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HOUSEHOLD DEBT AND ATTITUDES TOWARD RISK

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We explore the relationship between attitudes toward risk and the level of debt at the household level for a sample of households drawn from the U.S. Panel Study of Income Dynamics (PSID) over the period 1984 to 2007. Using a sequence of questions from the 1996 PSID, we analyze the implications of interpersonal differences in attitudes toward risk for the accumulation of unsecured debt, secured debt, and total debt at the household level. Our empirical findings suggest that attitudes toward risk are an important determinant of the level of debt acquired at the household level with risk aversion being inversely related to the level of debt accumulated by households.

JEL Codes: D12, D14

Keywords: debt, risk attitudes, risk preference

1. INTRODUCTION

Over the last decade, there has been a significant increase in consumer debt in the U.S. followed by a decline in household leverage, the ratio of debt to disposable income, with the onset of the recessionary period toward the end of 2007 (see Glick and Lansing, 2009). Increases in the level of household debt around the start of the millennium led to concern amongst policy-makers over the extent of financial vulnerability and risk at the household level. Figures from the U.S. Federal Reserve reveal that debt levels (consumer credit and mortgage debt) were nearly $13,823 billion in 2008 compared to $11,804 billion at the end of 2005 (Federal Reserve, 2009). However, household de-leveraging following the financial crisis, which may be related to both the supply-side and the demand-side, with lenders

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specifying tighter requirements for loans and households responding to the prevailing economic climate, has served to counteract this trend.

Despite the importance of understanding what influences household debt levels for policy-making, amongst academic economists research into the determinants of debt at the household level remains surprisingly scarce. There are, however, a small yet growing number of empirical studies on debt, which explore its determinants at the household or individual level. For example, Godwin (1997) analyzes the dynamics of households' use of consumer credit and attitudes toward credit using the U.S. Survey of Consumer Finances. The findings indicate considerable mobility in debt status during the 1980s, with the majority of households in a different debt quintile in 1989 relative to 1983. In addition, the findings suggest that respondents have become more negative toward credit, thereby suggesting an increase in debt aversion over this period. More recently, Crook (2001) explores the factors that explain U.S. household debt over the period 1990 to 1995 and finds that income, home ownership, and family size are all positively associated with the level of household debt. Brown *et al.* (2005) analyze British panel data and find that financial expectations are important determinants of unsecured debt at both the individual and the household level, with financial optimism being positively associated with the level of unsecured debt. In a more recent study, Brown *et al.* (2008) report a similar positive relationship between optimistic financial expectations and the level of secured, i.e. mortgage, debt.

In this paper, we focus on one particular influence on debt accumulation at the household level, namely attitudes toward risk. Given the uncertainty surrounding the capacity to acquire and repay debt, it is surprising that inter-personal differences in attitudes toward risk have not attracted much attention in the empirical literature on household debt. One reason why attitudes toward risk have attracted limited attention in the empirical literature may be due to the shortage of measures of risk preference at the household and individual level. One approach to their measurement used in the existing literature is based on responses to hypothetical situations. Barsky *et al.* (1997), which is arguably the seminal paper in this area, find that individuals who do not live in houses that they own, are more risk tolerant than individuals who do own their homes. Clearly, home ownership is an important factor in holding secured debt. Similarly, Donkers and Van Soest (1999) find that risk averse Dutch homeowners tend to live in houses with lower mortgages. Related issues explored in the economic psychology literature concern attitudes toward debt and debt aversion. For example, Lea *et al.* (1995) explore psychological influences in credit use, money management, and economic socialization, whilst, more recently, Watson (2003) explores the relationship between materialism, spending tendencies, debt, and saving, where materialistic individuals were found to have more favorable attitudes toward borrowing, i.e. less debt averse. Given the important role of attitudes toward debt and debt aversion in the use of credit at the household level, intuitively one might expect risk aversion to also influence households' use of credit and debt accumulation.

In contrast, there has been relatively more interest in the relationship between risk preferences and saving at the individual and household level. For example, Lusardi (1998) explores the importance of precautionary saving exploiting U.S. data on individuals' subjective probabilities of job loss from the Health and

Retirement Survey. Evidence in favor of precautionary saving is found for a sample of individuals who are close to retirement. In a similar vein, Guariglia (2001) uses the British Household Panel Survey to ascertain whether households save in order to self-insure against uncertainty. The findings support a statistically significant relationship between earnings variability and household saving, with households saving more if they are pessimistic about their future financial situation.

Households generally acquire debt to increase current consumption with repayments being made in the future. Typically, this may be due to life cycle reasons and liquidity shortages. Given that debt repayments are generally financed from household income, it is apparent that if income is subject to risk (due to, for example, redundancy, unemployment, or changes in real wages), then the attitudes toward risk of the individual will potentially play a key role in the decision to acquire debt, given the distribution of future income and interest rates. Intuitively, one might predict that the more risk averse an individual is, the lower will be the debt he/she incurs if there is a non-zero probability that they cannot repay the debt in the future. A related point concerns the individual's attitudes toward debt default, repossession, and bankruptcy, which individuals may ultimately face if they are unable to repay the debt.

In this paper, we explore the relationship between attitudes toward risk and household debt from an empirical perspective. In order to ascertain whether the relationship between debt and risk preference differs by type of debt, we analyze unsecured, secured, and total debt at the household level. Given the considerable level of concern amongst policy-makers in a number of countries over the level of household indebtedness, further research into the determinants of household debt is clearly warranted in order to ascertain which types of households are likely to accumulate relatively high levels of debt. Our findings, which are robust to a range of econometric specifications, support an inverse association between risk aversion and the level of debt at the household level. We therefore identify an important aspect to the decision to take on debt which has surprisingly attracted very little attention in the relatively small yet expanding literature on household debt.

2. Theoretical Background

We capture the influence of risk aversion on borrowing described above within a simple two period life cycle example, which serves to inform our subsequent empirical analysis. We aim to derive closed form solutions for the optimally chosen levels of consumer borrowing (and saving). From both a theoretical and an empirical perspective, the issue of how consumers with different risk preferences choose their optimal level of debt cannot be analyzed separately from their saving or asset holdings. So we adopt a mean-variance specification for the utility function in each period. With mean-variance utility, and with a finite life, the value function is also mean-variance in disposable resources. Hence, if we restrict attention to a two period problem, consumer choice over these periods will conveniently reflect the same choice over a multi-period horizon. In this context, the mean-variance form can be regarded as an approximation to an underlying more general utility function. With mean-variance utility, we can isolate the coefficient of risk aversion as a simple determinant of consumer behavior; with a general utility function, the coefficient of risk aversion becomes a function of current and future consumption, so that risk preferences will depend on current and future consumption and their determinants.[1]

Our notation is defined as follows: $D \geq 0$ is the stock of debt, which has a gross cost of R_D; and $S \geq 0$ is the stock of a savings asset, which has a gross return of R_S. The individual has labor income of y_t in periods $t = 1,2$ and starts life with given financial stocks, D_1 and S_1. So in period 1 disposable resources, w_1, are given by:

$$w_1 = y_1 + R_{S1}S_1 - R_{D1}D_1. \tag{1}$$

These exogenous resources are used in period 1 for either consumption or net financial asset holding for period 2. So the budget constraint in period 1 is given by:

$$w_1 = c_1 + S_2 - D_2. \tag{2}$$

Since period 2 is the final period, all available resources, w_2, are then consumed and thus constitute the budget constraint for period 2, which is given by:

$$w_2 = c_2 = y_2 + R_{S2}S_2 - R_{D2}D_2. \tag{3}$$

In period 1, the labor income and the interest rates of period 2 are uncertain and have a joint probability distribution. Utility in each period is defined by:

$$u(c_t) = E(c_t) - \frac{b}{2}\operatorname{var}(c_t); \quad t = 1,2, \tag{4}$$

discounted at time preference rate β. Hence, the trade-off between the mean and variance of consumption is given by:

$$-\frac{\partial E[u(c_t)]/\partial E[c_t]}{\partial E[u(c_t)]/\partial \operatorname{var}(c_t)} = \frac{2}{b}, \tag{5}$$

where $(b/2)$ is the coefficient of risk aversion. With equation (4), first period utility is linear in consumption because income is certain in the initial period and so has zero variance. With another utility function allowing for a closed form solution, for example quadratic utility, income would enter the model's solutions but the inter-temporal rate of substitution, equation (5), would no longer be equal to the risk preference parameter itself, but to the risk preference parameter plus expected consumption. More generally, utility forms other than mean-variance present difficulties distinguishing between the inter-temporal rate of substitution and the degree of risk aversion. Therefore, to preserve a clear relationship between debt and risk aversion, we have opted for a mean-variance specification.

[1]See equation (5).

The focus of both our theoretical and empirical analysis is to derive a direct relationship between $(b/2)$ and the optimally chosen level of D_2; that is, a relationship between debt and risk aversion, based on individual preferences, constraints, and optimal choice. To achieve this, we use equations (2) to (4) to set the individual's optimization problem as follows:

$$\text{(6)} \qquad \begin{aligned} &\max_{c_1,c_2,S_2,D_2} c_1 + \beta\left[E_1(c_2) - \frac{b}{2}\text{var}(c_2)\right] \\ &st. \quad c_1 = w_1 - S_2 + D_2 \\ &\qquad\; c_2 = y_2 + R_{S2}S_2 - R_{D2}D_2 \\ &\qquad\; S_2, D_2 \geq 0. \end{aligned}$$

In other words, the individual maximizes lifetime expected utility as given by equation (4) subject to the period budget constraints as given by equations (2) and (3); and subject to a non-negativity constraint on D_2 and S_2 ensuring that these two financial instruments represent the individual's holdings of debt and assets, respectively. Since all initial wealth is consumed over the individual's lifetime, the period budget constraints are used to eliminate c_1 and c_2 from problem (6), which reduces to:

$$\text{(7)} \qquad \begin{aligned} &\max_{S_2,D_2} w_1 - S_2 + D_2 + \beta\left[E_1(y_2 + R_{S2}S_2 - R_{D2}D_2) - \frac{b}{2}\text{var}(y_2 + R_{S2}S_2 - R_{D2}D_2)\right] \\ &st. \quad S_2, D_2 \geq 0. \end{aligned}$$

In order to solve problem (7), we then need to calculate the mean and variance of second period consumption in the square brackets. To do this, let μ_S, μ_D, μ_y denote the means of second period interest rates and labor income, respectively, and let:

$$\text{(8)} \qquad \begin{bmatrix} \sigma_{SS} & \sigma_{SD} & \sigma_{Sy} \\ \sigma_{SD} & \sigma_{DD} & \sigma_{Dy} \\ \sigma_{Sy} & \sigma_{Dy} & \sigma_{yy} \end{bmatrix}$$

denote the variance–covariance matrix of these variables. Then problem (7) becomes:

$$\text{(9)} \qquad \begin{aligned} &\max_{S2,D2} w_1 - S_2 + D_2 + \beta\Big[\mu_y + \mu_S S_2 - \mu_D D_2 - \\ &\qquad \frac{b}{2}(\sigma_{yy} + \sigma_{SS}S_2^2 + \sigma_{DD}D_2^2 + 2\sigma_{Sy}S_2 - 2\sigma_{Dy}D_2 - 2\sigma_{SD}S_2D_2)\Big] \\ &st. \quad S_2, D_2 \geq 0, \end{aligned}$$

with an interior solution characterized by holdings of both debt and savings:[2]

[2]The possible corner solutions of problem (9) are as follows: $\{S_2 = 0, D_2 > 0\}$, $\{S_2 > 0, D_2 = 0\}$, and $\{S_2 = 0, D_2 = 0\}$. Analysis indicating the importance of risk preference at the corners is omitted here due to brevity but is available from the authors on request.

(10) $$D_2 = A_{D2} + B_{D2}(2/b) \text{ and}$$

(11) $$S_2 = A_{S2} + B_{S2}(2/b),$$

where:

(12) $$A_{D2} = \frac{(\sigma_{SS}\sigma_{yD} - \sigma_{SD}\sigma_{yS})}{(\sigma_{SS}\sigma_{DD} - \sigma_{SD}^2)},$$

(13) $$B_{D2} = \frac{(\sigma_{SS}(1-\beta\mu_D) - \sigma_{SD}(1-\beta\mu_S))}{\beta(\sigma_{SS}\sigma_{DD} - \sigma_{SD}^2)},$$

(14) $$A_{S2} = \frac{(\sigma_{SD}\sigma_{yD} - \sigma_{yS}\sigma_{DD})}{(\sigma_{SS}\sigma_{DD} - \sigma_{SD}^2)},$$

(15) $$B_{S2} = \frac{(-\sigma_{DD}(1-\beta\mu_S) + \sigma_{SD}(1-\beta\mu_D))}{\beta(\sigma_{SS}\sigma_{DD} - \sigma_{SD}^2)}.$$

It is then clear from equation (10) that the optimally chosen stock of debt is a function of the coefficient of risk aversion. In particular, the sign of equation (13)—the slope of equation (10)—determines whether debt is increasing in (2/*b*), i.e. decreasing in risk aversion. The common denominator of equations (13) and (15) is equal to one minus the coefficient of correlation between costs and returns on debt and assets, multiplied by the product of the corresponding variances. The numerators of equations (13) and (15) depend on the discounted expected returns on debt and assets, weighted by the respective variances and covariances. So, for example, if the weighted expected return on debt is negative and that on assets is positive, then the relationship between debt and risk aversion is negative.

Given the predictions of the theory, in the remaining empirical sections of the paper, we focus on the relationship between debt and risk preferences at the household level: first, to explore whether our theoretical prediction that debt is influenced by risk preferences is supported from an empirical perspective; and second, to determine the nature of this relationship.

3. Data

3.1. *Measurement of Attitudes toward Risk*

The obvious problem with exploring the relationship between household debt and attitudes toward risk from an empirical perspective lies in locating a suitable measure of risk preference. For this purpose, we exploit data from the U.S. Panel Study of Income Dynamics (PSID), which is a representative panel of individuals, ongoing since 1968, conducted at the Institute for Social Research, University of Michigan.

The 1996 PSID Survey includes a Risk Aversion Section which contains detailed information on individuals' attitudes toward risk. The Risk Aversion Section contains five questions related to hypothetical gambles with respect to lifetime income. As stated above, Barsky *et al.* (1997) is the seminal contribution in the economics literature, which analyzes this type of risk preference measure based on hypothetical gambles over lifetime income. Specifically, in the PSID, all employed heads of household were asked the following question:

(M1): Suppose you had a job that guaranteed you income for life equal to your current total income. And that job was (your/your family's) only source of income. Then you are given the opportunity to take a new, and equally good, job with a 50–50 chance that it will double your income and spending power. But there is a 50–50 chance that it will cut your income and spending power by a third. Would you take the new job?

The individuals who answered "yes" to this question, were then asked:

(M2): Now, suppose the chances were 50–50 that the new job would double your (family) income, and 50–50 that it would cut it in half. Would you still take the job?

The individuals who answered "yes" to this question were then asked:

(M5): Now, suppose that the chances were 50–50 that the new job would double your (family) income, and 50–50 that it would cut it by 75 percent. Would you still take the new job?

The individuals who answered "no" to Question M1 were asked:

(M3): Now, suppose the chances were 50–50 that the new job would double your (family) income, and 50–50 that it would cut it by 20 percent. Then would you take the job?

Those individuals who replied "no" were asked:

(M4): Now, suppose that the chances were 50–50 that the new job would double your (family) income, and 50–50 that it would cut it by 10 percent. Then would you take the new job?

Thus the above questions alter the risk associated with taking the new job which we denote by α. As Luoh and Stafford (2005) point out, it is important to acknowledge that the question states that the new job will be "equally as good" such that there is no difference in the non monetary characteristics of the jobs. The responses to this series of questions are summarized in Table 1, where the percentages of individuals in each category are shown in the final column. The response rates relate to a sample of employed heads of household aged between 16 and 65. Interestingly, Kimball *et al.* (2009) analyze a sample of heads of households aged 20–69 and find that the most prevalent risk attitudes category is the least risk averse category. It is important therefore to acknowledge the potential importance of sample selection for the analysis. The sample, comprising 2,560 observations, relates to heads of household aged over 16 in 1996. The series of questions thus enables us to place individuals into one of six categories of risk attitudes, where, faced with a 50–50 gamble of doubling income or cutting it by a given factor, α, a head of household will accept the risky job if the expected utility from the job

TABLE 1
The Risk Attitudes Measure

Risk Attitudes Categories		
Response to Hypothetical Gamble	Risk Associated with the New Job α	% in Category
M1 = yes & M2 = yes & M5 = yes	3/4	5.97
M1 = yes & M2 = yes & M5 = no	1/2	11.94
M1 = yes & M2 = no	1/3	19.01
M1 = no & M3 = yes	1/5	18.64
M1 = no & M3 = no & M4 = yes	1/10	22.31
M1 = no & M3 = no & M4 = no	0	21.13

Note: "yes" denotes accept the gamble and "no" denotes decline the gamble.

change exceeds that of the utility from remaining with the current job where income is certain (see, e.g., Kimball *et al.*, 2008). Furthermore, as stated by Barsky *et al.* (1997, p. 540), "the categories can be ranked by risk aversion without having to assume a particular form for the utility function."

The series of questions described above accords with the general approach taken in the economics literature, which is based on classifying individuals in terms of their attitudes toward risk according to their marginal utility of income, with the relatively more risk averse individuals characterized by marginal utility of income diminishing at a relatively fast rate (Dave and Saffer, 2008). As stated by Dave and Saffer (2008), who explore the relationship between alcohol demand and risk preference, this measure of attitudes toward risk has been subject to extensive testing in order to "minimize misunderstandings and additional complications in interpretation and to ensure consistency with the economist's concept of risk preference" (p. 812). In particular, Barsky *et al.* (1997) find that risk tolerance, as measured by responses to hypothetical gambles over lifetime income, is positively associated with risky behavior such as smoking, drinking alcohol, not having insurance, and holding relatively risky financial assets, such as stocks.

Recently, however, Kimball *et al.* (2009) have highlighted a number of issues related to the PSID risk attitudes measure. In particular, they argue that the gambling responses are characterized by considerable measurement error due to unobserved heterogeneity in preferences. Furthermore, additional details in the description of the gambles can potentially influence the measurement of risk preferences. Moreover, there is the possibility that the job-related gamble may be interpreted differently by individuals at different stages of their career.

Kimball *et al.* (2009) discuss how to move from categorical survey responses to imputed values of preference parameters, allowing for measurement error in survey responses. They distinguish between variance due to measurement error and variance in true risk preferences by exploiting multiple responses by some individuals to the survey question to separate "signal from noise" in the survey responses. Kimball *et al.* (2009) assume that individuals have constant relative risk aversion utility, so given the gambles presented above, individuals will accept the risky job when their expected utility is greater than the expected utility of their current/safe job. They further assume that true risk tolerance is log-normally distributed and that survey response error is purely random measurement error. These assumptions together with the multiple responses to the series of hypothetical gamble questions presented enable the authors to assign a range of risk tolerance coefficients to each gamble response category, rather than treating the responses as an ordinal index. The authors argue that the imputations offer advantages over the categorical sequence of gamble responses in that the responses can be formulated into a single cardinal measure of preferences.[3] In the empirical analysis which follows, we adopt the imputed cardinal measure of risk attitudes constructed by Kimball *et al.* (2009), which is denoted by R_h.

3.2. *The Measurement of Household Debt*

Detailed information pertaining to unsecured debt is available in the PSID for 1984, 1989, 1994, 1999, 2001, 2003, 2005, and 2007 although the Risk Aversion Section is only available in the 1996 PSID. In each of these years, the head of household is asked the following question: "Aside from the debts that we have already talked about, like any mortgage on your main home, do you (or anyone in your family) currently have any other debts such as for credit card charges, student loans, medical or legal bills, or on loans from relatives? If you added up all of these debts (for all of your family), about how much would they amount to right now?" Thus, the responses to this question yield information pertaining to the level of unsecured debt at the household level at time t, which is denoted by ud_{ht}. For the same years, the PSID also includes information regarding secured, i.e. mortgage, debt. Heads of household are asked: "Do you have a mortgage on this property? About how much is the remaining principal on this mortgage?" Thus over the sample period we are able to construct the level of secured debt at the household level at time t, which is denoted by sd_{ht}. Total household debt is then constructed by the summation of unsecured and secured debt, i.e. $d_{ht} = ud_{ht} + sd_{ht}$.

Our sample is restricted to heads of household aged 16 or over. We analyze an unbalanced panel of data drawn from the 1984, 1989, 1994, 1999, 2001, 2003, 2005, and 2007 waves with risk attitudes, which are only measured at 1996, being time invariant in the panel. It should be noted that Sahm (2007), who analyzes hypothetical income gambles using data from the U.S. Heath and Retirement Study, finds that time invariant characteristics such as gender and ethnicity are responsible for a lot of the systematic variation in risk tolerance whilst risk tolerance is found to decline with age. The sample is unbalanced in the sense that not all heads of household h are present for the full period T; some individuals leave the sample, whereas new individuals can enter—providing they are observed in 1996 when the risk preference information was collected.[4] The sample size is $n = \sum_{h=1}^{H} t_h$ where t_h is the number of occasions on which the head of household is observed. The panel dataset comprises $n = 19{,}966$ observations, where 67 percent of individuals are in the sample for the entire period. The minimum (maximum) number of times an individual is in the PSID is 1 (8) times.

[3]Details of the estimation and imputation procedure are discussed in Kimball *et al.* (2009) and the accompanying appendix is available at http://www.aeaweb.org/articles.php?doi=10.1257/aer.99.2.363.
[4]Our findings are robust to restricting the analysis to a balanced panel.

4. Attitudes toward Risk and Household Debt

4.1. *Methodology*

In this section, we explore the relationship between attitudes toward risk and the levels of unsecured, secured, and total debt at the household level, denoted by ud_{ht}, sd_{ht}, and d_{ht}, respectively. Throughout the empirical analysis, the values of all monetary variables have been deflated with 2007 as the base year. Over time, the data reveal that around 45 percent (46 percent) of households do not have any unsecured (secured) debt and 24 percent of households have no debt. As in Brown *et al*. (2005, 2008) and Brown and Taylor (2008), in order to explore the determinants of the level of each type of debt at the household level, in our econometric analysis, we treat ud_{ht}, sd_{ht}, and d_{ht} as censored variables since they cannot have negative values. As the distributions of the three types of debt are highly skewed, following Gropp *et al*. (1997), we specify logarithmic dependent variables. For households reporting zero unsecured, secured debt or total debt, $\ln(ud_{ht})$, $\ln(sd_{ht})$, and $\ln(d_{ht})$ are recoded to zero, since there are no reported values of ud_{ht}, sd_{ht}, and d_{ht} between zero and unity in the PSID.

In Figure 1A, the distribution of log unsecured debt for those heads of household with positive amounts of unsecured debt, i.e. $\ln(ud_{ht}) > 0$, is shown for both 1984 and 2007. The median level of unsecured debt over the period is \$3,588 for the sample reporting positive unsecured debt. Similarly, Figure 1B shows the distribution of log secured debt for those heads of household with positive amounts of secured debt, i.e. $\ln(sd_{ht}) > 0$, for both 1984 and 2007, with the median level of secured debt for this sample being \$48,210. Finally, the distribution of total debt, the summation of unsecured and secured debt, is shown in Figure 1C for those heads of households with positive levels of debt, i.e. $\ln(d_{ht}) > 0$, where the median level of total debt for this sample is \$31,068. Noticeably, there has clearly been a shift in the distribution of each type of debt over the time period, i.e. toward higher levels of debt throughout the distribution.

We denote by $\ln(ud^*_{ht})$, $\ln(sd^*_{ht})$, and $\ln(d^*_{ht})$ the corresponding untruncated latent variables. The untruncated latent variables theoretically can have negative values. The determinants of each type of debt are modeled via a univariate tobit specification with Mundlak fixed effects. The following shows the method for unsecured debt, where the same modeling approach is then applied to secured debt and total debt:

$$\ln(ud^*_{ht}) = \boldsymbol{\beta}_1'\boldsymbol{X}_{ht} + \boldsymbol{\theta}_1'\bar{\boldsymbol{X}}_h + \pi_1 R_{ht} + \varepsilon_{1ht} = \boldsymbol{\psi}_1'\boldsymbol{Z}_{ht} + \varepsilon_{1ht} \tag{16}$$

$$\ln(ud_{ht}) = \ln(ud^*_{ht}) \quad if \quad ud^*_{ht} > 0 \tag{17}$$

$$\ln(ud_{ht}) = 0 \quad otherwise, \tag{18}$$

where the level of unsecured debt of household h over time t is given by ud_{ht} such that $h = 1, \ldots, n_h$ and $\boldsymbol{X}_{ht}$ represents a vector of head of household and household characteristics, which is defined below. In order to allow for the panel nature of the data to control for head of household time invariant effects, a vector of additional

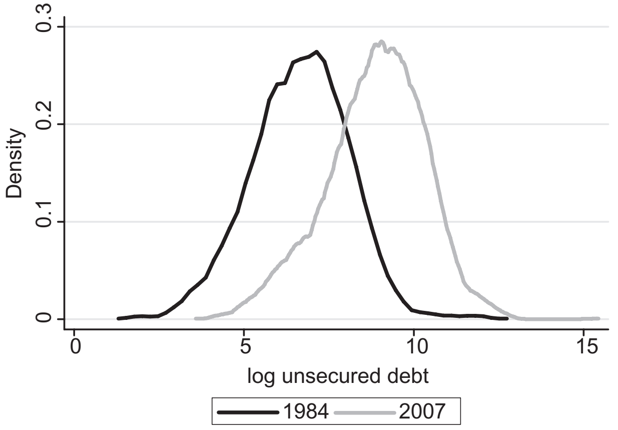

Figure 1A. Distribution of Log Unsecured Debt in 1984 and 2007, $\ln(ud_{ht}) > 0$

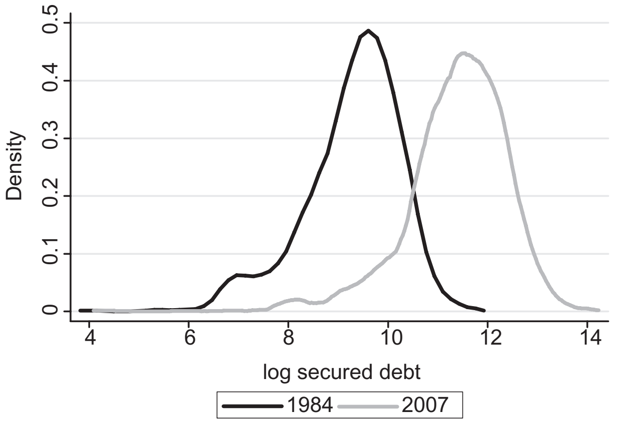

Figure 1B. Distribution of Log Secured Debt in 1984 and 2007, $\ln(sd_{ht}) > 0$

covariates is incorporated into the modeling, $\bar{\boldsymbol{X}}_h$, which represents the head of household means over time of those variables in $\boldsymbol{X}_{ht}$ that are time variant. An observed vector of parameters is denoted by $\boldsymbol{\theta}_1$. Following Mundlak (1978), as stated in Brown *et al*. (2010), this enables the $\boldsymbol{\beta}_1$ and π_1 to be considered as an approximation to a standard panel fixed effects estimator with dummy variables for heads of households rather than these means. Finally, the stochastic disturbance term is denoted by $\varepsilon_{1ht} \sim N(0, \sigma_{ht}^2)$. Thus, the estimated coefficient π_1 serves to inform us about the relationship between the level of unsecured debt and attitudes toward risk at the household level.

Explanatory variables in $\boldsymbol{X}_{ht}$ include controls for a number of influences drawn from the existing literature, which may affect the level of debt at the household level. Such controls include the following head of household character-

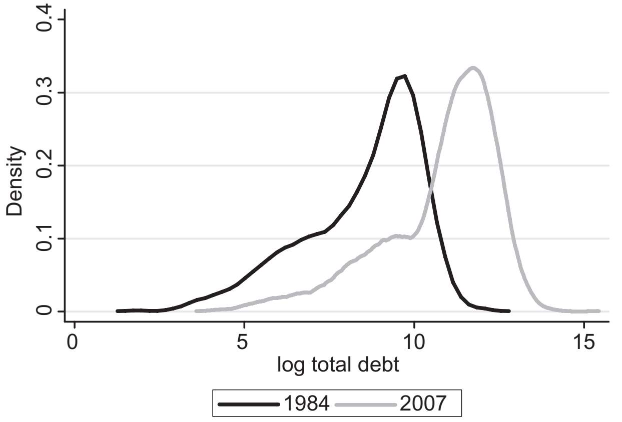

Figure 1C. Distribution of Log Total Debt in 1984 and 2007, $\ln(d_{ht}) > 0$

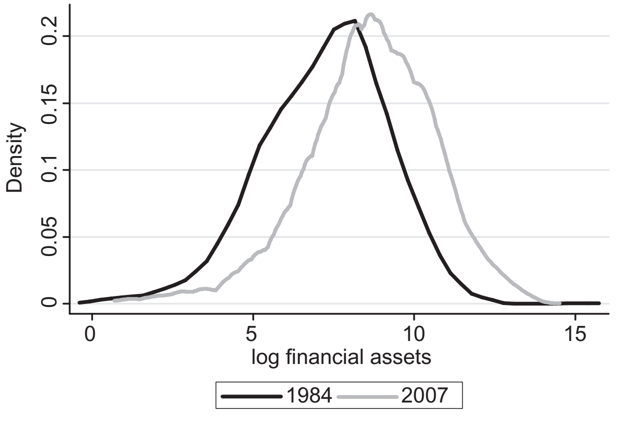

Figure 1D. Distribution of Log Financial Assets in 1984 and 2007, $\ln(fa_{ht}) > 0$

istics: binary indicators for age, specifically aged 25–35, aged 35–45, aged 45–55, and aged 55–65 (under 25 is the reference category); gender; ethnicity; marital status; whether the head of household is currently employed; whether the head of household's spouse is employed; whether the head of household owns a business; years of schooling; and whether the head of household has reported good health in the past 12 months. Household controls include: household size; household income (earned and other non-labor income); housing tenure and past income volatility as measured by the variance of labor income over the period 1969 to 2007. Finally, in order to control for the other side of the household's financial portfolio, we also include the financial assets of the household in the set of explanatory variables. Regarding the measurement of financial assets, the head of household is asked to specify the amount of shares of stock in publicly held corporations, mutual funds, and investment trusts, and money in current (i.e.

checking) or savings accounts, money market funds, certificates of deposit, and government savings bonds or treasury bills. The sum of these values is then used to obtain a measure of the household's financial assets.[5] Financial assets at the household level at time t are denoted by fa_{ht}, where 23 percent of households have no assets. Figure 1D shows the distribution of log financial assets for those heads of household with positive amounts of financial assets, i.e. $\ln(fa_{ht}) > 0$, in 1984 and 2007. Interestingly, in contrast to the distribution of unsecured and secured debt, the distribution of financial assets is relatively stable over the time period as can be seen from comparing Figures 1A to 1C with Figure 1D.

Table A1a presents summary statistics for the key monetary variables used in the empirical analysis.[6] Both medians and interquartile ranges are shown due to the skewed nature of the data. Table A1b presents the summary statistics of the control variables used in the empirical analysis. Year dummy variables are also included throughout the analysis. In terms of the average characteristics of the household head, 35–45 is the most populated age category, approximately 77 percent are male, and 63 percent are married. Finally, Table A2 reports average levels of unsecured, secured, and total debt by year, which reveals a nine-fold increase in overall debt. However, the median level of financial assets in 1984 is \$6,693, increasing to \$21,776 in 2007, i.e. only a three-fold increase. Thus, on average, it would appear that the change in financial assets over the period is largely outweighed by the change in debt.

4.2. *Results*

Table 2 reports the results from the univariate tobit analysis with Mundlak fixed effects, i.e. equations (16) to (18), investigating the determinants of unsecured debt (first column), secured debt (second column), and total debt (final column). Throughout each model, standard errors are robust to heteroscedasticity.

As stated in Brown and Taylor (2008), due to the truncated nature of the dependent variables, we focus on the conditional expected value of the truncated logged response given the covariates, since, unlike the untruncated case, the marginal effects are not given by the parameters. This is due to the fact that the marginal effects with truncated data depend on the values of the covariates and are not constant. Thus, throughout the tobit specifications presented, marginal effects are reported based on Greene (1999), the exception being the intercept term β_0, which is un-scaled and reported so that the effects of the dummy variables can be calculated. The marginal effects are found by focusing on the derivative of the conditional expected value of the truncated logged response, given the covariates, with respect to the covariates. The conditional expected value function of the truncated logged response, e.g. for unsecured debt $\ln(ud_{ht})$, is given by the following $E\{\ln(ud_{ht})|\boldsymbol{Z}_{ht}\} = \Phi(\boldsymbol{\psi}_1'\boldsymbol{Z}_{ht}/\sigma)\boldsymbol{\psi}_1'\boldsymbol{Z}_{ht} + \sigma\{\phi(\boldsymbol{\psi}_1'\boldsymbol{Z}_{ht}/\sigma)\}$ and will be heavily weighted toward zero, where φ and Φ denote the density and cumulative distribu-

[5]It is apparent that financial assets and debt may be jointly determined, which implies that treating assets as exogenous in this context is arguably problematic. In order to explore the robustness of the analysis, this issue is explored in detail in Section 6.

[6]Tables A1a, A1b, and A2 are all presented in the online appendix.

tion of the standard normal, respectively. For a continuous variable, differentiation of the expected value function yields:

$$(19)\quad \partial E\{\ln(ud_{ht})|\boldsymbol{Z}_{ht}\}/\partial \boldsymbol{Z}_{ht} = \Phi(\boldsymbol{\psi}_1'\boldsymbol{Z}_{ht}/\sigma)\boldsymbol{\psi}_1 = prob\{\ln(ud_{ht}) > 0|\boldsymbol{Z}_{ht}\}\boldsymbol{\psi}_1.$$

Assuming the errors are normally distributed, the probability of a non-censored observation, or scaling factor, is given by: $\Phi(\boldsymbol{\psi}_1'\boldsymbol{Z}_{ht}/\sigma)$ evaluated at the mean of the sample covariates. An approximation to the scaling factor is the proportion of uncensored observations. For unsecured, secured, and total debt, the proportions of uncensored observations are 0.55, 0.54, and 0.77, respectively; see Table A1a. For a dummy variable X_{ht}^D, an approximation of the marginal effect is to regard $\Phi(\boldsymbol{\psi}_1'\boldsymbol{Z}_{ht}/\sigma)$ and $\phi(\boldsymbol{\psi}_1'\boldsymbol{Z}_{ht}/\sigma)$ as being broadly the same for $X_{ht}^D = 1$ and $X_{ht}^D = 0$, in which case the marginal effect is the same as for continuous covariates, as given in equation (19), i.e. $\Phi(\boldsymbol{\psi}_1'\boldsymbol{Z}_{ht}/\sigma)\beta_1^D$.

Turning to the results in Table 2, those heads of household aged 25–35 have lower levels of unsecured debt relative to those aged under 25 (the reference category), focusing upon secured debt; this peaks when heads of household are aged between 35 and 55 when compared to the reference category. The results

TABLE 2
Univariate Tobit Models with Mundlak Fixed Effects

	Unsecured Debt		Secured Debt		Total Debt	
	M.E.	T Stat	M.E.	T Stat	M.E.	T Stat
Intercept β_0	–2.7047	*(2.49)*	–14.8781	*(11.45)*	–0.9393	*(1.99)*
Age 25–35	0.2951	*(2.02)*	0.0210	*(0.11)*	0.0451	*(0.37)*
Age 35–45	–0.0905	*(0.46)*	0.9412	*(3.92)*	–0.0078	*(0.05)*
Age 45–55	–0.0881	*(0.33)*	0.7002	*(2.25)*	0.0063	*(0.03)*
Age 55–65	–0.5847	*(1.72)*	–0.1961	*(0.50)*	–0.3486	*(1.30)*
Male	–1.0591	*(2.15)*	–1.0152	*(1.66)*	–1.0935	*(2.50)*
Non-white	0.2448	*(0.46)*	0.0887	*(0.14)*	0.1501	*(0.32)*
Married	0.1588	*(1.24)*	1.9734	*(12.42)*	0.4745	*(4.44)*
Employed	0.0093	*(0.08)*	0.3226	*(2.34)*	0.1363	*(1.43)*
Spouse employed	0.2196	*(2.21)*	0.4425	*(3.98)*	0.1448	*(1.92)*
Owns a business	–0.0635	*(0.51)*	0.5554	*(4.25)*	0.0899	*(1.00)*
Years of schooling	0.1276	*(4.87)*	–0.0109	*(0.36)*	0.1027	*(5.13)*
Good health	–0.2184	*(1.74)*	–0.3847	*(2.38)*	–0.2031	*(1.88)*
Household size	–0.0355	*(1.12)*	0.3474	*(9.01)*	0.0365	*(1.39)*
Log household labor income	0.0598	*(3.49)*	0.1457	*(7.83)*	0.0497	*(3.49)*
Log household other income	0.0016	*(0.13)*	0.0052	*(0.40)*	0.0052	*(0.48)*
Rented home	0.3679	*(2.40)*	–		0.9707	*(6.42)*
Home ownership (mortgage)	0.7302	*(5.39)*	–		4.7801	*(7.91)*
Home ownership (outright)	–0.6713	*(4.73)*	–		-0.7909	*(6.21)*
Log past income variance	–0.1042	*(5.13)*	–0.1856	*(7.09)*	–0.1220	*(6.65)*
Log financial assets	0.0555	*(4.63)*	0.0656	*(4.66)*	0.0486	*(4.92)*
Cardinal risk attitudes	–0.1143	*(6.95)*	–0.0627	*(3.28)*	–0.0843	*(6.31)*
σ	6.719		7.781		4.057	
F(*d*, *e*) *p value*	31.83 *p = [0.000]*		151.27 *p = [0.000]*		296.12 *p = [0.000]*	
Observations			19,966			

Notes: For unsecured debt and total debt degrees of freedom (*d*, *e*) equal (45, 19,921). For secured debt degrees of freedom (*d*, *e*) equal (39, 19,927). M.E. denotes marginal effect.

T statistics are based upon standard errors corrected for heteroscedasticity.

which follow are robust to using cohort dummy variables instead of age category dummy variables, or replacing the age category dummy variables with age in years specified as a quadratic function. Those heads of household in paid employment have higher levels of mortgage debt, on average, although there is no influence upon unsecured debt. Both total household labor income and income from other sources (e.g. benefits) have a positive association with each type of debt; however the influence is inelastic, and only household labor income is statistically significant. For example, a 1 percent increase in labor income is associated with a 0.05 percentage increase in total debt. In each specification, the natural logarithm of the financial assets of the household are included, where a 1 percent increase in financial assets is associated with a 0.06, 0.07, and 0.05 percent increase in unsecured, secured, and total debt, respectively. Debt is positively associated with the head of household having an employed spouse and the years of schooling of the head of household. Having a male head of household and a head of household in good health are both inversely associated with the level of each type of debt. These results generally tie in with the findings in the existing literature (see, e.g., Gropp *et al.*, 1997; Crook, 2001; Brown and Taylor, 2008).

From Table 2 it is apparent that risk attitudes are negatively related to each type of debt.[7] To evaluate the percentage impact of a one standard deviation increase in the risk attitudes measure upon the level of debt, we multiply the marginal effect by the standard deviation of the risk attitudes measure. The standard deviation of R_{ht} is 1.81, hence a one standard deviation increase in the cardinal risk attitudes measure reduces unsecured, secured, and total debt by approximately 20.7, 11.4, and 15.3 percentage points, respectively. It is important to acknowledge that the measure of risk attitudes only acts as a proxy for risk preferences. As such, it is important to explore the robustness of the risk attitudes effect to changes in the empirical specification. In particular, evidence has been found in the existing literature supporting a strong relationship between risk attitudes and educational attainment (see, e.g., Sahm, 2007). We find, however, that the effect of risk attitudes in terms of sign, magnitude, and statistical significance is not affected by omitting education from the set of explanatory variables.

The magnitude of the influence of risk attitudes upon debt can be placed into context by providing a comparison with the effects of other explanatory variables. For example, a one standard deviation increase in years of schooling increases unsecured and total debt by 38.3 and 30.8 percentage points, respectively. In terms of income effects, a one standard deviation increase in household labor income is associated with an increase in unsecured, secured, and total debt of 16.1, 39.3, and 13.4 percentage points, respectively. Whether the spouse of the head of household is employed is associated with an increase in unsecured, secured, and total debt of 21.9, 44.3, and 14.5 percentage points, respectively. Thus, the effect of attitudes toward risk upon the level of debt appears to be relatively large, yet in line with other key variables.

[7]As pointed out by an anonymous referee, it may be the case that more risk tolerant individuals may enter riskier jobs, with such jobs being compensated with relatively high income, which in turn leads to higher debt accumulation. In order to allow for such considerations, we have repeated the analysis with the debt to income ratio as the dependent variable. We find that the inverse association between risk attitudes and debt remains with this specification.

We have also explored the possible endogeneity of risk attitudes via instrumenting risk attitudes with the log expected value of the gamble. In order to test the validity of the instrument, we adopt an approach to exogeneity following Smith and Blundell (1986), by testing whether the residuals from the first stage regression (i.e., the risk attitudes equation) are statistically significant in the debt equation. We also test whether the excluded instrument in the debt equation is statistically significant in the first stage regression of risk attitudes. The residuals from the first stage are found to be statistically insignificant in the outcome equation and the instrument is statistically significant in the risk attitudes equation (at the 1 percent level). The results are robust to this approach in that the inverse relationship between debt and risk attitudes remains statistically significant. In a similar vein, we have estimated equations (16) to (18) with debt levels reported after 1996 regressed upon risk attitudes and debt reported prior to 1996. The idea behind this is that the least risk averse households might be those who accumulated debt most quickly, conditional upon their initial debt levels. The results are robust to this specification, indicating that the inverse relationship between debt and risk attitudes remains statistically significant.

Since the tobit estimator is sensitive to the assumption of normality, as a robustness check, we have also employed a Censored Least Absolute Deviations estimator which is robust to changes in the distribution (see Greene, 2008). The effect of the risk attitudes measure remains statistically significant at the 1 per cent level with coefficients of –0.18, –0.072, and –0.054 for unsecured, secured, and total debt, respectively. Finally, as mentioned above, the Mundlak approach has been adopted in order to account for the panel nature of the data. Our findings are, however, robust to a random effects specification. The marginal effects of the risk attitudes variable for unsecured debt, secured debt, and total debt are –0.124 ($t = 4.65$), –0.041 ($t = 2.55$), and –0.093 ($t = 4.62$), respectively. Moreover, the results reveal that the panel element of the data is important, with the individual effect being correlated over time with the estimated correlations of 0.335, 0.239, and 0.265 for unsecured, secured, and total debt, respectively, all being statistically significant at the 1 percent level.

5. Robustness: Quantile Regression Analysis

5.1. *Methodology*

In this section, we explore the robustness of the findings from the tobit analysis by performing quantile regression analysis (see Koenker and Bassett, 1978) in order to explain each type of debt. Due to the truncated nature of the dependent variable, we perform quantile regression analysis for each type of debt for those heads of household who hold that particular type of debt. As stated in Brown and Taylor (2008), the advantage of quantile regression analysis over regression at the mean is that it provides an analysis of different parts of the conditional distribution, hence providing a fuller description of the entire distribution. This is because when considering the effect of an explanatory variable on the dependent variable, under quantile regression analysis, the effect is allowed to vary at different quantiles of the conditional distribution. Thus, instead of assuming that covariates shift only the location or the scale of the conditional distribution, quantile regression explores the potential effects of covariates on the shape of the distribution. Hence, independent variables, which are statistically insignificant under regression at the mean, may have a statistically significant role at certain parts of the debt distribution or may differ in terms of the magnitude of the effect (Koenker and Hallock, 2001). The quantile regression approach is given by (focusing upon log unsecured debt, the same method is then applied to secured debt and total debt):

$$\ln(ud_{ht})_{|ud_{ht}>0} = \boldsymbol{\phi}_\theta' \boldsymbol{Z}_{ht} + \varepsilon_{\theta ht}, \tag{20}$$

where $\varepsilon_{\theta ht}$ is the error term associated with the θ-th quantile of $\ln(ud_{ht})_{|ud_{ht}>0}$ (i.e., for positive levels of debt) and $\text{Quant}_\theta(\varepsilon_{\theta ht}|\boldsymbol{Z}_{ht}) = 0$.

As in Section 4, the vector $\boldsymbol{Z}_{ht}$ includes a vector of head of household and household characteristics, $\boldsymbol{X}_{ht}$, as defined above. In accordance with the tobit analysis, to take into account the panel nature of the data in order to control for head of household time invariant effects, a vector of additional covariates is incorporated in $\boldsymbol{Z}_{ht}$, namely $\bar{\boldsymbol{X}}_h$, which represents the means over time of those variables in $\boldsymbol{X}_{ht}$ that are time variant. Following Mundlak (1978), this enables the estimated parameters to be considered as an approximation to a standard panel fixed effects estimator with dummy variables for heads of households rather than these means.

The θ-th conditional quantile of $\ln(ud_{ht})_{|ud_{ht}>0}$ for a given set of characteristics, $\boldsymbol{Z}_{ht}$, is denoted by:

$$\text{Quant}_\theta\left\{\ln\left(ud_{ht|ud_{ht}>0}\right)| \boldsymbol{Z}_{ht}\right\} = \boldsymbol{\phi}_{\theta ht}' \boldsymbol{Z}_{ht}, \tag{21}$$

where $\boldsymbol{\phi}_{\theta ht}$ denotes a vector of parameters. We explore each percentile of the distribution in order to investigate whether the influence of attitudes toward risk is uniform across the debt distribution.

5.2. *Results*

Table 3 presents the results of the quantile regression analysis of estimating the determinants of each type of debt for each decile, where the parameter estimate on the risk attitudes measure is shown, i.e. $\hat{\pi}_\theta$. For unsecured, secured, and total debt, there is an inverse relationship with risk aversion which decreases monotonically across the distribution (where statistically significant). For example, focusing upon a one standard deviation increase in the risk attitudes measure for a head of household at the bottom (top) of the distribution, this is associated with a 9.2 (3.3) percentage increase in total debt. Thus, interestingly, across each type of debt, the risk attitudes measure is found to have a larger impact at the bottom end of the debt distribution, i.e. the influence of risk attitudes diminishes as the debt burden of the household increases. This is particularly apparent in the case of unsecured debt, where the effect of risk attitudes is statistically insignificant at the top two deciles of the distribution indicating that, for those households who hold the highest levels of unsecured debt, the level of unsecured debt is not influenced by attitudes toward risk. Such findings suggest that risk preferences are unable to explain unsecured debt at the highest parts of the unsecured debt distribution.

TABLE 3
Quantile Regression Analysis with Mundlak Fixed Effects

	Unsecured Debt		Secured Debt		Total Debt	
	Coef	T Stat	Coef	T Stat	Coef	T Stat
10th decile, $\hat{\pi}_{0.1}$	–0.054	*(4.20)*	–0.022	*(1.81)*	–0.051	*(3.91)*
20th decile, $\hat{\pi}_{0.2}$	–0.047	*(3.83)*	–0.032	*(4.56)*	–0.028	*(3.70)*
30th decile, $\hat{\pi}_{0.3}$	–0.041	*(3.56)*	–0.039	*(7.24)*	–0.032	*(4.43)*
40th decile, $\hat{\pi}_{0.4}$	–0.038	*(3.67)*	–0.036	*(7.05)*	–0.035	*(5.79)*
50th decile, $\hat{\pi}_{0.5}$	–0.037	*(4.19)*	–0.033	*(6.36)*	–0.032	*(6.74)*
60th decile, $\hat{\pi}_{0.6}$	–0.039	*(4.03)*	–0.028	*(5.81)*	–0.026	*(5.05)*
70th decile, $\hat{\pi}_{0.7}$	–0.025	*(2.89)*	–0.029	*(5.88)*	–0.023	*(5.04)*
80th decile, $\hat{\pi}_{0.8}$	–0.010	*(1.21)*	–0.026	*(6.04)*	–0.026	*(4.91)*
90th decile, $\hat{\pi}_{0.9}$	–0.017	*(1.46)*	–0.021	*(3.64)*	–0.018	*(3.67)*

Notes: Quantile regressions are based upon the specification in Table 2. T statistics are based upon bootstrapped standard errors.

6. Robustness: Debt, Financial Assets and Attitudes toward Risk

Given the theoretical framework analyzed in Section 2, it is interesting to explore whether the inverse association between debt and risk attitudes prevails if we model debt and financial assets simultaneously (see Brown and Taylor, 2008). As in the case of debt, we employ a censored regression approach to ascertain the determinants of $\ln(fa_{ht})$, which allows for the truncation of the dependent variable, where for households reporting zero assets, $\ln(fa_{ht})$ is recoded to zero, as there are no reported financial assets between zero and unity. We denote by $\ln(fa^*_{ht})$ and $\ln(ud^*_{ht})$ (in the case of unsecured debt) the corresponding untruncated latent variables, which theoretically can have negative values.

We adopt a joint modeling approach by specifying a bivariate tobit model given that debt and assets represent two components of the household's financial portfolio. The bivariate tobit model allows for the possibility of interdependent decision making with respect to household financial assets and debt. The following shows the method for unsecured debt, where the same modeling strategy is then applied to secured debt and total debt:

(22) $$\ln(ud^*_{ht}) = \boldsymbol{\beta}'_2\boldsymbol{X}_{ht} + \boldsymbol{\theta}'_2\bar{\boldsymbol{X}}_h + \pi_2 R_{ht} + \gamma bk_{ht} + \varepsilon_{2ht} = \boldsymbol{\psi}'_2\boldsymbol{V}_{ht} + \varepsilon_{2ht}$$

(23) $$\ln(ud_{ht}) = \ln(ud^*_{ht}) \quad if \quad ud^*_{ht} > 0$$

(24) $$\ln(ud_{ht}) = 0 \quad otherwise$$

(25) $$\ln(fa^*_{ht}) = \boldsymbol{\lambda}'\boldsymbol{X}_{ht} + \boldsymbol{\mu}'\bar{\boldsymbol{X}}_h + \varphi' R_{ht} + \varepsilon_{3ht} = \boldsymbol{\Omega}'\boldsymbol{W}_{ht} + \varepsilon_{3ht}$$

(26) $$\ln(fa_{ht}) = \ln(fa^*_{ht}) \quad if \quad fa^*_{ht} > 0$$

(27) $$\ln(fa_{ht}) = 0 \quad otherwise,$$

where $\varepsilon_{2ht}, \varepsilon_{3ht} \sim N(0, 0, \sigma^2_{2ht}, \sigma^2_{3ht}, \rho)$ and the covariance between the error terms is denoted by $\sigma_{2ht,3ht} = \rho\sigma_{2ht}\sigma_{3ht}$. In the bivariate tobit model (see Brown and Taylor, 2008), the disturbance terms, ε_{2ht} and ε_{3ht}, are jointly normally distributed with variances σ^2_{2ht} and σ^2_{3ht}, respectively. If the correlation term, ρ, is zero, then assets and debt are independent. If $\rho \neq 0$, then this implies a degree of inter-dependence between debt and financial assets. The model in equations (22) to (27) is recursive (see Greene, 2008), due to the inclusion of binary indicators in the debt equation, *bk*, controlling for whether the head of household has ever been bankrupt. As with the univariate tobit models of debt accumulation and the quantile analysis, in order to control for the panel nature of the data, we include a vector of household means over time of those covariates which are not time invariant, i.e. Mundlak fixed effects. We then repeat the analysis, replacing unsecured debt with secured debt and total debt.

6.1. *Results*

Table 4 presents the determinants of each type of debt and financial assets based on the bivariate tobit model. Throughout the specifications, it is clear that $\rho \neq 0$, suggesting interdependency between debt and financial assets, hence endorsing the joint modeling approach. Interestingly, the level of financial assets is inversely related to unsecured debt but positively related to secured and total debt. Perhaps not surprisingly, those heads of household who have been previously bankrupt have lower levels of secured and total debt, yet have more unsecured debt. The results show that risk attitudes are generally unrelated to the level of financial assets but, in accordance with the previous findings, are negatively and significantly related to each type of debt.

7. Conclusion and Discussion

In this paper, we have contributed to the small yet growing empirical literature analyzing debt at the household level, focusing in particular on the role of attitudes toward risk in the decision to acquire both unsecured and secured debt. Given the uncertainty surrounding the decision to acquire debt, it is surprising that inter-personal differences in attitudes toward risk have not attracted much attention in the empirical literature on household debt. Our empirical analysis has investigated the relationship between attitudes toward risk and debt using U.S. household level data drawn from the PSID. Our empirical findings suggest that risk aversion is inversely associated with the amount of unsecured, secured, and total debt accumulated at the household level. This finding of an inverse association between risk aversion and debt is robust across a range of econometric specifications, namely univariate tobit analysis, bivariate tobit analysis, and quantile regression analysis.

It is apparent that households characterized by low levels of risk aversion are more tolerant of fluctuations in their financial circumstances and the associated fluctuations in their consumption; hence the finding that they are more inclined to accumulate debt accords with intuition. Conversely, those households who are relatively more risk averse, and hence, by definition, are less tolerant of such

TABLE 4

Bivariate Tobit Models with Mundlak Fixed Effects

	Unsecured		Assets		Secured		Assets		Total		Assets	
	M.E.	T Stat	M.E.	T Stat	M.E.	T Stat	M.E.	T Stat	M.E.	T Stat	M.E.	T Stat
Intercept β_0	4.9585	*(18.23)*	3.9598	*(8.85)*	6.9843	*(35.73)*	3.7134	*(12.58)*	4.5268	*(21.12)*	3.8498	*(12.66)*
Age 25–35	0.0017	*(0.04)*	0.0612	*(1.06)*	0.2018	*(6.71)*	–0.0641	*(1.08)*	0.1334	*(3.12)*	0.0475	*(0.81)*
Age 35–45	–0.0630	*(1.26)*	0.1993	*(2.66)*	0.1783	*(4.89)*	0.0684	*(0.89)*	0.1535	*(2.86)*	0.2077	*(2.74)*
Age 45–55	–0.0582	*(0.88)*	0.3284	*(3.34)*	0.0839	*(1.80)*	0.1961	*(1.95)*	0.0870	*(1.23)*	0.3356	*(3.39)*
Age 55–65	–0.1853	*(2.19)*	0.2293	*(1.85)*	0.0160	*(0.27)*	0.1484	*(1.16)*	–0.0488	*(0.55)*	0.2468	*(1.97)*
Male	–0.2129	*(1.80)*	–0.1752	*(0.93)*	–0.0345	*(0.41)*	–0.1323	*(0.68)*	–0.2108	*(1.68)*	–0.1375	*(0.72)*
Non-white	0.0678	*(0.52)*	–0.0926	*(0.50)*	0.0315	*(0.34)*	–0.0864	*(0.45)*	–0.0508	*(0.37)*	–0.0975	*(0.52)*
Married	0.1389	*(4.27)*	0.4423	*(9.18)*	0.0853	*(3.59)*	0.4333	*(8.78)*	0.2987	*(8.61)*	0.4515	*(9.28)*
Employed	0.0154	*(0.54)*	0.0236	*(0.57)*	–0.0444	*(2.19)*	–0.0484	*(1.14)*	0.0019	*(0.06)*	0.0328	*(0.78)*
Spouse employed	0.0676	*(2.72)*	–0.0342	*(0.95)*	–0.0139	*(0.85)*	–0.0703	*(1.89)*	0.0070	*(0.27)*	–0.0436	*(1.20)*
Owns a business	0.0431	*(1.40)*	0.2363	*(5.48)*	0.0163	*(0.85)*	0.2575	*(5.80)*	0.0746	*(2.37)*	0.2429	*(5.58)*
Years of schooling	0.0036	*(0.56)*	–0.0178	*(1.91)*	0.0275	*(6.29)*	–0.0275	*(2.88)*	0.0319	*(4.77)*	–0.0219	*(2.33)*
Good health	–0.0143	*(0.45)*	0.0889	*(1.79)*	0.0116	*(0.49)*	0.0749	*(1.46)*	–0.0033	*(0.10)*	0.0991	*(1.98)*
Household size	0.0015	*(0.19)*	–0.0093	*(0.74)*	0.0176	*(2.96)*	–0.0016	*(2.88)*	0.0347	*(3.97)*	–0.0063	*(0.50)*
Log household labor income	0.0084	*(1.92)*	0.0316	*(5.16)*	0.0204	*(8.20)*	0.0612	*(11.44)*	0.0102	*(2.31)*	0.0304	*(4.91)*
Log household other income	–0.0031	*(0.95)*	–0.0099	*(2.02)*	–0.0001	*(0.07)*	–0.0182	*(4.41)*	–0.0019	*(0.54)*	–0.0095	*(1.93)*
Rented home	0.0312	*(0.80)*	–0.0658	*(1.14)*	–		–		0.0463	*(1.04)*	–0.0456	*(0.78)*
Home ownership (mortgage)	0.0516	*(1.51)*	0.0766	*(1.53)*	–		–		1.5519	*(4.48)*	0.2174	*(4.00)*
Home ownership (outright)	–0.0801	*(2.23)*	0.3496	*(6.77)*	–		–		0.1087	*(2.77)*	0.3602	*(6.90)*
Log past income variance	0.0011	*(0.22)*	–0.0164	*(2.01)*	–0.0130	*(0.77)*	–0.0168	*(1.99)*	–0.0054	*(0.96)*	–0.0168	*(2.03)*
Bankrupt once	0.0407	*(1.81)*	–		–0.2194	*(3.13)*	–		–0.0110	*(2.41)*	–	
Bankrupt more than once	0.2928	*(2.34)*	–		–0.2036	*(2.91)*	–		–0.0087	*(2.07)*	–	
Log debt	–		–0.0509	*(18.62)*	–		0.0122	*(5.32)*	–		–0.0365	*(8.82)*
Log financial assets	–0.0149	*(5.38)*	–		0.0136	*(7.59)*	–		0.0066	*(2.34)*	–	
Cardinal risk attitudes	–0.0195	*(4.69)*	0.0020	*(0.34)*	–0.0185	*(6.04)*	0.0178	*(2.88)*	–0.0248	*(5.69)*	0.0051	*(0.82)*
ρ	0.1073 p = *[0.000]*				0.1372 p = *[0.000]*				0.1545 p = *[0.000]*			
Wald chi squared (d)	3,744.18 p = *[0.000]*				7,724.10 p = *[0.000]*				19,801.43 p = *[0.000]*			
Observations	19,966											

Notes: M.E. denotes marginal effect. $d = 46$ except in the model which estimates secured debt and financial assets where $d = 40$. T statistics are based upon standard errors corrected for heteroscedasticity.

fluctuations, are found to accumulate less debt. Such findings suggest that observed debt accumulation partially reflects the risk attitudes of households and indicates a relatively limited role for policy intervention in this regard, with households tailoring their debt levels in accordance with their individual preferences. However, the results from the quantile regression analysis add an additional dimension to the findings, indicating that the relationship between unsecured debt and risk attitudes breaks down at the two highest percentiles of the unsecured debt distribution. Differences clearly exist between unsecured and secured debt. For example, unsecured debt is arguably easier to obtain than secured debt with a wide range of credit arrangements available. In addition, mortgage debt is distinct from unsecured debt in the sense of being related to housing investments. The finding that preferences are unable to explain unsecured debt at the highest parts of the debt distribution may mean that policy intervention is appropriate and that future research on further exploring the determinants of unsecured debt at the higher end of the unsecured debt distribution may be warranted.

An additional interesting line of enquiry for future research, subject to data availability, concerns whether the extent of the de-leveraging of households in the U.S. witnessed with the onset of the recessionary period toward the end of 2007 differs by attitudes toward risk. Our findings suggest that the most risk averse individuals may be more inclined to de-leverage than less risk averse households. It should be acknowledged, however, that de-leveraging reflects both supply-side and demand-side factors. Hence, it may be the case that a less risk averse individual may experience de-leveraging if lenders, for whatever reason, are reluctant to lend, regardless of the individual's desire for more credit. Future focus on the role of risk attitudes for debt accumulation at the individual and household level in the context of the interaction of demand-side and supply-side factors may yield interesting insights for policy-makers. The availability of more recent data, which includes information on risk attitudes, such as the U.S. Survey of Consumer Finances 2010, will hopefully provide opportunities to explore such issues in the future.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table A1a: Medians and Interquartile Ranges
Table A1b: Summary Statistics (Control Variables)
Table A2: Average Unsecured, Secured and Total Debt by Year