcome equation results, in which the dependent variable is the percentage of financial assets invested in risky assets. The number of observations is 4,049. (2) Because the data is imputed, Rubin's combination rule (Rubin, 1987) is applied to the estimated coefficients. The standard errors are also adjusted accordingly to generate the correct inference.

While the above results are mostly consistent with the existing literature, we do find new and improved evidence. Our results suggest that households in the early life cycle (with a younger head less than 35 years old) and the later life cycle (retired) are less likely to participate in risky asset investment with marginal effects of -10.69% and -8.71% .⁸ The young typically are faced with credit constraints and with limited cash, while the retired are concerned with the easiness that stocks can be liquidated. Furthermore, our results show that the age profile concerns the decision to enter and exit the market for risky assets, not managing the portfolio share. Similarly, "Turned Down," which is used as a proxy for the household's credit constraint, and "Health Risk" are also significant determinants only in the participation equation. Higher health risk reduces the probability to invest in risky assets by a marginal effect of 5.38% , but it does not significantly affect the conditional risky asset shares.

Gender of household head and net worth are only significant in the outcome equation. Male-headed households tend to invest 3.984% more in risky assets, which is consistent with the evidence presented in the existing literature. However, they are not more likely to invest in risky assets than female-headed households. Households with higher net worth invest relatively more in risky asset (they can tolerate the risk better than low net worth households), but net worth is not a significant predictor of the decision to invest in any risky asset in the first place. This result contradicts the classical prediction that, after controlling for risk attitude, the portfolio share of risky assets, conditional on holding it, should be independent of the level of wealth (Guiso et al., 2002).

Now turning to the liquidity constraint measures (“LIQ,” “LIQ CON,” “Committed Expense,” “High Expense,” “LOC”), only “LIQ” has a significant negative coefficient in the outcome equation. Contrary to the findings of previous studies on the committed expense risks, our result suggests that committed expenses neither affect the participation nor the conditional risky asset shares. Another key finding is that households with higher saving and checking account balances are more likely to enter the market for risky assets, but for those already investing in risky asset, households with more cash on hand tend to invest less in risky assets.

5.2. Testing the joint decision of asset and debt allocations

We apply a bivariate Tobit model, which allows the potential simultaneity in the decision of households to hold risky assets and to hold secured debt (see Eqs. 15 and 16). Both the univariate and bivariate Tobit models are estimated for comparison and as robustness check. Tables 3a and 3b show the results.

The interdependence of the two dependent variables is tested by the likelihood ratio test on the correlation coefficient- ρ defined in Eq. (20). ρ is constrained at zero in the univariate case. The likelihood ratio test statistic follows asymptotically a χ^2 distribution with one degree of freedom under the null hypothesis that there is no interdependence in the data, $\rho = 0$. The test statistic is large enough to reject the null hypothesis at the 1% level. Therefore, the simultaneous equation bivariate Tobit model used here is appropriate to analyze the two decisions. The share of risky asset and the share of secured debt are likely to be jointly determined by the households.

By taking the potential simultaneity into consideration, our bivariate model provides further evidence. Compared with the coefficients from the univariate Tobit model, “Age < 35,” the number of kids, “Retired,” health risk, “Turned Down,” and “Committed Expense” become significant predictors of unconditional risky asset holding in the bivariate model, while the coefficients of gender of household head and net worth become insignificant. For example, the retired turns to invest 5.23% less and poor health people invest 4.108% less in risky assets. Checking account balance has a positive and significant coefficient of 0.598 for secured debt share. It has no impact on the risky asset share as opposed to the significant negative coefficient (−0.609) in the univariate case. Contrary to the evidence provided in the literature, our bivariate model results show that one percentage higher monthly committed expenses to monthly income ratio leads to a 0.129% larger share of financial asset allocated to risky assets. This can be explained by the fact that higher debt obligations push the household to seek higher return investment opportunities.

Table 3 a Estimation results of univariate Tobit model

| Explanatory variables | (1) Risky asset ratio | | (2) Secured debt ratio | |
|-----------------------|-----------------------|----------------|------------------------|----------------|
| | Coefficient | Standard error | Coefficient | Standard error |
| HHSex | 2.243 | 2.046 | 7.515*** | 1.935 |
| Age < 35 | -10.377** | 4.058 | -10.537** | 4.130 |
| Age 35-44 | -2.232 | 3.918 | -5.454 | 4.040 |
| Age 45-54 | 1.042 | 3.766 | -2.711 | 3.884 |
| Age 55-64 | 0.585 | 3.670 | -0.764 | 3.666 |
| Age 65-74 | -3.558 | 3.743 | 2.146 | 3.657 |
| Education | 5.354*** | 0.904 | -4.902*** | 0.857 |
| Kids | -1.444** | 0.694 | 1.097 | 0.687 |
| Race | 10.590*** | 1.574 | 5.432*** | 1.622 |
| Retired | -5.226** | 2.378 | 1.906 | 2.453 |
| Ln(income) | 17.363*** | 1.266 | 21.655*** | 1.267 |
| Ln(checking) | 0.021 | 0.162 | 0.596*** | 0.170 |
| Ln(saving) | 0.593** | 0.276 | -0.115 | 0.288 |
| Net worth | 0.000 | 0.000 | -0.002*** | 0.000 |
| Risk aversion | -9.008*** | 0.880 | 0.668 | 0.932 |
| Turned down | -6.530*** | 2.061 | -9.184*** | 1.992 |
| Late pay | -2.095 | 2.264 | -10.741*** | 2.182 |
| High expense | -0.634 | 1.750 | -4.530*** | 1.629 |
| Committed expense | 12.435** | 5.395 | 168.956*** | 5.245 |
| Private business | -9.023*** | 2.001 | -5.497*** | 1.945 |
| LIQ CON | -0.848 | 0.760 | 2.236*** | 0.698 |
| LOC | -0.001 | 0.004 | -0.002 | 0.005 |
| LIQ | -0.010*** | 0.004 | -0.003 | 0.005 |
| Health risk | -4.084** | 1.799 | -2.629 | 1.730 |
| Constant | -172.431*** | 13.915 | -206.994*** | 14.181 |
| ρ | 0 | | 0 | |
| σ_1 | 32.40 | | — | |
| σ_2 | — | | 43.03 | |

Notes: ***, **, and * indicate significance at 1%, 5%, and 10% level, respectively. (1) Eqs. (1) and (2) are estimated separately. (2) Because the data is imputed, Rubin's combination rule (Rubin, 1987) is applied to the estimated coefficients. The standard errors are also adjusted accordingly to generate the correct inference.

Our results identify the types of households that typically hold relatively more secured debt and more risky assets. These households earn higher income, have a White head of household, have higher committed expenses ratio, or are less credit constrained (did not fear denial or was not turned down for credit). Higher income households may better take advantage of lower interest rate on secured debt and exploit the wealth-generating potential of the equity premium. The types of households that hold relatively less secured debt and less risky assets are the younger households (<35 years old), or owning a private business, which is consistent with the findings from the existing literature. The younger households tend to hold 10.381% less on risky asset and 10.572% less on secured debt. The households owning a private business hold 9.034% less risky asset as well as 5.504% less secured debt. Well educated or higher net worth households tend to have relatively 5.304% more risky assets but 4.915% less secured debt.

“Retired,” “Health Risk,” “Risk Averse,” family size, checking account balances and total liquid assets (LIQ) are significant predictors for the share of risky assets, but not for the debt

Table 3 b Estimation results of bivariate Tobit model

| Explanatory variables | (1) Risky asset ratio | | (2) Secured debt ratio | |
|-----------------------|-----------------------|----------------|------------------------|----------------|
| | Coefficient | Standard error | Coefficient | Standard error |
| HHSex | 2.189 | 2.044 | 7.498*** | 1.936 |
| Age < 35 | -10.381** | 4.060 | -10.572** | 4.132 |
| Age 35-44 | -2.228 | 3.919 | -5.475 | 4.041 |
| Age 45-54 | 1.007 | 3.766 | -2.735 | 3.885 |
| Age 55-64 | 0.562 | 3.670 | -0.793 | 3.667 |
| Age 65-74 | -3.541 | 3.743 | 2.128 | 3.658 |
| Education | 5.304*** | 0.907 | -4.915*** | 0.857 |
| Kids | -1.446** | 0.695 | 1.092 | 0.687 |
| Race | 10.595*** | 1.574 | 5.433*** | 1.622 |
| Retired | -5.230** | 2.378 | 1.893 | 2.454 |
| Ln(income) | 17.444*** | 1.270 | 21.688*** | 1.267 |
| Ln(checking) | 0.024 | 0.162 | 0.598*** | 0.170 |
| Ln(saving) | 0.594** | 0.276 | -0.113 | 0.288 |
| Net worth | 0.000 | 0.000 | -0.002*** | 0.000 |
| Risk aversion | -8.997*** | 0.880 | 0.672 | 0.933 |
| Turned down | -6.457*** | 2.058 | -9.175*** | 1.991 |
| Late pay | -2.111 | 2.265 | -10.770*** | 2.184 |
| High expense | -0.602 | 1.750 | -4.542*** | 1.629 |
| Committed expense | 0.129** | 5.425 | 1.691*** | 5.248 |
| Private business | -9.034*** | 2.001 | -5.504*** | 1.946 |
| LIQ CON | -0.851 | 0.760 | 2.238*** | 0.699 |
| LOC | -0.001 | 0.004 | -0.002 | 0.005 |
| LIQ | -0.010*** | 0.004 | -0.003 | 0.005 |
| Health risk | -4.108** | 1.802 | -2.639 | 1.731 |
| Constant | -173.274*** | 13.968 | -207.338*** | 14.187 |
| ρ | 0.055*** | 0.018 | | |
| σ_1 | 35.694 | | | |
| σ_2 | 42.818 | | | |

Notes: ***, **, and * indicate significance at 1%, 5%, and 10% level, respectively. Likelihood ratio test: $H_0: \rho_{12} = 0$. $\chi^2 = 50.450$, $p = 0.000$. (1) Eqs. (1) and (2) are estimated simultaneously. (2) Because the data is imputed, Rubin's combination rule (Rubin, 1987) is applied to the estimated coefficients. The standard errors are also adjusted accordingly to generate the correct inference.

structure, while gender of household head, saving account balances, net worth, "Late Pay," "High Expense," "LIQ CON" only significantly affect the secured debt share.

The above evidence demonstrates that when households decide on risky asset holdings, they do not make the decision in isolation from their debt structure and obligations, vice versa. The bivariate Tobit model setup allows us to identify, in this simultaneous decision-making process, the demographic and financial factors that can contribute to the household overall financial portfolio structure.

6. Conclusions

Analyzing the allocation of financial portfolio, including financial assets and liabilities, is of paramount importance for economic policy making. This is especially imperative at the

household level as it indicates the financial pressure and stress faced by the households in the quick-changing economic environment. In this research, we first test the effect of secured debt on risky assets by using a two-step Tobit model. We separate the decision to participate in investing in risky assets from the decision on how much risky assets to hold and provide improved evidence upon the existing literature. We find robust relationships between debt structure and asset allocation. Although the debt structure does not prompt households to start investing in risky assets, it does affect the share of financial assets allocated in risky assets for those that are already investing.

We then allow the potential simultaneity in the decisions of household debt structure and asset allocation by applying a bivariate Tobit model. This setup clarifies some contradicting conclusions from the previous studies that neglect the simultaneity of choices and allows us to identify the demographic and financial factors that contribute to the households' overall financial portfolio structure. It also allows us to gain insights into the factors affecting the households' vulnerability to adverse changes in the financial market. The positive relationship between the committed expense ratio and the share of risky assets investment supports the argument that households invest in risky assets to pay off the debt (Brown and Tyler, 2008). These are the households that are more vulnerable in the time of financial market down turns. Holding more risky assets with higher secured debt obligations leaves the household with an unbalanced financial portfolio exposed to leveraged financial risks. Such households need to be targeted for financial advice. Better educated household heads seem to better take advantage of higher return from risky assets without being significantly constrained by the illiquidity caused by the secured debt. Lower income households are less likely to participate in investing risky assets and tend to invest less, but they hold relatively more unsecured debts, which typically incur higher interest expenses. If provided with the investment opportunities and are better informed about financial matters, they may be able to exploit the wealth-generating potential of the equity premium. This further affirms the importance of financial literacy education.

Notes

- 1 Cox and Jappelli (1993) introduce a three-equation generalized Tobit model, where the authors add one additional participation equation.
- 2 For Probit models with standard normal density, the hazard is equal to the inverse Mill's ratio.
- 3 Similar setup is adopted by Brown and Taylor (2008).
- 4 To obtain a clearer picture of how aggregate holdings of various asset categories are related to household-level characteristics, the SCF tends to oversample wealthy households, because the wealthy segment holds most assets (Guiso et. al., 2002; Perraudin and Sorensen, 2000).
- 5 Cardak and Wilkins (2009) point out that labor uncertainty and health risk are the two major background risk factors.
- 6 Some variables, for example, marital status, are omitted to avoid multicollinearity problem. The remaining independent variables in the equations all have very low correlation coefficients.

- 7 As discussed in Section 3.1. (under Eq. 13), the marginal effect $\partial E[y|x]/\partial x$ is β_2 in the outcome equation. The economic significance of Secured Debt is calculated using median values of households' financial assets (\$48,690), risky assets (\$8,345), risky-asset ratio (0.4093), and the marginal effect (estimated coefficient) of 0.04.
- 8 As discussed in Section 3.1. (under Eq. 13), the marginal effect of variable x_j in the participation equation is given by $\frac{\partial p(x)}{\partial x_j} = \beta_j \phi(x' \beta)$. The marginal effect of a dummy variable is the change in predicted probabilities when the dummy variable changes from 0 to 1 while all other variables are kept at their means.

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