Relaxed Lending Standards and the 2007 Mortgage Crisis: Changes in Household Debt and Borrowing Behaviors*

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Using the 1998 and 2007 Survey of Consumer Finances data, this paper examines changes in household debt and borrowing behaviors following a decline in lending standards. The findings suggest that households desired more debt and obtained more of their desired debt in 2007 than they did in 1998. This is especially true for the credit-constrained households headed by someone that was 34 years of age or younger or between 54 and 65, and for constrained households with annual income of between $30,000 and $60,000 or of more than $345,000. Households headed by someone that was 34 or younger or between 44 and 65, and households with income levels of more than $60,000 were also less likely to be credit constrained in 2007.

JEL Codes: G01, G21, G28, D12, D14, D91.

1. Introduction

Research in the wake of the 2007 subprime mortgage crisis has found that its contributing factors included a decline in lending standards and a rise in household borrowing, especially by higher-risk borrowers who drew against their rising home equity.[1] Although the decline in lending standards has been well documented in literature,

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[1]For the decline in lending standards, see Dell'Ariccia, Igan, and Laeven (2008), Demyanyk and Van Hemert (2011), Foote et al. (2008), Keys et al. (2009, 2010), Mian and Sufi (2009b), and Purnanandam (2011). For the rise in household borrowing, see Mian and Sufi (2009a, 2010).

the change in household debt and borrowing behavior has not been analyzed in light of the decline in lending standards. This paper adds to the literature on the financial crisis by examining in detail the changes in household desired debt and whether households were able to obtain a higher proportion of their desired debt in the run-up to 2007. The goal is not to show the generalized trends of more borrowing since 1989. The goal is to show whether households had a greater capacity to borrow following the decline in lending standards. Through use of the Federal Reserve Board's 1998 and 2007 Survey of Consumer Finances (SCF), this paper addresses three questions regarding the relaxation of lending standards in the 1998–2007 period: (i) Did household demand for credit rise? (ii) Were households less likely to be credit constrained (that is, more likely to get all the credit they desired)? (iii) Did households that were credit constrained obtain more of the credit they desired? Households are subgrouped into different categories based on their age and income. The paper analyzes how answers to the three questions vary among households in different age and income subgroups.

The literature on the role of lending standards in the 2007 subprime mortgage crisis has focused on mortgage loan characteristics and mortgage loan qualities to draw inferences about lending standards. The goal in this paper is to analyze more directly how households' desired debt and borrowing behaviors changed in a period of declining lending standards. The focus is on households generally, not just mortgage borrowers, because the unemployment and loss of wealth caused by the crisis were similarly widespread. Conducted every three years, the SCF is a rigorous, representative sampling of U.S. households that provides detailed information about their outstanding debt levels, financial and nonfinancial assets, attitudes about debt, and expectations about the economy.[2] This study is the first to measure households' desired debt in assessing their borrowing behavior in the years leading up to the 2007 crisis.[3]

[2]See http://www.federalreserve.gov/econresdata/scf/scfindex.htm.

[3]Desired debt has been studied in other contexts. See, for example, Cox and Jappelli (1993), Crook (2001), Crook and Hochguertel (2006), Duca and Rosenthal (1993), Gropp, Scholz, and White (1997), Lyons (2003), Magri (2007), and Manrique and Ojah (2004).

As part of its analysis, this study computes, for various household characteristics in both 1998 and 2007, the amount of debt desired by credit-constrained households and the gap between their desired and actual stock of debt; it then examines how this gap changed from 1998 to 2007 for various characteristics of credit-constrained households. In 1998, lenders were making subprime mortgages, but the decline in lending standards had not yet begun; by 2007, lending standards had been relaxed for some time. Any difference in household debt behavior between 1998 and 2007 will be the more notable because household expectations about interest rates and the general economy, as documented in the surveys, were similar across the two years.[4]

Following the decline in lending standards, one would expect that credit-constrained households will obtain more of their desired debt and that the gap between actual and desired stock of debt will decline. Thus, as a means of analyzing the changes in households' debt and borrowing behaviors, this study tests the following null hypothesis: The gap between the desired and actual stock of debt for credit-constrained households was lower in 2007 than in 1998. Testing for this hypothesis will help address the three issues posed at the outset: whether the amount of debt desired rose between the two years, whether households became less likely to be credit constrained, and whether credit-constrained households in 2007 received more of their desired debt than in 1998. It will also be possible to address which households—and specifically which age and income groups—have experienced those changes.

To identify credit-constrained households, the present study uses the self-reported indicators in the SCF data that have been widely used in the literature (Cox and Jappelli 1990, 1993; Crook 1996, 2001; Jappelli 1990; Lyons 2003): whether the household has ever

[4]The interviews for the 1998 SCF were conducted between July and December 1998; those for the 2007 SCF were conducted between May and December 2007. Regarding attitudes about the economy in the 1998 (2007) survey, 48 percent (41 percent) of households expected the economy to be the same in the next five years, 24 percent (29 percent) expected it to be better, and 28 percent (30 percent) expected it to be worse. Regarding attitudes about interest rates in the 1998 (2007) survey, 63 percent (63 percent) of households expected them to be lower five years from now, 30 percent (29 percent) expected them to be the same, and 7 percent (8 percent) expected them to be higher.

been denied credit, or has ever been given less credit than it applied for, or has ever been discouraged from applying for credit. Because these self-reported constraint indicators are for any loan type, the analysis here encompasses all household debt.

One difficulty with testing the null hypothesis is determining the desired stock of debt of credit-constrained households. The stock of debt desired by unconstrained households can be taken to be the same as their outstanding debt, as reported in the SCF, because they can obtain the full loan amount they desire. However, households with borrowing constraints can obtain only part of the loan amount they desire. The SCF data show neither the loan amounts originally requested by constrained households nor the amounts that they did not apply for because they assumed that the request would be denied. Thus, the analysis must estimate the stock of debt desired by constrained households.

To do so, this study follows the procedure in Cox and Jappelli (1993). As an initial step, the desired stock of debt for all unconstrained households is estimated and derived from indebted unconstrained households. As the second step, the desired stock of debt for the constrained households is derived from the coefficients estimated in the initial step.

The literature on household debt has not considered the entire distribution of net wealth that is provided in the SCF data. This study does so; it includes wealthy households in its analysis and adjusts for the SCF's oversampling of wealthy households by using the sampling weights provided in the SCF data. Other ways in which this study extends the literature is that it applies previously used techniques—constructs of permanent income and instrumenting the net worth variable used in the regressions—to more recent data (the 2007 SCF).[5] The standard errors are also bootstrapped to generate correct standard errors.

The findings of the present analysis show that desired debt was greater in 2007 than in 1998. And even though desired debt rose, credit-constrained households were able to receive more of their

[5]The construction of permanent income follows the techniques developed in Cox and Jappelli (1993) and King and Dicks-Mireaux (1981). The regressions used here control for constructed permanent income, and the standard errors are bootstrapped to generate correct standard errors.

desired debt. This was especially true for households with household heads that were age 34 or younger or between 54 and 65, with annual income of between $30,000 and $60,000, and with income of more than $345,000. And less likely to be credit constrained in 2007 were households with income of more than $60,000 and with household heads that were age 34 or younger or between 44 and 65.

These findings imply that households had a greater capacity to borrow following the decline in lending standards. Households desired more debt and were less likely to be credit constrained, and credit-constrained households received more of their desired debt. These results warrant the greater attention that regulators are placing on credit markets to preserve financial stability. Monitoring the status of lending standards, desired debt, and credit constraints in time allows regulators to apply precautionary restraints across credit markets to better protect borrowers, the financial system, and the wider economy.

The paper proceeds as follows. Sections 2, 3, and 4 review the literature on household debt and present the theory and model. Sections 5, 6, and 7 describe the variables, cover the data and descriptive statistics, and present the findings. Section 8 concludes.

2. Literature Review

Many papers have attempted to determine whether households are constrained in their access to credit, and most of them used SCF data for their analysis. To determine the presence of constraint, some used indirect measures such as assets, the wealth-to-income ratio, and the saving rate. The findings of the papers using indirect measures have been ambiguous. Some of them concluded that approximately 20 percent of U.S. households had credit constraints (Hall and Mishkin 1982; Hayashi 1985; Hubbard and Judd 1986; Mariger 1987; Zeldes 1989). Other studies (Altonji and Siow 1987; Attanasio and Weber 1995; Dejuan and Seater 1999; Runkle 1991) with indirect measures concluded that households did not have any credit constraints. Lyons (2003) suggested that the ambiguity of these findings was probably due to their lack of a more direct measure to identify households with credit constraints.

A large number of other studies (Cox and Jappelli 1990, 1993; Crook 1996, 2001; Duca and Rosenthal 1993; Fissell and Jappelli

1990; Gropp, Scholz, and White 1997; Jappelli 1990; Lyons 2003) have used a more direct measure from the SCF data, namely, self-reporting on the questions regarding constrained access: whether the household (i) has ever been denied credit, (ii) has ever been given less credit than the amount it applied for, and (iii) has ever been discouraged from applying for credit. Overall, Crook (1996) has found that 19 percent to 20 percent of households were credit constrained prior to 1983 and 1989. The studies found a wide range of factors that significantly influenced the probability of a household being credit constrained. Among the factors lowering the probability were a smaller household size and a household head with any of the following characteristics: older; white; married; a good credit history; a checking account; higher income; higher net worth; more numbers of debit, credit, and charge cards; owning a home; a longer tenure as a homeowner at the current address; a longer tenure as an employee at the current employer; more years of schooling; in the habit of saving; not receiving any welfare payments; and no near-term prospect of a major expenditure. Also decreasing the likelihood of a credit constraint was living in a more rural area and in an area with a lower level of banking competition. Findings by Gropp, Scholz, and White (1997) suggest that bankruptcy exemption, level of Herfindahl index for financial institutions in the area, and whether there are multibank holding companies in the state are also significant determinants of having credit constraints.

In a departure from the rest of the credit-constraint literature, Cox and Jappelli (1993) and Crook and Hochguertel (2006) related the determinants of credit constraint to an estimate of households' permanent income (that is, the long-term income households anticipate having on the basis of their assets, skills, and education), computed as in King and Dicks-Mireaux (1982). Cox and Jappelli (1993) find that being credit constrained is negatively related to permanent income at the weakest (10 percent) significance level. Among the Crook and Hochguertel (2006) findings for the United States is that the greater the amount by which current income exceeds permanent income, the higher is the probability of the household having a credit constraint. Findings by Crook and Hochguertel (2006) also show that the probability of constraint varies directly with household head's being self-employed, years of education, and the number of children. The probability varies inversely with net

worth, income, household head's age, and household head's being unemployed, female, or single.

Some studies derived determinants of credit constraint as a step in estimating desired debt (Cox and Jappelli 1993; Crook 2001; Crook and Hochguertel 2006; Duca and Rosenthal 1993; Gropp, Scholz, and White 1997; Magri 2007; Manrique and Ojah 2004). They conditioned their estimates of desired debt on households that have positive amounts of desired debt and are not credit constrained. These studies found a wide range of factors that significantly influenced the desired debt. Among the factors increasing the desired debt were larger household size and a household head with any of the following characteristics: male, young, more years of schooling,[6] currently working, ownership of a home, higher net worth,[7] higher income,[8] willingness to borrow to finance luxury items, and near-term prospect of a major expenditure.

Cox and Jappelli (1993) showed that desired debt has a positive relation with permanent income and that desired debt declines after a threshold age. Crook and Hochguertel (2006) suggest that, in the United States, a reduction in current income below permanent income positively affects the amount of debt that is demanded. Rising age (until 30) also has a positive effect on desired debt, but desired debt levels decline after age 65. Crook (2001) showed a negative relation with age for household heads aged above 54 years old, income squared, and risk aversion. Gropp, Scholz, and White (1997) found a negative relation of desired debt to concentration of the financial market, living in certain regions, number of years the household head has been working at current employer, and to rising age for those between 34 and 65.

The literature excludes wealthy households from analysis and does not consider the entire distribution of net wealth that is provided with the SCF data. This study fills this gap by including wealthy households in the analysis and using SCF sampling weights. Use of the weights adjusts for the oversampling of wealthy

[6] Crook and Hochguertel (2006) find a negative relation with desired debt and education.

[7] Crook (2001) showed that desired debt declines with higher net worth.

[8] Cox and Jappelli (1993) found a negative relation with current income.

households and reflects the U.S. population. As another extension to the literature, this study includes more recent data (the 2007 SCF).

Simultaneity exists between net worth and desired debt, and between net worth and being credit constrained. It is not obvious whether the literature corrects for this simultaneity—see Crook (2001), Crook and Hochguertel (2006), and Manrique and Ojah (2004). This paper corrects for the simultaneity by instrumenting net worth in the manner of Cox and Jappelli (1993) and Duca and Rosenthal (1993).[9]

Crook (2005) suggests using permanent income while determining debt demand functions; few have done so and controlled for it—see Cox and Jappelli (1993), Lyons (2003), and Crook and Hochguertel (2006). This study constructs permanent income, and the regressions control for it; standard errors are bootstrapped to generate correct standard errors.

3. Theory

According to the life-cycle permanent-income hypothesis (LCPIH), households smooth their consumption over their lifetime in line with their expected lifetime (permanent) income. Households that anticipate an increase in their expected future incomes will borrow to increase their current consumption without waiting for the income increase to take effect. Without the ability to borrow, the LCPIH fails: households' current consumption levels are limited to their current income levels because they must defer any increase in consumption until their present income actually increases.

Following Zeldes (1989), the present study applies the LCPIH model to consumers operating with a borrowing constraint over two periods. Each consumer starts period 1 with some financial wealth (A_1), receives labor income at the beginning of each period, and chooses a consumption level. By the end of period 2, the consumers have spent all their financial and labor income and die without

[9]In estimating the desired amount of debt, Magri (2007) took into consideration the fact that net wealth can be affected by simultaneity problems; as a robustness check, she therefore instrumented net wealth with a lag of net wealth. However, she did not correct for this simultaneity in estimating the demand for debt or the probability of being unconstrained.

any debts or bequests. In this setting, the consumers solve for the problem given below to determine their optimal consumption levels that will maximize their total utility. The desired consumption level determines whether debt is desired in period 1 and how much is desired (D_1^*).

$$Max_{C_1C_2}U(C_1) + U(C_2) \tag{1}$$

subject to

1. $A_2 = (A_1 + Y_1 - C_1)(1 + r)$
2. $A_2 + Y_2 = C_2$
3. $A_1 + Y_1 - C_1 \geq -BC$
4. $C_1, C_2 \geq 0$.

Utility (U), a one-period utility function, is assumed to be a constant relative risk aversion utility function defined as $U(C) = \frac{C^{1-\alpha}-1}{1-\alpha}$. C_1 and C_2 and Y_1 and Y_2 are consumption and labor income in each of the two periods; A_1 and A_2 are financial wealth at the beginning of each of the two periods (before labor income and consumption); r is the interest rate earned on holding funds from period 1 into period 2; and BC, the borrowing constraint, is the maximum amount that the consumer can borrow in period 1. The above problem can be reduced to the following maximization problem:[10]

$$Max_{C_1}F(C_1) = U(C_1) + U[(1 + r)(A_1 + Y_1 - C_1) + Y_2] \tag{2}$$

subject to

5. $C_1 \geq A_1 + Y_1 + \min\left(BC, \frac{Y_2}{1+r}\right)$
6. $C_1 \leq 0$.

[10]In equation (1), the combination of constraints 4, 2, and 1 gives $C_2 = (1 + r)(A_1 + Y_1 - C_1) + Y_2 \geq 0$. Solving for C_1 gives $C_1 \leq A_1 + Y_1 + \frac{Y_2}{1+r}$. Constraint 3 is the same as $C_1 \leq A_1 + Y_1 + BC$. The combination of the two inequalities for C_1 gives $C_1 \leq A_1 + Y_1 + \min\left(BC, \frac{Y_2}{1+r}\right)$.

If there is no boundary solution, the solution to the maximization problem is

$$C_1^* = \frac{(1+r)^{-1/\alpha}(Y_2 + (1+r)(A_1 + Y_1))}{1 + (1+r)^{1-\frac{1}{\alpha}}}.$$

If there is a boundary solution, $C_1^* = A_1 + Y_1 + \min\left(BC, \frac{Y_2}{1+r}\right)$.

Appendix A shows the solution to the maximization problem. Given the desired consumption level, C_1^*, and the resources that are available (A_1, Y_1), the consumer determines the desired loan size and thus the desired stock of debt, D_1^*.

4. Model

To assess changes in household debt and borrowing behaviors between 1998 and 2007, this study tests the following null hypothesis: The gap between the desired and actual stock of household debt was lower in 2007 than in 1998. The test will help determine (i) whether households in 2007 desired more debt than households in 1998, (ii) whether households were less likely to be credit constrained in 2007 than in 1998, and (iii) whether credit-constrained households obtained a higher proportion of their desired debt in 2007 than in 1998.

The actual stock of debt is the debt outstanding at the time of the survey and is observed in the SCF data. Desired debt is not observed. The desired stock of debt for unconstrained households (D_{1U}^*) can be considered to have the same value as their actual stock of debt (D_{1U}) because unconstrained households can obtain the full amount of the loans they desire. For households with credit constraints, the actual stock of debt (D_{1C}) is by definition less than the desired stock (D_{1C}^*). Therefore, the debt desired by credit-constrained households must be estimated.

The gap between desired and actual debt for credit-constrained households is constructed in three steps for 1998 and again for 2007, following Cox and Jappelli (1993). In the first step for each year, the desired debt of households that have no credit constraints and have positive demand for debt is estimated on the basis of outstanding debt. In the second step, the desired stock of debt for

credit-constrained households is computed with the estimated coefficients obtained from the first step. In the third step, the gap for credit-constrained households is calculated by measuring the difference between the estimated level of desired debt and the outstanding debt. The gap levels in 2007 are then compared with the gap levels in 1998.

The first step—estimating the desired stock of debt for the indebted and unconstrained households—consists of the generalized Tobit model shown in equations (3), (4), and (5). The main goal is to predict equation (3), the desired stock of debt for households having positive demand for debt and no credit constraint.

$$D_1^* = \beta_1 X_1 + \theta_1 \lambda_1 + \theta_2 \lambda_2 + \varepsilon_1, \tag{3}$$

where the dependent variable, D_1^*, is the desired stock of debt; D_1^* is observable only when D_1^* equals the amount of debt that is outstanding. This equality is true only when the household has a positive demand for debt and does not have any credit constraints. X_1 is a vector of variables that determine the desired consumption levels and the resources that are available to pay for consumption; hence, the vector implies the level of desired debt. The variables for the vector are net worth, family income, permanent income (constructed), homeownership, future expenses, attitudes toward debt, and demographics (as in Cox and Jappelli 1993; Crook 1996, 2001; Duca and Rosenthal 1993; Jappelli 1990).

Equations (4) and (5) are the selection equations needed for equation (3). Equation (4) defines the probability of having positive demand for debt, and equation (5) defines the probability of not having any credit constraints.

$$l_1 = \beta_2 X_2 + \varepsilon_2, \tag{4}$$

where l_1 is an unobserved or latent variable representing demand for debt. The observed variable, H, is defined by the following two relations:

- If $l_1 > 0$, then H = 1 and the household has outstanding debt.
- If $l_1 \leq 0$, then H = 0 and the household has no outstanding debt.

X_2 is a vector of variables that determine whether a household has a demand for debt. As in Crook (2001) and Duca and Rosenthal (1993), the same variables determine the existence of a demand for debt and the level of desired debt. Thus, the vector of X_2 is the same as the vector of X_1.

$$l_2 = \beta_3 X_3 + \varepsilon_3, \tag{5}$$

where l_2 is an unobserved or latent variable representing excess supply of credit. The observed variable, V, is defined by the following two relations:

- If $l_2 > 0$, then V = 1 and the household has no credit constraint.
- If $l_2 \leq 0$, then V = 0 and the household has a credit constraint.

Households will have credit constraints only when they demand more debt than lenders will grant them, which represents an excess demand for debt. Thus, X_3 is a vector of (i) variables that determine the existence of a demand for debt and the level of desired debt (the demand side) and (ii) of borrower characteristics that are used in credit-scoring models (the supply side) to guide lenders' decisions on how much credit to grant an applicant (as in Cox and Jappelli 1993; Crook 1996, 2001; Duca and Rosenthal 1993; Jappelli 1990). X_3 consists of X_2 and additional variables that proxy for credit history.[11]

The error terms are assumed to have a trivariate normal distribution, and ρ_{23} is assumed to be zero (as in Cox and Jappelli 1993; Crook 2001; Crook and Hochguertel 2006; Duca and Rosenthal 1993; Gropp, Scholz, and White 1997; Lyons 2003).

$$\varepsilon_1 \sim \mathrm{N}(0, \sigma^2); \varepsilon_2 \sim \mathrm{N}(0,1); \varepsilon_3 \sim \mathrm{N}(0,1)$$
$$\mathrm{corr}(\varepsilon_1, \varepsilon_2) = \rho_{12}; \mathrm{corr}(\varepsilon_1, \varepsilon_3) = \rho_{13}; \mathrm{corr}(\varepsilon_2, \varepsilon_3) = \rho_{23} = 0$$

[11] Cox and Jappelli (1993) and Gropp, Scholz, and White (1997) use regional dummies to control for variations in the regulation and characteristics of credit markets; this study does not do so because this information is not in the publicly available SCF data.

As in Duca and Rosenthal (1993), when $\rho_{23} = 0$, the estimate of equation (3) (the desired stock of debt) is derived from the estimate of equations (4) and (5) as follows:

- Estimate β_2 and β_3 by running a univariate probit on equations (4) and (5).
- Compute the inverse Mills ratios λ_1 and λ_2 and evaluate them at $\beta_2 X_2$ and $\beta_3 X_3$, respectively.[12]
- Include λ_1 and λ_2 in equation (3) as additional explanatory variables, and conduct an ordinary least squares (OLS) calculation on this regression for a sample of unconstrained households that have outstanding debt.

As shown in Duca and Rosenthal (1993), standard errors for this procedure will not be correct even though the procedure produces consistent estimates of β_1. Correct standard errors are produced through bootstrapping, which is done here with the replicate weights provided in the SCF data.

A similar issue arises with permanent income, an independent variable constructed here according to Cox and Jappelli (1993) and King and Dicks-Mireaux (1981). The estimation process for permanent income generates a measurement error, and such errors for an independent variable can raise endogeneity and inconsistent OLS estimates. Because the literature on household debt did not raise any endogeneity issues for the constructed permanent-income variable, this study assumes that it is exogenous—see Cox and Jappelli (1993), Crook and Hochguertel (2006), and Lyons (2003). According to Wooldridge (2002, p. 74), under exogeneity, the OLS procedure will produce consistent estimates but will inflate the error variance and thus inflate the variance for the parameter estimates and underestimate significance of the parameter estimates. Here again, bootstrapping is applied to generate correct standard errors.

Another issue is the simultaneity between net worth and debt. As noted in Duca and Rosenthal (1993), borrowing to finance the consumption of nondurables immediately lowers net worth; hence,

[12]The inverse Mills ratio for selection equation (4), the probability of demand for debt, is $\frac{f(\beta_2 X_2)}{F(\beta_2 X_2)}$, where $f(\ )$ is the probability density function and $F(\ )$ is the cumulative distribution function.

there is a simultaneous relationship between net worth and demand for debt and between net worth and desired debt level. Moreover, the observed level of net worth is sensitive to whether the household is credit constrained. Therefore, as in Cox and Jappelli (1993) and Duca and Rosenthal (1993), net worth here is instrumented in equations (3), (4), and (5).

Net worth is instrumented by variables that are correlated with net worth, but those variables have no direct effect on demand for debt, outstanding debt, or the probability of being credit constrained and are not correlated with the error terms in equations (3), (4), and (5). The instrument variables used in this study are from the literature, as follows: years of education of the spouse of the household head, whether household head or spouse received or expects to receive a large inheritance, and the natural log of expected inheritance (Cox and Jappelli 1993; Duca and Rosenthal 1993).[13] This instrumentation can proxy for a family's socioeconomic status and thus be a good candidate for proxying net worth. Also, as inheritances are concentrated among households at the top of the wealth distribution, they can differentiate households with high net worth from those with low net worth. Table 1 gives a detailed description of variables in X_1, X_2, and X_3 as well as the variables used in instrumenting net worth.

For the second step of estimating equation (3), its estimated coefficient values are used to predict the desired stock of debt for the constrained households (D^*_{1C}). In the third step, the gap between the desired and actual stock of debt is calculated for each year, as in equation (6), and the gap measure in 2007 is compared with the one in 1998.

$$GAP = 1 - \left(\frac{\overline{D_1}}{p\overline{D^*_{1U}} + (1-p)\,\overline{D^*_{1C}}} \right) \tag{6}$$

$\overline{D_1}$ is the average of the outstanding debt that is observed in the SCF data. $\overline{D^*_{1U}}$ is the average of the desired stock of debt for unconstrained households. Given that unconstrained households borrow their desired debt levels, $\overline{D^*_{1U}}$ will be equal to the average of their

[13]Lag of net worth is not used as an instrument because the data are cross-sectional.

Table 1. List of Variables and Definitions

Variable	Definition
X_1: Ln Desired Debt Level[a] or X_2: Demand for Debt	
Ln Net Worth[a]	Net worth (constructed, see appendix B) in 2007 dollars, then transformed to natural log
Homeownership	1 if owns a home
Ln Income[a]	Family's total annual income from all sources (wages, interest income, dividends, capital gains, unemployment compensation, retirement income, etc.) in 2007 dollars, then transformed to natural log
Ln Permanent Income[a]	Permanent income (constructed, see appendix C) in 2007 dollars, then transformed to natural log
Years of Education	Household head's years of education
Current Employment Status	1 if household head is unemployed and looking for work
Age	Spline function for age
Married	1 if household head is married
Black	1 if household head is black /African-American
Female	1 if household head is female
Family size	Number of people in the household
Foreseeable Large Expenses	1 if in the next 5 to 10 years, there are foreseeable large expenses (educational expenses, purchases of a new home or other durable goods, health care costs, etc.) that the household has to pay
Whether Household Feels It Is All Right to Borrow to Finance:	
Vacation Expenses	1 if yes, to finance expenses of a vacation trip
Living Expenses	1 if yes, to cover living expenses when income is cut
Purchase of Luxury Items	1 if yes, to finance the purchase of luxury items (fur coat, jewelry)
Purchase of a Car	1 if yes, to finance the purchase of a car
Educational Expenses	1 if yes, to finance educational expenses
Risk Averse	1 if household head or spouse not willing to take any financial risk when they save or make investments
Expectation about Interest Rates Five Years from Now	Household head's expectation about interest rates five years from now: 1: if higher, 2: if lower, 3: if about the same

(*continued*)

Table 1. (Continued)

Variable	Definition
X_3: Additional Variables (Has No Borrowing Constraint)	
Number of Credit Cards	Number of any type of credit cards
Has Checking Account	1 if family has checking account
Welfare	1 if family received any income from Aid to Dependent Children, Aid to Families with Dependent Children, food stamps, or other forms of welfare
Time at Current Address	How many years the family has lived within 25 miles of their current address
Time at Current Job	Number of years household head worked for the current employer
Credit History:	
Almost Always/Always Pay Off Balance on Credit Cards	1 if household always/almost always pays off total balance owed on credit cards each month
No Loan	1 if household did not have any type of loan or mortgage payments during the last year
Timely on Loan Payments	1 if during the last year all loan or mortgage payments were made as scheduled or ahead of schedule
Instrumenting Net Worth	
Spouse's Years of Education	Spouse's years of education
Whether Received Inheritance in the Past	1 if household head or spouse received an inheritance or was given substantial assets in a trust or in some other form
Expected Inheritance	1 if household head or spouse expect to receive substantial inheritance or transfer of assets
Ln Expected Inheritance[a]	Value of expected inheritance or transfer of assets (in 2007 dollars), then transformed to natural log

[a]If $x >= 0$, then ln (1+x) ; if $x < 0$, then $-$ln (1–x).

outstanding debt ($\overline{D_1}$). $\overline{D_{1C}^*}$ is the average of the desired stock of debt for constrained households, p is the probability of being unconstrained, and $(1 - p)$ is the probability of being constrained.

5. Variables

Following a large number of other studies (Cox and Jappelli 1990, 1993; Crook 1996, 2001; Duca and Rosenthal 1993; Fissell and Jappelli 1990; Gropp, Scholz, and White 1997; Jappelli 1990; Lyons 2003), this study defines households with credit constraints as those that in the preceding five years were denied credit, or could not get as much credit as they applied for, or were discouraged from applying for credit.[14] Specifically, a household is considered to have a credit constraint if it answered yes to either of the following questions:

- In the past five years, has a particular lender or creditor turned down any request you made for credit or not given you as much credit as you applied for?
- Was there any time in the past five years that you thought of applying for credit at a particular place but changed your mind because you thought you might be turned down?

Previously denied households that were later able to obtain the full loan amount they requested by reapplying to the same institution or by applying elsewhere are not included in the sample of constrained households.

Discouraged households are considered here to be constrained because the findings by Jappelli (1990) indicate that such households are similar in characteristics to those that have been turned down and could be expected to have been rejected if they had applied for credit.

The net worth variable used in estimating desired debt and the probability of having credit constraints is defined in appendix B. The effect of net worth on desired debt levels (the demand side) is

[14]This definition of being credit constrained is fairly standard in SCF literature, because SCF data does not have any information on credit scores. Although it is fairly standard, it is not a perfect measure because households may not necessarily have been credit constrained at the time of the survey, although they were at some point in the past five years.

ambiguous. On one hand, households with high net worth can have less need to borrow against their future income to smooth their consumption, and thus the amount of debt they demand can be low; on the other hand, such households have the wherewithal to demand a high level of debt desired to fund a major purchase (for instance, home purchase). On the supply side, the creditor-imposed debt ceiling varies directly with net worth—any lender would consider a household with high net worth to be less risky and would grant more or higher loans to those households. Nonetheless, the ambiguous effect of net worth on desired debt means that the effect of net worth on excess demand for debt and the probability of being unconstrained are predicted to be ambiguous.

Under the assumption that home purchases are funded with debt, homeowners are a proxy for individuals with good credit history, and the creditor-imposed debt ceiling on constrained households is therefore expected to be higher for homeowners. From the demand side, it is possible that individuals purchased their homes because they were willing to take on larger debt. Homeowners can also choose to upgrade their homes if they are willing to take on larger debt. Therefore, the effect of homeownership on desired debt is predicted to be positive. An increase in desired debt and the debt ceiling will have an ambiguous effect on the excess demand for debt and the probability of being unconstrained.

As current income increases, a household's demand for durables can increase, resulting in an increase in demand for debt. However, the increase in current income could instead reduce the need to borrow to finance current consumption and thus lower the demand for debt. On the supply side, lenders will see a household's increase in income as an increase in its ability to repay debt and will thus increase the debt ceiling and grant larger loan amounts. The ambiguous effect of higher income on the demand for debt means that it will have an ambiguous effect on the excess demand for debt and the probability of being unconstrained.

The construction of permanent income is based on Cox and Jappelli (1993) and King and Dicks-Mireaux (1981) and is detailed in appendix C. Following the life-cycle hypothesis, an increase in permanent income raises desired consumption (including of durable goods) and thus desired borrowing to finance the increase in consumption. If lenders expect a rise in the ability of households to

repay their loans, they will increase the debt ceiling, resulting in an ambiguous effect on the excess demand for debt and the probability of being unconstrained.

Highly educated households are expected to have greater future income and therefore to have a higher desired consumption and demand for debt and a higher debt ceiling. Thus, the relationship between the probability of being unconstrained and education level is ambiguous. Being unemployed proxies for low expected future income, resulting in a decline in desired consumption, desired debt, and the debt ceiling. Hence, the relationship between the probability of being unconstrained and being unemployed is likewise ambiguous.

Age is defined here, as in the literature, by a spline function. According to the LCPIH, individuals have the highest level of desired stock of debt during their middle years, and a spline function for age captures the life-cycle features of desired debt. The spline function—see Cox and Jappelli (1993)—is defined as follows:

- $\text{Age}^{(1)} = \text{Age}$ if age ≤ 24; $\text{Age}^{(1)} = 24$ otherwise,
- $\text{Age}^{(2)} = \text{Min}\,(\text{Age} - 24, 10)$ if age > 24; $\text{Age}^{(2)} = 0$ otherwise,
- $\text{Age}^{(3)} = \text{Min}\,(\text{Age} - 34, 10)$ if age > 34; $\text{Age}^{(3)} = 0$ otherwise,
- $\text{Age}^{(4)} = \text{Min}\,(\text{Age} - 44, 10)$ if age > 44; $\text{Age}^{(4)} = 0$ otherwise,
- $\text{Age}^{(5)} = \text{Min}\,(\text{Age} - 54, 10)$ if age > 54; $\text{Age}^{(5)} = 0$ otherwise,
- $\text{Age}^{(6)} = \text{Age} - 64$ if age > 64; $\text{Age}^{(6)} = 0$ otherwise.

As in Crook (1996) and Jappelli (1990), age has an ambiguous relationship with the probability of being unconstrained. The debt ceiling is likely to increase with the age of the household head because the probability of default declines with the advancing age of the head. On the demand side, there are two effects. If young household heads expect their income in future periods to be much greater than their current income, they will demand more debt than older household heads. If the rate of time preference is low relative to the real rate of interest, the household will delay consumption, and the desired consumption and debt will increase with age. Because of the ambiguous effect of age on demand for debt, the net effect of age on the probability of being unconstrained is ambiguous.

As noted in Jappelli (1990), desired consumption by married couples can be lower because of economies of scale in the consumption of durables. But married couples may demand more debt, especially

if one spouse is not working and is dependent on the working spouse. From the supply side, lenders will increase the debt ceiling for married couples because they are less mobile and both partners can be responsible for repaying the loan. Because of the ambiguous effect on demand for debt, excess demand for debt and the probability of being unconstrained are ambiguous for married couples.

The effect of race and gender on the probability of being unconstrained is ambiguous. Compared with others, because of their lower expected future income, nonwhites and females may have lower desired consumption and desired borrowing, and they may be granted lower amounts of credit. The result is an ambiguous effect on excess demand for loans. As family size increases, desired consumption increases and so does the desired debt level. Crook, Thomas, and Hamilton (1992) show that the probability of default rises with the number of children, which leads to a predicted decline in the debt ceiling; the result is a greater excess demand for debt and a lower probability of being unconstrained. Crook (1996) argues that households with foreseeable large expenses in the next 5 to 10 years would desire higher debt to pay for those expenses but are credit constrained. In this case, the excess demand for debt is predicted to be higher and the probability of being unconstrained is lower.

Household preferences for holding debt are proxied by whether they are risk averse. Households that are willing to borrow to finance educational and living expenses, a vacation, and purchase of luxury items and a car will hold more debt; but from the supply side, lenders will be unwilling to grant them high loan amounts. So, with the willingness to borrow, the excess amount of desired debt will increase and the probability of being unconstrained will decline. In contrast, risk-averse households will be willing to hold less debt, save more, and wait to consume at later stages in their lives when they are financially more secure. So risk-averse households are expected to desire less debt. From the supply side, the debt ceiling will be higher for risk-averse households because lenders will perceive them as being less likely to default. Given risk aversion, the excess demand for debt will decline, and the probability of being unconstrained will be greater.

Expectations about interest rates five years from now can also affect the willingness of households to consume today and borrow. If households expect interest rates to be lower in the next five years,

they will probably prefer to save and invest today and wait to borrow and consume. Thus, their desired debt is expected to be low. From the supply side, lenders would prefer to grant loans at higher interest rates today, so current debt ceilings are expected to be high. With a household's expectation of lower future interest rates, the excess demand for debt is expected to decline and the probability of being unconstrained is expected to increase.

All of the above variables are included as regressors in determining both the desired stock of debt and the probability of being unconstrained. Additional regressors, which are generally requested in loan application forms, are considered in determining the probability of being unconstrained. These regressors are number of credit cards owned, whether the household has a checking account, whether the household received public assistance, the household head's time at the current job and at the current address, and whether the household had any problems making previous loan payments. Time at the current job and time at the current address proxy for the household's mobility and can be important factors in lenders' decisions on whether to grant loans.

6. Data and Descriptive Statistics

The SCF data, collected every three years under the auspices of the Board of Governors of the Federal Reserve System, contain detailed information about household balance sheets, income, use of financial services, past and current employment histories, retirement plans associated with their previous and current jobs, and demographics. The SCF sample of households is based on a dual-frame design in which the SCF oversamples wealthy households. To adjust for the oversampling, the SCF staff construct sampling weights with the post-stratification technique; the weights are provided in the data set of each survey's results.[15]

The SCF staff impute missing data with a multiple imputation technique involving six iterations. The sixth iteration produces the five implicates published in the data set—see Kennickell (1991).

[15]Kennickell, McManus, and Woodburn (1996) give detailed information on sampling and the construction of the weights.

To adjust for oversampling of wealthy households, the analysis throughout the present study takes into consideration the sampling weights. Meanwhile, the paper corrects for sampling variance by bootstrapping standard errors. The analysis is based on implicate 1 because the replicate weights for bootstrapping are valid only for implicate 1. The paper does *not* adjust for multiple imputation.[16] If statistics are not adjusted for multiple imputation and corrected for imputation uncertainty, the estimated standard error of a statistic will be smaller than the true standard error and the significance of variables will be overestimated (for instance, it may be concluded that a variable is significant at 1 percent even though it is significant at 5 percent or 10 percent, or it is not significant at all).

Observations in which permanent income is missing or family income is negative are deleted. All values are expressed in 2007 dollars. The distributions for total debt, net worth, income, permanent income, and the amount of inheritance that households expect to receive are highly skewed; a log transformation has been applied to normalize the distributions.[17]

The descriptive statistics for 1998 and 2007 were adjusted for population by using the sampling weights provided by the SCF staff. In both 1998 and 2007, the characteristics of debt-holding households and unconstrained households in comparison with other households were generally as expected (tables 2 and 3).

[16]The SCFCOMBO module (https://ideas.repec.org/c/boc/bocode/s458017.html) in Stata corrects for imputation uncertainty by estimating five sets of coefficients from five data sets, and meanwhile corrects for sampling variance by bootstrapping standard errors with the replicate weights (wgt1–wgt999) provided for implicate 1. Users can use the *scfcombo* command to run simple models; that's purely run dependent variables on several independent variables. It is not fit for advanced models such as probit models with instrumental variables and two-stage least-squares models, which are used in this paper. Therefore, in this paper, it is not possible to correct for imputation uncertainty by using the SCFCOMBO module.

It is also possible to correct for the imputation uncertainty with the user-written micombine.ado file or *mi estimate* command in Stata. For *mi estimate* and *micombine* commands, all five implicates should be used and five sets of coefficients should be estimated. However, if these commands are used, it is not possible to bootstrap standard errors, because bootstrap replication weights are valid only for the first implicate and are not available for the other (four) implicates. Therefore, in this paper, it is also not possible to correct for imputation uncertainty by using the micombine.ado file or *mi estimate* command.

[17]Following Crook and Hochguertel (2006), the following transformations have been applied: If $x < 0$, then $-\ln(1 - x)$. If $x > 0$, then $\ln(1 + x)$.

Table 2. Descriptive Statistics for 1998

	All		Debt Holders		Non-debt Holders		Difference		Unconstrained		Constrained		Difference	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Hold Debt	0.786	0.009	1.000	0.000	NA	NA	NA	NA	0.774	0.010	0.838	0.018	-0.063^{***}	0.020
Unconstrained	0.823	0.008	0.811	0.010	0.866	0.015	-0.055^{***}	0.018	1.000	0.000	NA	NA	NA	NA
Ln Total Debt	8.233	0.098	10.481	0.043	0.000	0.000	10.481^{***}	0.043	8.205	0.111	8.364	0.198	−0.159	0.227
Ln Net Worth	10.684	0.127	10.627	0.153	10.895	0.181	−0.268	0.237	11.406	0.121	7.326	0.402	4.080^{***}	0.420
Homeownership	0.722	0.009	0.766	0.010	0.562	0.023	0.204^{***}	0.025	0.775	0.009	0.477	0.026	0.298^{***}	0.027
Ln Income	10.728	0.032	10.890	0.033	10.138	0.078	0.752^{***}	0.085	10.818	0.032	10.311	0.096	0.507^{***}	0.101
Ln Permanent Income	9.462	0.033	9.807	0.028	8.200	0.089	1.607^{***}	0.093	9.362	0.039	9.930	0.040	-0.568^{***}	0.056
Years of Education	13.180	0.063	13.506	0.065	11.985	0.154	1.521^{***}	0.168	13.266	0.070	12.777	0.134	0.489^{***}	0.151
Current Employment Status	0.030	0.004	0.025	0.004	0.047	0.010	-0.022^{**}	0.010	0.027	0.004	0.045	0.011	−0.018	0.011
Age	47.056	0.352	44.258	0.335	57.308	0.902	-13.051^{***}	0.962	48.867	0.393	38.627	0.619	10.241^{***}	0.733
Married	0.724	0.010	0.752	0.011	0.624	0.022	0.128^{***}	0.025	0.742	0.010	0.641	0.024	0.101^{***}	0.026
Black	0.085	0.006	0.078	0.007	0.109	0.014	-0.031^{**}	0.016	0.073	0.006	0.141	0.018	-0.069^{***}	0.019
Female	0.002	0.001	0.001	0.001	0.003	0.002	−0.002	0.002	0.001	0.001	0.004	0.003	−0.002	0.003
Family Size	2.878	0.031	3.046	0.035	2.263	0.054	0.782^{***}	0.064	2.808	0.032	3.203	0.086	-0.395^{***}	0.092
Foreseeable Large Expenses	0.530	0.011	0.568	0.012	0.391	0.022	0.177^{***}	0.025	0.498	0.012	0.676	0.024	-0.177^{***}	0.027
Attitudes Toward Credit to Finance:														
Vacation Expenses	0.137	0.007	0.154	0.009	0.074	0.011	0.080^{***}	0.014	0.128	0.008	0.178	0.020	-0.050^{**}	0.021
Living Expenses	0.423	0.011	0.438	0.012	0.370	0.022	0.068^{***}	0.025	0.391	0.012	0.571	0.025	-0.180^{***}	0.028
Purchase of Luxury Items	0.058	0.005	0.067	0.006	0.025	0.007	0.042^{***}	0.009	0.052	0.005	0.086	0.014	-0.035^{**}	0.015
Purchase of a Car	0.815	0.008	0.861	0.009	0.648	0.022	0.212^{***}	0.024	0.812	0.009	0.831	0.019	−0.019	0.021
Educational Expenses	0.812	0.009	0.846	0.009	0.688	0.022	0.158^{***}	0.024	0.797	0.010	0.880	0.017	-0.083^{***}	0.019
Risk Averse	0.330	0.010	0.283	0.011	0.499	0.023	-0.216^{***}	0.026	0.319	0.011	0.380	0.025	-0.061^{**}	0.027

(*continued*)

Table 2. (Continued)

	All		Debt Holders		Non-debt Holders		Difference		Unconstrained		Constrained		Difference	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Expectation about Interest Rates Five Years from Now:														
Higher	0.661	0.010	0.681	0.011	0.589	0.023	0.091^{***}	0.025	0.650	0.011	0.714	0.023	-0.064^{**}	0.026
Lower	0.058	0.005	0.051	0.005	0.084	0.012	-0.033^{**}	0.013	0.055	0.005	0.075	0.013	-0.020	0.014
About the Same	0.281	0.010	0.268	0.011	0.327	0.022	-0.058^{**}	0.024	0.296	0.011	0.211	0.021	0.084^{***}	0.024
Number of Credit Cards	3.879	0.084	4.343	0.096	2.179	0.153	2.164^{***}	0.180	4.067	0.092	3.004	0.201	1.063^{***}	0.221
Has Checking Account	0.893	0.007	0.926	0.006	0.774	0.019	0.152^{***}	0.020	0.916	0.007	0.788	0.020	0.128^{***}	0.021
Welfare	0.042	0.004	0.033	0.004	0.075	0.012	-0.043^{***}	0.012	0.029	0.004	0.102	0.015	-0.073^{***}	0.015
Time at Current Address	37.943	0.802	35.829	0.894	45.684	1.745	-9.855^{***}	1.961	39.390	0.884	31.204	1.870	8.186^{***}	2.069
Time at Current Job	7.291	0.199	8.101	0.224	4.323	0.403	3.778^{***}	0.461	7.714	0.225	5.325	0.404	2.389^{***}	0.463
Almost Always/Always Pay Off	0.419	0.011	0.397	0.012	0.499	0.023	-0.102^{***}	0.026	0.479	0.012	0.136	0.017	0.343^{***}	0.021
No Loan	0.206	0.009	0.000	0.000	0.961	0.008	-0.961^{***}	0.008	0.216	0.010	0.159	0.017	0.057^{***}	0.020
Timely on Loan Payments	0.635	0.010	0.799	0.010	0.035	0.007	0.763^{***}	0.012	0.661	0.011	0.517	0.026	0.144^{***}	0.028
No. of Observations	3,332													

Notes: ***, **, and * refer to significance levels at 1 percent, 5 percent, and 10 percent, respectively. The values for dummy variables are in decimals, and they need to be multiplied by 100 to be expressed in percentages.

Table 3. Descriptive Statistics for 2007

	All		Debt Holders		Non-debt Holders		Difference		Unconstrained		Constrained		Difference	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Hold Debt	0.806	0.008	1.000	0.000	NA	NA	NA	NA	0.802	0.009	0.827	0.020	−0.025	0.022
Unconstrained	0.841	0.008	0.837	0.009	0.858	0.016	−0.021	0.019	1.000	0.000	NA	NA	NA	NA
Ln Total Debt	8.746	0.096	10.853	0.044	0.000	0.000	10.853***	0.044	8.821	0.106	8.347	0.222	0.474*	0.246
Ln Net Worth	10.993	0.123	11.002	0.144	10.955	0.205	0.048	0.251	11.649	0.120	7.523	0.399	4.127***	0.417
Homeownership	0.738	0.009	0.778	0.009	0.571	0.023	0.207***	0.025	0.784	0.009	0.494	0.026	0.290***	0.028
Ln Income	10.904	0.022	11.024	0.024	10.408	0.045	0.616***	0.051	10.978	0.025	10.513	0.043	0.465***	0.049
Ln Permanent Income	10.055	0.021	10.238	0.018	9.295	0.058	0.943***	0.061	10.046	0.024	10.104	0.029	−0.058	0.037
Years of Education	13.378	0.059	13.622	0.061	12.367	0.157	1.255***	0.168	13.556	0.064	12.440	0.137	1.116***	0.152
Current Employment Status	0.023	0.003	0.017	0.003	0.048	0.010	−0.031***	0.011	0.019	0.003	0.048	0.011	−0.030**	0.012
Age	48.445	0.354	46.344	0.341	57.166	1.019	−10.822***	1.075	49.919	0.392	40.652	0.692	9.267***	0.795
Married	0.704	0.010	0.737	0.010	0.566	0.024	0.170***	0.026	0.727	0.010	0.581	0.026	0.146***	0.028
Black	0.096	0.006	0.095	0.007	0.101	0.014	−0.006	0.015	0.079	0.006	0.190	0.021	−0.112***	0.022
Female	0.005	0.002	0.005	0.002	0.007	0.004	−0.002	0.004	0.005	0.002	0.007	0.004	−0.002	0.005
Family Size	2.826	0.029	2.965	0.033	2.248	0.060	0.718***	0.068	2.774	0.031	3.099	0.085	−0.324***	0.090
Foreseeable Large Expenses	0.542	0.010	0.572	0.011	0.418	0.023	0.154***	0.026	0.522	0.011	0.647	0.025	−0.125***	0.028
Attitudes Toward Credit to Finance:														
Vacation Expenses	0.138	0.007	0.148	0.008	0.095	0.014	0.053***	0.016	0.132	0.008	0.171	0.020	−0.040*	0.021
Living Expenses	0.509	0.010	0.531	0.012	0.419	0.023	0.112***	0.026	0.479	0.011	0.671	0.025	−0.193***	0.027
Purchase of Luxury Items	0.051	0.005	0.056	0.005	0.029	0.008	0.027***	0.010	0.050	0.005	0.058	0.012	−0.009	0.013
Purchase of a Car	0.816	0.008	0.860	0.008	0.633	0.023	0.228***	0.024	0.814	0.009	0.825	0.020	−0.010	0.022
Educational Expenses	0.838	0.008	0.876	0.008	0.680	0.022	0.196***	0.024	0.826	0.009	0.899	0.016	−0.072***	0.018
Risk Averse	0.361	0.010	0.318	0.011	0.541	0.024	−0.223***	0.026	0.337	0.011	0.490	0.026	−0.153***	0.028

(*continued*)

Table 3. (Continued)

	All		Debt Holders		Non-debt Holders		Difference		Unconstrained		Constrained		Difference	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Expectation about Interest Rates Five Years from Now:														
Higher	0.656	0.010	0.657	0.011	0.653	0.023	0.005	0.025	0.644	0.011	0.723	0.024	-0.079^{***}	0.026
Lower	0.077	0.006	0.076	0.006	0.082	0.013	-0.006	0.015	0.078	0.006	0.073	0.014	0.004	0.015
About the Same	0.267	0.009	0.267	0.010	0.266	0.021	0.001	0.024	0.279	0.010	0.204	0.021	0.075^{***}	0.024
Number of Credit Cards	3.494	0.073	3.897	0.083	1.821	0.125	2.075^{***}	0.150	3.773	0.080	2.019	0.160	1.753^{***}	0.179
Has Checking Account	0.913	0.006	0.951	0.005	0.756	0.020	0.195^{***}	0.021	0.933	0.006	0.808	0.020	0.125^{***}	0.021
Welfare	0.065	0.005	0.053	0.005	0.119	0.015	-0.066^{***}	0.016	0.040	0.004	0.197	0.021	-0.157^{***}	0.021
Time at Current Address	37.049	0.748	35.959	0.827	41.570	1.729	-5.611^{***}	1.917	37.290	0.809	35.774	1.964	1.516	2.124
Time at Current Job	7.196	0.188	7.783	0.211	4.760	0.386	3.023^{***}	0.440	7.680	0.212	4.638	0.351	3.041^{***}	0.410
Almost Always/Always Pay Off	0.418	0.010	0.405	0.011	0.469	0.024	-0.064^{**}	0.026	0.472	0.011	0.131	0.018	0.341^{***}	0.021
No Loan	0.184	0.008	0.000	0.000	0.946	0.009	-0.946^{***}	0.009	0.186	0.009	0.171	0.020	0.016	0.022
Timely on Loan Payments	0.622	0.010	0.760	0.010	0.047	0.009	0.713^{***}	0.013	0.652	0.011	0.464	0.026	0.188^{***}	0.028
Number of Observations	3,511													

Notes: ***, **, and * refer to significance levels at 1 percent, 5 percent, and 10 percent, respectively. The values for dummy variables are in decimals, and they need to be multiplied by 100 to be expressed in percentages.

7. Results

Regression results for equations (3), (4), and (5) are provided for 1998 in table 4 and for 2007 in table 5. The regressions adjust for the survey nature of the SCF data by using the sampling weights, and they apply the bootstrap technique by using the replicate weights provided in the data. Table 6 displays the gaps between actual and desired debt levels. The regression results obtained from the construction of permanent income are presented and discussed in table C.2 in appendix C.

For 1998, the results for equation (3) show that homeownership, income, permanent income, and years of education had a positive relation with the desired stock of debt (table 4). A 1 percent increase in family income would increase the desired stock of debt by 0.249 percent. Likewise, a 1 percent increase in permanent income would increase the desired stock by 0.952 percent. Households between 44 and 54 years of age would desire more debt as they aged, and risk-averse households would desire less debt.

Likewise, the results for equation (3) for 2007 show a higher desired debt for homeowners and for households with high income and high permanent income, and lower desired debt for households that are risk averse in their savings or investments (table 5). The desired stock of debt was greater for household heads that were married, that had more family members, and that were willing to borrow to finance educational expenses. The unemployed demanded less debt. Younger household heads, households with foreseeable large expenses, and households that were willing to borrow to finance the purchase of a car demanded more debt, but only at the weakest (10 percent) significance level.

The effect on desired debt from variations in homeownership, income, being unemployed, family size, having foreseeable large expenses, and being risk averse are consistent with the findings of Crook (2001), Crook and Hochguertel (2006), and Duca and Rosenthal (1993). Desired debt varies significantly and directly with permanent income, a result consistent with the findings of Cox and Jappelli (1993) and Crook and Hochguertel (2006). Some of the previous literature found desired debt to be negatively related to age for household heads in the later stages of their lives (Cox and Jappelli 1993; Crook and Hochguertel 2006; Gropp, Scholz, and White 1997),

Table 4. Regression Results for 1998

	Natural Log of Stock of Debt: Equation (3)		Debt Holders: Equation (4)		Unconstrained: Equation (5)	
	Coeff.	Bootstrap Std. Err.	dy/dx	Delta-Method Std. Err.	dy/dx	Delta-Method Std. Err.
Ln Net Worth	−0.090	0.252	−0.028**	0.012	0.012	0.010
Homeownership	3.177**	1.550	0.342***	0.049	0.031	0.047
Ln Income	0.249**	0.112	0.016**	0.007	0.002	0.006
Ln Permanent Income	0.952***	0.135	0.077**	0.031	0.050	0.031
Years of Education	0.074*	0.038	0.009***	0.003	−0.002	0.003
Current Employment Status	−0.475	0.688	−0.112***	0.035	0.023	0.030
Age $\leq$ 24	0.084	0.105	0.008	0.012	−0.007	0.012
24 $<$ Age $\leq$ 34	0.031	0.052	0.005	0.006	0.001	0.004
34 $<$ Age $\leq$ 44	0.025	0.020	0.006	0.004	0.001	0.003
44 $<$ Age $\leq$ 54	0.053***	0.020	0.004	0.003	0.001	0.003
54 $<$ Age $\leq$ 64	0.004	0.109	−0.009	0.005	0.016***	0.005
64 $<$ Age	0.027	0.093	0.004	0.006	0.012**	0.006
Married	0.036	0.169	0.025*	0.015	−0.021	0.013
Black	−0.118	0.271	−0.006	0.018	−0.034	0.023
Female	−0.085	0.233	−0.080	0.117	−0.027	0.101
Family Size	0.069	0.103	0.014***	0.006	−0.009*	0.005
Foreseeable Large Expenses	−0.030	0.323	0.036***	0.012	−0.039***	0.013
Attitudes Toward Credit to Finance:						
Vacation Expenses	0.338	0.311	0.070***	0.017	−0.003	0.017
Living Expenses	−0.004	0.262	0.009	0.011	−0.040***	0.013
Purchase of Luxury Items	0.025	0.223	0.010	0.022	−0.053**	0.025
Purchase of a Car	0.299	0.408	0.087***	0.018	−0.003	0.016
Educational Expenses	−0.061	0.098	−0.025*	0.015	−0.026*	0.015
Risk Averse	−0.424**	0.192	−0.034**	0.015	−0.006	0.013

(*continued*)

Table 4. (Continued)

	Natural Log of Stock of Debt: Equation (3)		Debt Holders: Equation (4)		Unconstrained: Equation (5)	
	Coeff.	**Bootstrap Std. Err.**	**dy/dx**	**Delta-Method Std. Err.**	**dy/dx**	**Delta-Method Std. Err.**
Expectation about Interest Rates Five Years from Now:[a]						
Lower	−0.330*	0.180	−0.027	0.027	−0.034	0.024
About the Same	0.046	0.111	−0.011	0.014	0.008	0.015
Number of Credit Cards	NA	NA	NA	NA	0.000	0.002
Has Checking Account	NA	NA	NA	NA	0.010	0.031
Welfare	NA	NA	NA	NA	−0.013	0.028
Time at Current Address	NA	NA	NA	NA	(3.465E-04)**	1.645E-04
Time at Current Job	NA	NA	NA	NA	0.001	0.001
Almost Always/Always Pay Off	NA	NA	NA	NA	0.107***	0.024
No Loan	NA	NA	NA	NA	0.058*	0.030
Timely on Loan Payments	NA	NA	NA	NA	0.055**	0.022
Constant	−7.691*	4.306				
Inverse Mills (Debt Holders)	1.903	2.912				
Inverse Mills (Unconstrained)	0.239	2.994				
Number of Observations	2,155		3,332		3,332	
Prob > chi2	0.0000		0.0000		0.0000	
athrho			0.501*	0.304	−0.228	0.305

Note: ***, **, and * refer to significance levels at 1 percent, 5 percent, and 10 percent, respectively.
[a]Omitted category in expectation about interest rates five years from now is "higher."

Table 5. Regression Results for 2007

	Natural Log of Stock of Debt: Equation (3)		Debt Holders: Equation (4)		Unconstrained: Equation (5)	
	Coeff.	Bootstrap Std. Err.	dy/dx	Delta-Method Std. Err.	dy/dx	Delta-Method Std. Err.
Ln Net Worth	−0.622	0.398	−0.046***	0.009	−0.026**	0.011
Homeownership	8.944**	4.199	0.404***	0.028	0.180***	0.058
Ln Income	0.620*	0.328	0.027***	0.009	−0.002	0.010
Ln Permanent Income	2.288**	0.983	0.085***	0.021	0.108***	0.019
Years of Education	0.015	0.028	0.004	0.003	0.000	0.003
Current Employment Status	−3.200*	1.904	−0.184***	0.052	−0.047	0.038
Age $\leq$ 24	0.714*	0.419	0.030*	0.015	0.008	0.012
24 < Age $\leq$ 34	−0.019	0.033	3.11E-05	0.004	0.001	0.003
34 < Age $\leq$ 44	0.101	0.069	0.005*	0.003	0.001	0.002
44 < Age $\leq$ 54	0.107	0.080	0.004	0.003	0.013***	0.003
54 < Age $\leq$ 64	0.011	0.017	−0.001	0.003	0.003	0.003
64 < Age	−0.021	0.023	−0.002	0.003	0.018***	0.003
Married	1.007**	0.413	0.047***	0.016	−0.003	0.017
Black	−0.319	0.415	−0.004	0.024	−0.060***	0.022
Female	−0.231	0.742	−0.046	0.074	0.138***	0.047
Family Size	0.143**	0.063	0.014***	0.005	0.005	0.005
Foreseeable Large Expenses	0.446*	0.248	0.035***	0.012	−0.029**	0.012
Attitudes Toward Credit to Finance:						
Vacation Expenses	0.042	0.230	0.000	0.018	−0.021	0.017
Living Expenses	0.086	0.094	0.012	0.011	−0.037***	0.011
Purchase of Luxury Items	−0.118	0.194	0.005	0.026	−0.026	0.027
Purchase of a Car	1.637*	0.885	0.112***	0.017	−0.005	0.016
Educational Expenses	0.322**	0.128	0.018	0.015	−0.053***	0.017
Risk Averse	−1.005**	0.453	−0.060***	0.013	−0.036***	0.014

(*continued*)

Table 5. (Continued)

	Natural Log of Stock of Debt: Equation (3)		Debt Holders: Equation (4)		Unconstrained: Equation (5)	
	Coeff.	**Bootstrap Std. Err.**	**dy/dx**	**Delta-Method Std. Err.**	**dy/dx**	**Delta-Method Std. Err.**
Expectation About Interest Rates Five Years from Now[a]:						
Lower	−0.066	0.185	−0.003	0.019	0.013	0.019
About the Same	−0.026	0.094	0.009	0.011	0.005	0.014
Number of Credit Cards	NA	NA	NA	NA	0.005**	0.002
Has Checking Account	NA	NA	NA	NA	0.041	0.025
Welfare	NA	NA	NA	NA	−0.181***	0.041
Time at Current Address	NA	NA	NA	NA	0.000	0.000
Time at Current Job	NA	NA	NA	NA	0.003***	0.001
Almost Always/Always Pay Off	NA	NA	NA	NA	0.125***	0.020
No Loan	NA	NA	NA	NA	0.114***	0.025
Timely on Loan Payments	NA	NA	NA	NA	0.076***	0.019
Constant	−44.699*	25.894	NA	NA	NA	NA
Inverse Mills (Debt Holders)	8.495*	4.931				
Inverse Mills (Unconstrained)	1.802	1.751				
Number of Observations	2,350		3,511		3,511	
Prob > chi2	0.0000		0.0000		0.0000	
athrho			0.916***	0.247	0.682***	0.256

Note: ***, **, and * refer to significance levels at 1 percent, 5 percent, and 10 percent, respectively.
[a]Omitted category in expectation about interest rates five years from now is "higher."

whereas this study finds a positive relation for household heads that are 44 to 54 (as well as, like other studies, in their 20s).

For 1998, the results for equation (4) show that net worth had a negative relation with the likelihood of holding debt (table 4). For instance, if net worth increased from $5,000 to $15,000, the probability of holding debt declined by about 3 percent.[18] Households that owned homes were more likely to hold debt, by 34 percent, than other households. Income, permanent income, and years of education also had a positive effect on the probability of holding debt. Unemployed and risk-averse households were less likely to hold debt. More likely to hold ddebt were households with large families, or with foreseeable large expenses that they had to pay in the next 5 to 10 years, or that were willing to borrow to finance their vacation expenses and car purchases.

The findings for likelihood of holding debt in 2007 (table 5) are mostly similar to those for 1998. The notable differences are that, in 2007, household heads that were younger than 24 or between 34 and 45 were more likely to hold debt as they aged, but only at the 10 percent significance level. Also, in 2007 unlike 1998, education level and attitudes toward credit to finance vacations or educational expenses did not have any effect on the probability of holding debt.

With respect to the probability of being unconstrained, the results for equation (5) show that, in 1998, household heads aged 55 years or older were more likely to be unconstrained as they aged (table 4). Also more likely to be unconstrained were households that stayed longer in their current neighborhood, had a good credit history, almost always or always paid off their total balances in their credit cards, and were timely on their loan payments. Less likely to be unconstrained were households with large foreseeable expenses in the next 5 to 10 years and households that were willing to borrow to finance their living expenses, purchases of luxury items, and educational expenses.

The findings for 2007 show that net worth had a negative effect on the probability of being unconstrained (table 5). Households that owned homes were more likely to be unconstrained (by 18 percent), as were households with more permanent income, more credit cards,

[18]That is, (ln $15,000 – ln $5,000) * 0.028 = 0.0308.

no welfare payments, good job tenure, and a good record of credit card and loan payments. Households were more likely to be unconstrained as they aged, particularly those in the group between ages 44 and 55 and older than 64. Households were less likely to be unconstrained if the household head was black and male, or if the households had foreseeable large expenses in the next 5 to 10 years, were willing to borrow to finance living and educational expenses, and were risk averse in their savings or investments. These results on probability of being unconstrained are generally consistent with the findings of Cox and Jappelli (1993), Crook (1996, 2001), Duca and Rosenthal (1993), and Jappelli (1990).

Table 6 shows averages of desired and actual stocks of debt for age and income subgroups of unconstrained and constrained households in 1998 and 2007, along with the gap between the two debt measures. It indicates that (i) households overall had higher desired debt levels and lower probabilities of being credit constrained in 2007 than in 1998, (ii) each subgroup of constrained and unconstrained households desired higher levels of debt in 2007, and (iii) only some of the subgroups had a lower probability of being credit constrained in 2007 than in 1998 (34 or younger, or between 44 and 65, or had income greater than $60,000).[19]

Overall, the borrowing gap increased from about 38.91 percent in 1998 to about 41.60 percent in 2007 (table 6). But the gap declined for some households, namely those with household heads 34 or younger, or between 54 and 65, or with income between $30,000

[19]When the analysis is extended to periods 2001 and 2004, the results show an evolving trend for decline in the probability of being credit constrained.

From 2004 to 2007, for the overall sample (without classifying households into age or income groups), there was a decline in the probability of households being credit constrained. This result implies that a lower percentage of households were denied for credit.

The decline in the probability is also observed as follows:

- from 1998 to 2001, for households in age groups ($24 < \text{age} \leq 34$) and ($44 < \text{age} \leq 54$) and for households with income > $60,000;
- from 2001 to 2004, for households in age groups ($\text{age} \leq 24$) and ($\text{age} > 64$) and for households with income > $100,000;
- from 2004 to 2007, for households in age group ($\text{age} \leq 64$) and for households with income ≤ $345,000.

Table 6. Gap Calculations

	1998					
	Unconstrained	Constrained		Probability		Average Outstd. Debt
	Desired Debt = Actual Debt	Actual Debt	Desired Debt	Unconstrained	Constrained	
All	\$3,661	\$4,291	\$16,666	0.8076	0.1924	\$3,765
Subgroups						
Age $\leq$ 24	\$1,846	\$151	\$4,640	0.6663	0.3337	\$876
24 $<$ Age $\leq$ 34	\$11,405	\$2,743	\$15,007	0.6692	0.3308	\$7,462
34 $<$ Age $\leq$ 44	\$19,137	\$7,073	\$18,965	0.7695	0.2305	\$15,707
44 $<$ Age $\leq$ 54	\$16,860	\$10,105	\$27,620	0.8072	0.1928	\$15,510
54 $<$ Age $\leq$ 64	\$3,528	\$9,861	\$19,953	0.8863	0.1137	\$3,926
64 $<$ Age	\$45	\$4,166	\$7,303	0.9650	0.0350	\$52
Income $\leq$ 30,000	\$153	\$365	\$6,204	0.7493	0.2507	\$190
30,000 $<$ Income $\leq$ 60,000	\$2,125	\$8,074	\$20,283	0.7876	0.2124	\$2,813
60,000 $<$ Income $\leq$ 100,000	\$16,805	\$29,549	\$34,962	0.8529	0.1471	\$18,285
100,000 $<$ Income $\leq$ 345,000	\$29,500	\$56,686	\$58,605	0.9156	0.0844	\$31,032
345,000 $<$ Income	\$22,022	\$17,353	\$165,981	0.9530	0.0470	\$21,766

(*continued*)

Table 6. (Continued)

	2007							
	Unconstrained	Constrained		Probability		Average Outstd. Debt	GAP	
	Desired Debt = Actual Debt	Actual Debt	Desired Debt	Unconstrained	Constrained		1998	2007
All	$6,778	$4,218	$28,732	0.8185	0.1815	$6,285	0.3891	0.4160
Subgroups								
Age $\leq$ 24	$2,259	$137	$4,907	0.7253	0.2747	$1,197	0.6847	0.5993
24 < Age $\leq$ 34	$19,957	$3,605	$24,619	0.7325	0.2675	$13,326	0.4076	0.3716
34 < Age $\leq$ 44	$25,541	$8,579	$43,816	0.7360	0.2640	$20,198	0.1775	0.3348
44 < Age $\leq$ 54	$20,655	$10,083	$55,577	0.8180	0.1820	$18,536	0.1808	0.3138
54 < Age $\leq$ 64	$9,291	$2,737	$22,098	0.8908	0.1092	$8,397	0.2724	0.2145
64 < Age	$232	$1,281	$26,439	0.9476	0.0524	$255	0.8275	0.8413
Income $\leq$ 30,000	$197	$381	$11,013	0.7380	0.2620	$232	0.8865	0.9236
30,000 < Income $\leq$ 60,000	$3,858	$6,290	$23,560	0.7779	0.2221	$4,294	0.5298	0.4785
60,000 < Income $\leq$ 100,000	$26,873	$59,689	$153,275	0.8784	0.1216	$29,645	0.0612	0.2983
100,000 < Income $\leq$ 345,000	$52,107	$122,725	$139,901	0.9545	0.0455	$54,232	0.0289	0.0333
345,000 < Income	$26,557	$6,359	$178,955	0.9711	0.0289	$25,469	0.2438	0.1772

Note: The average dollar values are computed from the averages of natural log values.

and $60,000 or above $345,000.[20] The decline in the gap implies that households on average obtained a greater fraction of their desired debt. For instance, among the younger age groups in 2007, the group 24 or younger borrowed more and obtained about 9 percentage points more of their desired debt, and the group between 54 and 65 obtained about 6 percentage points more of their desired debt. The group with income between $30,000 and $60,000 obtained about 5 percentage points more of their desired debt in 2007.[21]

[20]The decline in the gap for the group with income above $345,000 is consistent with earlier findings that high-income households may also have benefited from the relaxed lending standards (Foote et al. 2008; Keys et al. 2009).

[21]The analysis is extended to periods 2001 and 2004.

From 2001 to 2004 and 2004 to 2007, for the overall sample (without classifying households into age or income groups), there was an increase in desired debt for both unconstrained and constrained households. Meanwhile, the gap declined and credit-constrained households obtained a greater fraction of their desired debt.

From 1998 to 2001, for households with income > $345,000, there was a decline in desired debt for both unconstrained and constrained households in this income group. Meanwhile, the gap declined.

From 2001 to 2004:

- For any age group, there was an increase in desired debt for unconstrained households and also for constrained households (except for the constrained households in age group (24 < age ≤ 34).
- For households in age groups (age ≤ 24) and (44 < age ≤ 54) and for households with $30,000 < income ≤ $100,000, there was an increase in desired debt for unconstrained and constrained households in this age and income group. Meanwhile, the gap declined and credit-constrained households obtained a greater fraction of their desired debt.

From 2004 to 2007:

- There was an increase in desired debt for unconstrained households in age groups (24 < age ≤ 34 and age > 54) and constrained households in age groups (24 < age ≤ 54 and age > 64). For any age group, the gap declined and credit-constrained households obtained a greater fraction of their desired debt.
- There was an increase in desired debt for unconstrained households with $60,000 < income ≤ $345,000 and for constrained households with income ≤ $345,000. For households with income ≤ $30,000 and income > $100,000, the gap declined and credit-constrained households obtained a greater fraction of their desired debt.

8. Conclusions

This study is motivated by the 2007 subprime crisis and the findings in the literature that declines in lending standards and increases in household debt were some of the contributors to the crisis. The goal here is to examine changes in household borrowing behaviors and debt following the decline in lending standards. Using the 1998 and 2007 data collected under the sponsorship of the Board of Governors of the Federal Reserve System in its triennial Survey of Consumer Finances, this study aims to determine whether the decline in lending standards in the years between those two surveys was accompanied by (i) a desire by households for more debt, (ii) a decrease in the likelihood that households would be credit constrained (that is, an increase in the likelihood that they could get all the credit they desired), and (iii) an increase in the proportion of desired debt obtained by credit-constrained households.

The analysis uses the self-reported credit-constraint indicators from the survey data in computing the gap between households' desired and outstanding debt levels. It compares the gap in 1998 (when subprime lending was in effect but before the decline in lending standards) with the gap in 2007 (when lending standards had been in effect for some time). Desired debt has long been a topic of study, but this is the first analysis to look at households' desired debt in the run-up to the subprime mortgage crisis.

Because desired debt is not directly observed, the gap measure is constructed in three steps, as in Cox and Jappelli (1993). The first step is to estimate the desired debt for indebted and unconstrained households. The second step is to compute the desired debt for constrained households by using the estimated coefficients from the first step. The third step is to calculate the difference between the predicted debt and the observed debt levels. This paper applies these steps for 1998 and 2007.

The paper also extends the literature on household debt by including the 1998 and 2007 SCF data on wealthy households. (Those households are oversampled by the SCF; the present analysis corrects for the oversampling by using the sampling weights that are provided in the SCF data.) This paper also instruments net worth, constructs a permanent-income variable, controls the regressions for the constructed permanent-income variable, and bootstraps

standard errors with the replicate weights that are provided in the data.

The findings show that (i) households desired more debt in 2007 than in 1998; (ii) the likelihood of being credit constrained declined from 1998 to 2007 for households headed by someone who was 34 years of age or younger or between the ages of 44 and 65, and for households with an annual income above $60,000; and (iii) credit-constrained households received more of the credit they desired in 2007 than in 1998 if they were headed by someone 34 years of age or younger or between the ages of 54 and 65, or if they had an income between $30,000 and $60,000 or more than $345,000.

These results suggest that it is well worth the effort for regulators to track these attributes of borrowing behaviors and debt as part of their intensified efforts to preserve financial stability.

Appendix A

$$Max_{C_1} F(C_1) = U(C_1) + \mathrm{U}[(1+r)(A_1 + Y_1 - C_1) + Y_2] \quad \text{(A.1)}$$

subject to

$$C_1 \leq A_1 + Y_1 + \min\left(BC, \frac{y_2}{1+r}\right) \quad \text{(A.2)}$$

$$C_1 \geq 0 \quad \text{(A.3)}$$

$$F'(C_1) = C_1^{-\alpha} + (Y_2 + (1+r)(A_1 + Y_1 - C_1))^{-\alpha}(-(1+r)) = 0$$

$$C_1^{-\alpha} = (1+r)(Y_2 + (1+r)(A_1 + Y_1 - C_1))^{-\alpha}$$

$$C_1 = (1+r)^{-1/\alpha}(Y_2 + (1+r)(A_1 + Y_1 - C_1))$$

$$C_1 = (1+r)^{-1/\alpha}(Y_2 + (1+r)(A_1 + Y_1)) - (1+r)^{1-\frac{1}{\alpha}} C_1$$

$$C_1^* = \frac{(1+r)^{-1/\alpha}(Y_2 + (1+r)(A_1 + Y_1))}{1 + (1+r)^{1-\frac{1}{\alpha}}}$$

In order to check whether the critical point C_1^* is a maximum point or not, $F(C_1)$is written as $U(C_1) + \mathrm{U}(\mathrm{R} - \beta C_1)$, where

$R = Y_2 + (1+r)(A_1 + Y_1)$ and $\beta = (1+r)$.

$$F'(C_1) = C_1^{-\alpha} + (R - \beta C_1)^{-\alpha}(-\beta)$$

$F''(C_1) = -\alpha C_1^{-\alpha-1} + \beta^2(-\alpha)(R - \beta C_1)^{-\alpha-1} < 0$. Thus, the critical point is a maximum point.

The range that C_1 can take is $(0, \mathrm{A}_1 + Y_1 + \min(BC, \frac{Y_2}{1+r}))$.

Denote $\mathrm{A}_1 + Y_1 + \min(BC, \frac{Y_2}{1+r})$ as Q.

Let P be the optimal solution for C_1.

If $P \leq \mathrm{Q}$, there is no boundary solution. Thus, $C_1^* = P = \frac{(1+r)^{-1/\alpha}(Y_2+(1+r)(A_1+Y_1))}{1+(1+r)^{1-\frac{1}{\alpha}}}$.

If $P > \mathrm{Q}$, there is a boundary solution. Thus, $C_1^* = \mathrm{Q} = \mathrm{A}_1 + Y_1 + \min\left(BC, \frac{Y_2}{1+r}\right)$.

Appendix B

B.1 "Total Loan" Derivation

The dependent variable "total loan" is the outstanding debt level in credit or store cards, mortgage loans on principal residence, other loans received for the purchase of principal residence, home improvement loans, loans received for the purchase of investment real estate and vacation properties, lines of credit, vehicle loans, education loans, and other consumer loans. All the outstanding debt levels are expressed in 2007 dollars.

B.2 "Net Worth" Derivation

Net Worth = Financial Assets + Nonfinancial Assets – Debt

Financial assets include dollar value accumulated in pension accounts and IRA/Keogh accounts, savings/money market accounts, annuities, trusts, and managed investment accounts, checking accounts, certificates of deposit, mutual funds, savings bonds, bonds other than savings bonds, publicly traded stocks, call money accounts/cash at stock brokerages, and cash-value insurance.

Nonfinancial assets include value of business interests, owned vehicles, equity in principal residence, real estate investments, vacation properties, and any other assets (artwork, precious metals,

antiques, oil and gas leases, futures contracts, future proceeds from a lawsuit or estate, etc.).

Debt includes outstanding loans on pension plans from current job, margin loans at a stock brokerage, outstanding loans on cash-value insurance policies, outstanding vehicle loans, outstanding loans or mortgages on investment real estate, vacation properties, and principal residence; any other outstanding loans used to purchase principal residence; outstanding loans on principal residence improvement; outstanding loans on credit/store card debts; lines of credit; any money owed to business; education loans; other consumer loans; and any other debt not recorded earlier.

Appendix C

Based on King and Dicks-Mireaux (1981),

$$\log Y_i = \gamma Z_i - C(A_i) + s_i, \tag{C.1}$$

where Y_i is the permanent income of individual i; Z_i is a vector of observable variables (education and occupation) for individual i; γ is the associated coefficient for Z_i; A_i is individual i's age in the sample year; $C(A_i)$ is a cohort effect, which reflects the fact that for a given Z, younger generations are better off than older generations due to technological advances and capital accumulation; and s_i is an error term that measures individual i's unobservable characteristics (skill, good fortune, etc.). Also, s_i has a population mean of zero and a variance of σ_s^2.

$$\log E_{it} = \log Y_i + h(A_{it} - \overline{A}) + u_{it}, \tag{C.2}$$

where E_{it} is the earnings for individual i at period t, $\overline{A}$ is a standard age with respect to which permanent income is defined, $h(A_{it} - \overline{A})$ is the age earnings profile which is assumed to be constant across the population, and u_{it} is the unobservable transitory component of earnings.[22] Moreover, u_{it} is uncorrelated with s_i and has a mean of zero and a variance of σ_u^2.

[22]The age earnings profile is the mean earnings of workers at various ages.

Combining equations (C.1) and (C.2) gives earnings equation (C.3).

$$\log E_{it} = \gamma Z_i + g(A_{it}) + s_i + u_{it}, \tag{C.3}$$

where $g(A_{it}) = h(A_{it} - \overline{A}) - C(A_{it})$ and is approximated by a cubic function of age. Additionally, $s_i + u_{it}$ is the error term and has a mean of zero and a variance of $\sigma_s^2 + \sigma_u^2$.

There are two ways to estimate permanent income. The first estimate is based on equation (C.1). Using equation (C.1) and omitting the unobservable individual effects s_i in equation (C.1), permanent income can be estimated as in equation (C.4).

$$\log Y_i^e = \gamma Z_i - C(A_{it}) \tag{C.4}$$

The second estimate is based on equation (C.2). Permanent income is estimated as in equation (C.5), by using the age earnings profile and the information contained in the observation of current earnings. This second estimate includes the unobservable transitory component of earnings.

$$\log Y_i^e = \log E_{it} - h(A_{it} - \overline{A}) \tag{C.5}$$

Following King and Dicks-Mireaux (1981), a more efficient estimate is obtained by taking a weighted average of (C.4) and (C.5). This procedure gives (C.6):

$$\log Y_i^e = \alpha \{\log E_{it} - h(A_{it} - \overline{A})\} + (1 - \alpha) \{\gamma Z_i - C(A_{it})\}. \tag{C.6}$$

Substituting (C.3) into (C.6) gives (C.7):

$$\log Y_i^e = \gamma Z_i - C(A_{it}) + \alpha(s_i + u_{it}). \tag{C.7}$$

Based on Cox and Jappelli (1993) and King and Dicks-Mireaux (1981), permanent income is predicted separately for men and women in each year, 1998 and 2007. The category "men" includes household heads that are male or spouses of female household heads. The category "women" includes household heads that are female or spouses of male household heads.[23] The steps below describe in

[23]Household heads with a spouse from the same gender are excluded. In 2007 SCF (including all the five implicates), out of 17,560 male household heads, 50 of

detail the estimation of permanent income separately for men and women in 2007. The same steps are applied for 1998. While predicting permanent income, individuals with negative earnings are deleted from each of the samples.[24]

As the first step, earnings equation (C.3) is estimated separately for each of the following two samples: men with annual earnings greater than \$8,000 and women with annual earnings greater than \$8,000.[25] Individuals with zero earnings or annual earnings less than or equal to \$8,000 are excluded from the estimation.[26] Any possible bias that may arise from excluding individuals with low or zero earning levels is corrected by Heckman MLE (maximum-likelihood estimation). In the first stage, a selection equation is estimated for the full sample to predict individuals with annual earnings greater than \$8,000 (table C.1, panel A). The selection equation controls for determinants of zero or low earnings. The Heckman MLE results are displayed in table C.2.

As the second step, permanent income is predicted separately for the following samples: men with annual earnings greater than \$8,000 ($\$8{,}000 < E_i$); men with annual earnings less than or equal to \$8,000 ($\$0 \leq E_i \leq \$8{,}000$); women with annual earnings greater

them have a spouse from the same gender. Out of 4,530 female household heads, 15 of them have a spouse from the same gender.

In 1998 SCF (including all the five implicates), out of 16,805 male household heads, 165 of them have a spouse from the same gender. Out of 4,720 female household heads, 115 of them have a spouse from the same gender.

[24]The "men" sample, in the 2007 SCF, has a total of 17,575 observations, and 20 of those observations have negative earnings. Likewise, the "women" sample has a total of 19,320 observations, and 15 of those observations have negative earnings. In the 1998 SCF, the men sample has a total of 16,670 observations, and 10 of those observations have negative earnings. The women sample has a total of 18,355 observations, and 5 of those observations have negative earnings.

[25]King and Dicks-Mireaux (1981) use \$2,000 as the earnings level. This earnings level corresponds to the 1976 data. The \$2,000 in 1976 is equivalent to \$8,000 in 2007 and \$6,000 in 1998. Therefore, this paper uses an earnings level of \$8,000 for the 2007 survey and \$6,000 for the 1998 survey, while estimating earnings equations for individuals with earnings above a certain level.

[26]Following King and Dicks-Mireaux (1981), earnings equation (12) assumes that individuals are in full-time employment. Hence the earnings equation is estimated for individuals with earnings levels greater than \$6,000 (\$8,000). For a detailed argument in favor of excluding individuals with low earnings, please refer to King and Dicks-Mireaux (1981).

Table C.1. Estimation of Permanent Income

Variables	Definitions
A. Selection Equation	
Dependent Variable	1 if annual earnings greater than \$6,000 in the 1998 survey or \$8,000 in the 2007 survey, 0 if less than or equal to \$6,000 (\$8,000) or equal to zero.
Marital Status	1 if married
Education	1 if elementary or less education
Age < 22	1 if age less than 22 years old
Age > 65	1 if age greater than 65 years old
Nonworker	1 if not currently employed/not self-employed or waiting to start work
Part-Time Worker	1 if current job is part time
Financial Assets	Financial assets for the family (self-constructed, see appendix B)
Number of Children under Age 18	Number of children under 18 that live in the housing unit
B. Earnings Equation	
Dependent Variable	Natural log of annual earnings
Age	Age
Agesq	Age squared
Age-cubed	Age cubed
Education	1 if none or elementary school 2 if middle school or some high school 3 if high school graduate 4 if some college 5 if college graduate 6 if graduate or professional school
Occupation	0: not doing any work for pay 1: manager and professional 2: technical, sales, and administrative 3: services 4: production, craft, and repair 5: operators and laborers 6: farming, forestry, and fishery
Race	1 if household head is black
Marital Status	1 if married

Note: While calculating annual earnings, it is assumed that there are 52 weeks in a year, and for hourly workers it is assumed that they work 40 hours a week.

Table C.2. Regression Results for Permanent Income

	Probability of Having Earnings Greater than $6,000				Probability of Having Earnings Greater than $8,000			
	1998				2007			
	Female		Male		Female		Male	
	Coeff.	Linearized Std. Err.	Coeff.	Linearized Std. Err.	Coeff.	Linearized Std. Err.	Coeff.	Linearized Std. Err.
Marital Status	−0.328***	0.091	−0.109	0.102	−0.175*	0.091	0.027	0.099
Education	−0.422***	0.102	−0.486*	0.266	−0.500***	0.170	−0.083	0.371
Age < 22	0.386	0.324	0.067	0.219	0.358	0.350	−0.294	0.304
Age > 65	−0.639***	0.155	−0.801***	0.139	−0.694***	0.126	−0.493***	0.139
Nonworker	−3.108***	0.094	−2.761***	0.102	−3.259***	0.093	−2.994***	0.100
Part-Time Worker	−0.140	0.168	0.146	0.243	−0.357**	0.172	0.278	0.280
Financial Assets	−2.06E-08	1.97E-08	(7.08E-08)***	1.80E-08	−7.07E-09	1.01E-08	(2.39E-08)**	9.96E-09
Number of Children under Age 18	−0.055	0.039	0.126***	0.045	−0.030	0.033	0.033	0.047
Constant	1.896***	0.088	1.744***	0.095	1.946***	0.091	1.747***	0.090

(*continued*)

Table C.2. (Continued)

	Natural Log of Annual Earnings							
	1998				2007			
	Female		Male		Female		Male	
Age	0.081***	0.023	0.116***	0.027	0.082***	0.029	0.080***	0.025
Agesq	−0.001***	0.001	−0.002***	0.001	−0.001*	0.001	−0.001*	0.001
Age-cubed	(6.92E-06)*	3.75E-06	(8.51E-06)*	4.51E-06	4.80E-06	4.96E-06	3.71E-06	3.87E-06
Education:								
Middle or Some High School	0.044	0.092	0.173*	0.090	0.034	0.107	0.209***	0.068
High School Graduate	0.182**	0.081	0.301***	0.085	0.196*	0.100	0.462***	0.059
Some College	0.296***	0.082	0.414***	0.085	0.389***	0.102	0.522***	0.063
College Graduate	0.422***	0.087	0.561***	0.092	0.618***	0.103	0.840***	0.068
Graduate or Professional School	0.645***	0.090	0.768***	0.098	0.903***	0.110	0.986***	0.077
Occupation:								
Manager and Professional	0.467***	0.116	0.384***	0.118	0.294**	0.127	0.660***	0.087
Technical, Sales, and Administrative Services	0.223*	0.115	0.174	0.118	0.168	0.128	0.342***	0.088
Production, Craft, and Repair	−0.005	0.118	−0.156	0.118	−0.055	0.130	0.186**	0.088
Operators and Laborers	0.346***	0.128	0.093	0.113	0.109	0.152	0.308***	0.083
	0.132	0.121	0.019	0.113	−0.019	0.138	0.242***	0.086

(*continued*)

Table C.2. (Continued)

	Natural Log of Annual Earnings							
	1998				2007			
	Female		Male		Female		Male	
Race	0.009	0.044	−0.156***	0.043	−0.062	0.040	−0.163***	0.048
Marital Status	−0.050	0.030	0.131***	0.030	−0.028	0.029	0.142***	0.031
Constant	8.085***	0.338	7.691***	0.388	8.240***	0.410	8.024***	0.361
athrho	−0.177***	0.061	−0.374***	0.056	−0.253***	0.067	−0.274***	0.057
lnsigma	−0.654***	0.031	−0.501***	0.022	−0.597***	0.020	−0.462***	0.019
rho	−0.175	0.059	−0.357	0.049	−0.248	0.063	−0.267	0.053
sigma	0.520	0.016	0.606	0.013	0.550	0.011	0.630	0.012
lambda	−0.091	0.031	−0.216	0.031	−0.136	0.035	−0.168	0.034
Number of Observations	3,660		3,326		3,838		3,498	
Prob > F	0.0000		0.0000		0.0000		0.0000	

Notes: ***, **, and * refer to significance levels at 1 percent, 5 percent, and 10 percent, respectively. Omitted category in education is "none or elementary school." Omitted category in occupation is "farming, forestry, and fishery."

than \$8,000 (\$8,000 $< E_i$); and women with annual earnings less than or equal to \$8,000 (\$0 $\leq E_i \leq$ \$8,000) (table C.1, panel B).

In order to predict permanent income for men with annual earnings greater than \$8,000, equation (C.7) is estimated. While estimating equation (C.7), the same vector of explanatory variables (Z), estimated γ coefficient values, and estimated residuals from step 1, earnings equation (C.3), are used. Standard age is taken as 45 and the cohort effect is taken as 0.75 percent. For instance, $C(A_i)=$ (Age-45)*(0.0075). The α value is assumed to be 0.5.

However, for men with \$0 $\leq E_i \leq$ \$8,000, permanent income is predicted by equation (C.4), but by using the same vector of explanatory variables (Z) and the estimated γ coefficient values from earnings equation (C.3) in step 1. The cohort effect is still taken as 0.75 percent and standard age is taken as 45.

An initial permanent income is estimated for women with \$0 $\leq E_i \leq$ \$8,000 or \$8,000 $< E_i$ by applying the same procedures as used for males. In contrast to the procedure for males, a final permanent income is estimated by using the initial permanent-income estimate and adjusting it for the possibility of nonparticipation in the labor force by women and using the estimated probabilities of having low or no earnings.

$$Y_i^w = Y_i^e \, prob\,(E_i > \$8,000) + \overline{E_w} \, prob\,(\$0 \leq E_i \leq \$8,000)$$

Y_i^e is the initial permanent-income estimate for women, E_i is annual earnings in the sample year, and $\overline{E_w}$ is mean earnings of women with annual earnings less than or equal to \$8,000 (\$0 $\leq E_i \leq$ \$8,000). The probabilities of earnings being above and below \$8,000 are computed for each woman in the sample from the probit regression estimated in the first stage of the Heckman model in step 1.

Permanent income for households is constructed by summing the computed permanent incomes for household head and the spouse.

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