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DEBTS ON DEBTS

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Debts on Debts

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Debts on Debts

Abstract

This paper studies the impact of mortgages on consumer debt and on debt on durable goods. We first present a stylized model in which an outstanding debt, representing mortgages, affects positively consumer debt, and debt on durable goods. The model is empirically tested for the U.S. using PSID 2005 wave. Our results are striking. First, we find strong evidence supporting a positive association between mortgage loans and consumer debts, regardless of the measures used, the control variables used, and the methods used. Second, we find that the effects of mortgages on the debt on durable goods are in general smaller than the effects of mortgages on consumer debt. Third, our distributional analysis reveals that the effects monotonically decrease as the quantile increases. Finally, our results are also confirmed by the results using the U.K. data.

Keywords: Consumer expenditure, Housing, Credit, Censored Regressions

JEL Codes: G21; E44; R21; R31

1. Introduction

The current financial crisis in the U.S. has been one of the worst recessions since the Great Depression.[1] Policymakers and researchers alike have actively sought to understand the causes of the current crisis. The sharp increase in household debt to unsustainable levels during the period 2001 - 2007 before the recessions has been well-documented and found to be one of the primary drivers of the current crisis, among other potential causes.[2]

Understanding why the level of household debt increased drastically is essential for the understanding of the causes of the current financial crisis.[3] A potential explanation for the increase in household indebtedness is related to housing wealth effect, in which households are allowed to borrow to finance their consumption against their home equity. The development of financial markets, by generating more credit and easier access to it, has increased the demand for housing, and house ownership, in many countries.[4] In the meantime, it has also raised household debt and lead to the appreciation of house prices. More importantly, home ownership and the increase in house prices allow households to have access to more credit; it further increases their debt, although facilitating their consumption of durables (Muellbauer, 2007).

In the prior literature of permanent income hypothesis of consumption, the possibility of

[1]Estimates released by the Bureau of Economic Analysis indicate that the real GDP decreased at an annual rate of 6.4 percent in the first quarter of 2009. [http://www.bea.gov/newsreleases/national/gdp/gdpnewsrelease.htm] The national unemployment rate rose to 9.7 percent in August, 2009 [http://www.bls.gov/news.release/laus.nr0.htm].

[2]Mian and Sufi (2009) find a strong link between the timing and the extent of severity of recessions and the level of household leverage.

[3]Cox et al. (2002) and Aizcorbe et al. (2003) present descriptive analyses of household debt by type of households in the UK and U.S., respectively [They draw upon Guiso et al. (1996)and Brown et al. (2005) to specify the control variables in their econometric estimation]. Brown and Taylor (2008) investigate the effects on household debt of various household characteristics. Specifically, they find that the characteristics of household heads such as gender, marital status, and employment status play important roles in household indebtedness. However, the trend of population composition has been more or less stable in the past decade. Without dramatic changes in population composition, these studies alone cannot help us understand the causes of the sharp increase in household debt.

[4]According to Leamer (2007) housing has a larger impact on output than any other sector, and housing is by far the best leading indicator of economic activity.

any housing wealth effect has been disregarded or minimized.[5] However, when informational problems are taken into account generating credit constraints, it is possible to show the existence of a housing wealth effect. As argued by Aron and Muelbauer (2000) and Muellbauer (2007), credit markets matter for the effect of house prices on consumption through two channels: (1) for first-time buyers; and (2) for those already possessing housing collateral.

Potential first-time buyers have to save a significant fraction of their income for a housing deposit. If credit markets develop improving the access to unsecured credit so as to reduce the minimum down-payment as a fraction of the value of the house, or a rise in the maximum loan-to-income ratio, it has the potential to make the young households to save less and consume more (e.g. Japelli and Pagano, 1994; Engelhardt, 1996).

Credit development that allows home owners to obtain loans backed by housing equity increases the liquidity of housing wealth and may have a large positive effect on consumption (e.g. Case et al., 2005; Carroll and Slacalek, 2006). It has the potential to be an explosive process of debt formation, since households may have incentives, and channels, to accumulate debt beyond their capacity to pay the principal and/or the interest due on outstanding debts. In the Minskyan terminology this debt formation process has the potential to transform households into Ponzi units (Minsky, 1986). The Ponzi-like debt formation process increases the vulnerability of the financial system and makes the occurrence of financial crisis more likely. Indeed, these two related channels are considered to be responsible for the sharp increase in household debt during the period 2001-2007 (Mian and Sufi, 2009).

Extensive empirical studies have been devoted to assess the housing wealth effects and generally found evidence supporting its existence.[6] These studies typically focus on the

[5]This also holds true for the general equilibrium macro-models based on the efficient financial markets and rational expectations, as Benito et al. (2006).

[6]Muellbauer (2007) offers the most complete and updated review of the literature. There is a large empirical literature assessing the impact of the housing wealth effect [as a result of house price growth] on consumption. Case et al. (2005) find for the US and a panel of 14 countries, that the housing wealth effect is larger than the stock market wealth effect (see also (Benjamin, Chinloy, and Jud, 2004); (Carroll and Slacalek, 2006). (Calomiris et al., 2009) control for the possibility that both consumption and housing prices are driven by changes in expected future income and contrary to Case et al. (2005) find little effect of housing wealth on consumption. For UK micro data, Attanasio et al. (2009) express skepticism that a large housing

level of consumption level, instead of the level of consumer debt. Therefore, while shedding lights on the housing effects on household's consumption behavior, the literature does not directly allow us to infer the housing effects on household debt accumulation. Moreover, consumption of durable goods and other types of consumption goods are not distinguished in the literature. As we shall see below, there exist substantial differences in the effects of mortgage on the consumption of durable goods and other types of goods.

This paper contributes to the literature in the following important ways. First, the model explicitly incorporates mortgage loans as a determinant of household's debts. Second, we complement the literature of house wealth effects by directly looking at the amplified collateral effects on the level of consumer debts, rather than the level of consumption. This allows for direct inference of housing effects on debt accumulation. We also allow for differential effects of mortgages on different types of consumer debts, by treating durable goods and other consumption separately. Third, the empirical analysis relies on data at the household level (discussed below); it allows us to control for a rich set of household characteristics, enabling more plausible interpretation of causal relation between consumer debt and mortgage. As noted in Cox et al. (2002), analyses of aggregate data do not allow us to look at which household accumulate more debts. Finally, we tackle the issue whether debts-on-debts exist for all consumers, by assessing the effects of mortgage on consumer debt within a distributional framework. This approach uncovers any heterogeneity in the magnitude and existence of the effects across the distribution of consumer debt. The analysis sheds light on the debts-on-debts process, and it is useful for sound policymaking.

To perform the analysis, we first present a stylized theoretical model capturing the process of consumer debt formation from house ownership, in which debt generates debt. Home ownership is generally associated with mortgages, which is an outstanding debt. If a home owner, who is a debt holder, is allowed to have more credit, because the owned home rep-

wealth effect exists, while Campbell and Cocco (2007) find that the largest house price effects are for the older homeowners. For the US micro data Lehnert (2004) also finds the largest house price effects are for the older homeowners.

resents better collateral than other assets, this may allow her to increase her debt through the financed consumption of durable goods. Our model characterizes this process of debt formation in which debt facilitates and grows with debt. As a result, consumer debt and the demand for durable goods are positively related to mortgage payments, suggesting that mortgage holders have greater access to credit and facility to finance their durable goods expenditures, increasing their indebtedness.

Utilizing data from the 2005 Panel Study of Income Dynamics (PSID) for the U.S., we empirically test our theoretical model, using both parametric and semi-parametric approaches. The results are striking, yielding three main conclusions. First, we find strong evidence supporting a positive association between mortgage loans and consumer debts, regardless of measures used, the control variables used, and the methods used. Second, we find that the effects of mortgages on the debt on durable goods are in general smaller than the effects of mortgages on other types of debts. Third, our distributional analysis reveals an interesting pattern of the effects on consumer debt of mortgage over the distribution. Specifically, the effects monotonically decrease as the quantile increase, with the smallest effects being at the upper tail of the distribution. Finally, to further assess the robustness of our results, we also utilize the British Household Panel Survey (BHPS), Wave 15 (2005). Our results are also confirmed by the results using the U.K. data.

The remainder of the paper is organized as follows: section 2 provides a stylized theoretical model; sections 3 and 4 details the econometric method and data; sections 5 and 6 presents the baseline and robustness results, respectively; and, section 7 concludes.

2. Theoretical Model

Our stylized model is a partial equilibrium model with one representative consumer that may accumulate debt in a deterministic environment and supplies labor inelastically. The representative consumer solves the following optimization problem:

$$\max_{c} \int_0^{\infty} (U(c) + F(D))e^{-\delta t} dt \tag{1}$$

$$\dot{B} = c + D(1 - \alpha(r)) + r(B + \theta M + \alpha(r)D) + \theta M - y \tag{2}$$

$$\dot{D} = f(\alpha(r)D, B, \theta M, y) \tag{3}$$

Where δ is the positive rate of time preference, c is consumption of nondurables, D is the stock of durable goods, y is labor income, B is debt, M is mortgage payments, f is expenditures on durable goods,α is the share of durable goods that are financed, r is the real interest rate and θ is a parameter that indicates whether the consumer owns a house $[\theta = 1]$ or not $[\theta = 0]$. We assume that the share of expenditures on durable goods is a negative function of r, $\alpha_r < 0$. As in Galí (1993) we assume separable preferences between c and D, and that the stock of durable goods is adjusted through expenditures on durable goods, given by (3).

The expenditures on durable goods, given by the function f in (3), are an increasing function of mortgage payments M, $f_M > 0$, reflecting the assumption that home owners have easier access to credit, and labor income, y, $f_y > 0$. We assume that expenditures on durable goods are a negative function of the stock of durable goods, D, $f_D < 0$ and increasing function of outstanding debt, B, $f_B > 0$.

The dynamic budget constraint in equation (2) assumes, differently from Iacoviello (2005), that there are no changes in holdings of housing[7], which according to Calomiris et al. (2009) characterizes most homeowners, which own roughly what they intend to consume in housing services. This allows us to eliminate the real housing price from the budget constraint, so as that the housing wealth effect plays no role in our analysis. So in the dynamic budget

[7]See Mishkin (2007) discussion of user cost of residential capital

constraint the household can accumulate debt, which increases with expenditures on durable goods [financed or not] and monthly mortgage payments, in the case where the household owns a house.

The Hamiltonian function of the consumer problem is:

$$H = U(c)+F(D)+\lambda[c+D(1-\alpha(r))+r(B+\theta M+\alpha(r)D)+\theta M-y]+\mu f(\alpha(r)D, B, \theta M, y)$$

where λ and μ are the co-state variables for debt (B) and stock of durable goods (D), respectively. The first order conditions of the representative agent problem are:

$$\begin{aligned} U'(c)+\lambda &= 0 && (4)\\ \dot{\lambda}-\lambda\delta &= -[\lambda r+\mu f_B(\alpha(r)D, B, \theta M, y)] && (5)\\ \dot{\mu}-\mu\delta &= -[F'(D)+\lambda(\alpha(r)(r-1))+\mu f_D(\alpha(r)D, B, \theta M, y)] && (6) \end{aligned}$$

Plus the transversality conditions. In the above model Equations (2)-(6) determine five endogenous variables, c, B, D, λ, and μ.

This model has multiple equilibria, however we confine our analysis to the case where δ, the positive rate of time preference is equal to the real interest rate, r. Assuming $\delta = r$, the steady state equilibrium, denoted by an asterisk over the variables $[c^*, D^*, B^*]$,is:

$$\begin{aligned} \dot{D} &= 0 \Longrightarrow f(\alpha(r)D^*, B^*, \theta M, y) = 0 && (7)\\ \dot{\lambda} &= 0 \Longrightarrow f_B(\alpha(r)D^*, B^*, \theta M, y) = 0 && (8)\\ \dot{B} &= 0 \Longrightarrow c^* = y - D^*(1-\alpha(r)) - r(B^*+\theta M+\alpha(r)D^*) - \theta M && (9) \end{aligned}$$

Equations (7) and (8) determine simultaneously the steady state equilibrium values of demand for durable goods, D^*, and consumer debt, B^*, and then Equation (9) determines the equilibrium value of consumption of nondurables, c^*. Notice that in (8) we assume that μ is different from zero in equilibrium. Equations (7) and (8) depend on the expenditure

function f and its derivative with respect to B. These equations show that equilibrium consumer debt and equilibrium consumption of nondurables are related to each other since they are determined simultaneously and are affected by the same set of variables, the real interest rate r, mortgage payments M, and labor income y.

The focus of this model is to assess the impact of mortgage payments, M, on the equilibrium demand for durable goods and on consumer debt. In order to obtain the multipliers from the comparative statics analysis assume that $f_{BB} < 0; f_{BM} > 0; f_{BD} = 0$. The main results of the model are presented in the following propositions:

PROPOSITION 1 Mortgage payments M have a positive impact on equilibrium consumer debt B^*:

$$\frac{dB^*}{dM} = -\theta \frac{f_{BM}}{f_{BB}} > 0 \tag{10}$$

PROPOSITION 2 As $-f_M f_{BB} > 0 > -f_B f_{BM}$, mortgage payments have a positive impact on the equilibrium demand for durable goods since

$$\frac{dD^*}{dM} = \theta \frac{(f_B f_{BM} - f_M f_{BB})}{f_D f_{BB}} > 0 \tag{11}$$

Of course mortgage payments only affect the households who own a house, $\theta = 1$. Notice that mortgage payments may have a either larger or smaller impact on the equilibrium demand for consumer debt than on the equilibrium demand for durable goods.

3. Empirical Methodology

3.1. Parametric Approach

Notice that (observed) household debt can take only on nonnegative values, and that there exists a significant fraction of households possessing no debts. A linear model of consumer debt, $ln(y_i)$, might be a good approximation of the underlying conditional expec-

tation function $\mathbb{E}[ln(y_i)|x_1, \ldots, x_k]$ only when x_i near the mean values (Wooldridge, 2008); it may underestimate the effects otherwise. Following Bertaut and Starr-McCluer (2002) and Brown and Taylor (2008), we therefore estimate the following Tobit model to test our theoretical predictions:

$$ln(y') = \beta_1 ln(M) + X\beta_2 + \epsilon, \quad \epsilon|ln(M), X \sim \mathbb{N}(0, \sigma^2) \tag{12}$$

$$ln(y) = \max\{0, ln(y^*)\} \tag{13}$$

where $ln(y)$ is observed household debt, either consumer debt or debt on durable goods; $ln(y')$ is the untruncated latent household debt, which in principle can take on negative values; M is mortgage payments; X is a vector of controls (including a constant); and ϵ is the error term as usual, normally distributed with mean zero and constant homoskedastic variance σ^2. We can now restate our theoretical predictions in light of Equations (12) and (13). Both Propositions 1 and 2 imply that $\beta_1 > 0$.

Prior to continuing, a few comments are warranted regarding the model assumptions. First, the *causal* interpretation of the effects of mortgage payment on other household debt hinges on the assumption of *conditional exogeneity* or *selection-on-observables* (termed as in the literature of treatment effects, see Heckman and Robb, 1985). This assumption requires that conditioning on observable characteristics, mortgage payment is not correlated with the error term (other unobservable determinants of consumer debt). As noticed above, our theoretical model suggests that consumer debt and durable goods both are interrelated and endogenously determined by all other variables including income and mortgage payments. It is not difficult to imagine that, in an extended model in which mortgage payment is also endogenously determined, all three types of debts would be functions of a same set of exogenous variables. This presents a great challenge to any empirical studies of this type, as it is difficult to find an exogenous instrument variable that determine mortgage payment but are uncorrelated with consumer debt; any instrument variables proposed could thus be

controversial. Like most of the literature on housing wealth effects, while we are not able to find a valid instrument variable, we are able to include a rich set of household characteristics in our estimation. The richness of covariates in PSID makes the assumption of "selection-observable" reasonably plausible.

Second, the Tobit model also relies crucially on the assumption that the error term is normally distributed, with zero mean and homoskedastic variance. Viloations of the assumptions could potentially lead to inconsistent estimates of β_1, but the magnitude of the bias will depend on the severity of the voliation. As noted in Wooldridge (2008, p.594), moderate departures from homoskedasticity and normality may still allow the Tobit model to provide good estimates of β_1. In order to assess the validity of the assumptions, we utilize both informal and formal approaches. Wooldridge (2008) proposes an informal way to evaluate the appropriateness of the Tobit model by estimating a probit model where the dependent variable equals one if $ln(y) > 0$, and zero otherwise. Notice that, if the assumptions of Tobit model hold, the coefficients of $ln(M), X$ obtained from this probit model, denoted β^{probit}, are equivalent to the Tobit coefficients divided by the estimate of σ, denoted β^{tobit}/σ. Thus, the closeness between β^{probit} and β^{tobit}/σ indicate whether or not the assumptions of normality and homoskedasticity are indeed reasonable. In addition to the informal approach, we also implement conditional moment tests of normality and homoskedasticity (see,Skeels and Vella, 1997, and Drukker, 2002).

3.2. Semi-parametric Approach: CLAD, SCLS, and Censored Quantile Regression

In addition to the Tobit model, we employ two alternative semi-parametric estimation methods under weaker assumptions – censored least absolute deviations (CLAD) and symmetrically-censored least squares (SCLS) methods.[8] These methods are robust to the presence of non-normal and heteroscedastic disturbances and thus allow us to further assess the sensitivity of the Tobit estimates to the relaxation of the assumptions of normality and

[8]Interested readers are referred to Chay and Powell (2001) for an excellent summary of these methods

homoskedasticity. CLAD is proposed by Powerll (1984) and SCLS Powerll (1986). As noted in Chay and Powell (2001), both methods are involved with two alternating steps: regression step and recensoring step; the algorithm is as follows:

1. Use certain estimation technique to obtain initial estimates of β_1, β_2 (*regression* step)
2. Generate predicted values $\widehat{ln(y)}$ based on the estimates
3. Drop the observations if the predicted values do not meet the preset criterion. (*recensoring* step)
4. Repeat (1) – (3) using the remaining sample until the preset criterion is met. The last set of estimates is our estimates of β_1, β_2.

The regression step of SCLS is based on ordinary least square (OLS) estimation; while the regression step of CLAD is based on the least absolute deviation (LAD) estimation which minimizes the following "check" function:

$$\min_{(\beta_1,\beta_2)\in R^k} \sum_{i=1}^{N} \{\tau I[u_i \geq 0] + (1-\tau) I[u_i < 0]\} |u_i| \tag{14}$$

where $I[.]$ is the indicator function, equal to 1 if $u \geq 0$, zero otherwise; τ is the quantile, here, $\tau = .5$ and $u = ln(y) - \beta_1 ln(M) - X\beta_2$.

The recentering step of SCLS is based on symmetric trimming; the values $ln(y) > 2\widehat{ln(y)}$ are replaced by $2\widehat{ln(y)}$ and then the observations with $ln(y) < 0$ are dropped. The recentering step of CLAD, on the other hand, keeps only the observations with $\widehat{ln(y)} \geq 0$.[9]

Notice that the logic of CLAD can be easily extended to estimate the effects across the whole distribution by setting different values of $\tau \in (0, 1)$; we denote this *censored quantile regression estimation* (see Conley and Galenson (1994, 1998) for some interesting applications of censored quantile regression). Censored quantile regression approach allows

[9] As noted in Li and Racine (2007), CLAD estimator could potentially break down in the cases of heaving censoring. In the situations where there exists a significant fraction of zeros, we randomly drop part of the observations with zeros to get CLAD started; in this sense, we may think that we are estimating an effect at a higher quantile than reported.

us to obtain estimates of β_1 at each quantile τ, thereby obtaining a much more complete picture of the effects of mortgage payments on consumer debt at different portions of the distribution of consumer debt.

In sum, we employ both parametric (Tobit) and semi-parametric (CLAD and SCLS) approaches to test our theoretical predictions. Moreover, we assess the predictions within a distributional framework using censored quantile regression.

4. Data

The data are obtained from Panel Studies of Income Dynamics (PSID). The PSID contains a longitudinal sample of "a representative sample of U.S. individuals (men, women, and children) and the family units in which they reside".[10] We utilize the 2005 wave (the more recent sample before the crisis started.) to form a sample of 7,500 households.

The variables of main interest are mortgage payments, debt on durable goods, and other type of consumption goods. We use two measures of mortgage payments to assess the robustness of our results. The first one is total *remaining* principal on all mortgages, and the second one is total *monthly* mortgage payments. The debt on durable goods is correspondingly measured by the total loan for vehicles and total monthly payment for all vehicles. Similarly, the debt on other type of debts is measured by total amount of any other debts such as credit card charges and student loans and total monthly payment for these debts.

As we mentioned above, PSID provides rich information on household characteristics. In order to make the assumption of selection-on-observables more plausible as well as to increase the precision of estimates, we include a rich set of individual, household, and geographic characteristics in our estimation. Inclusion of the household heads' characteristics is particularly important, as they might capture their preferences, personal financial knowledge, income constraints, and so on. Moreover, our specification of the additional covariates

[10]PSID is publicly available at `http://psidonline.isr.umich.edu/`. See PSID documentation for a complete description

is similar to that in Brown and Taylor (2008) and Guiso et al. (1996, 2003), which facilitates the comparison with the existing literature on debt formation. Specifically, we include a set of dummy variables for age of household head (aged 16-24, 25-34, 35-44, 45-54, 55-60, and aged 60 and above); dummy variables for education level of household head (below high school, high school, and college and above); a dummy variable indicating the gender of household head, equal to one if male, zero otherwise; a dummy variable indicating the current marital status of household head, equal to one if currently married, zero otherwise; a dummy variable indicating the race of household head, equal to one if white, zero otherwise; the number of children residing in the household; a dummy variable indicating whether or not the household head is currently employed; and a dummy variable indicating whether or not household head's health status is good.[11] Moreover, we also include dummy variables for regions. Table (A1) presents the summary statistics.

5. Results

5.1. Baseline Results

We begin by reporting OLS results in Table (1). Columns (1) and (2) are the results for the *total* loans on durable goods and other types of debts, respectively; Columns (3) and (4) are the results for the *monthly* payment on durable goods and other types of debts, respectively. This gives a basis for future comparisons. We control for the variables discussed above in the data section. The OLS results show a large, positive effect of mortgage payment on

[11] This variable is corresponding to the question: Would you (HEAD) say your health in general is excellent, very good, good, fair, or poor?

1. Excellent
2. Very Good
3. Good
4. Fair
5. Poor
6. DK
7. NA; refused

(1)-(3) are coded to one; (4)-(5) zero; and the rest missing values.

consumer debts across all four specifications. The elasticities of consumer debts with respect to mortgage payment range from 6.3 percent to roughly 13 percent. All these estimates are statistically significant at $p \leq 0.001$. These results appear to be strongly consistent with our theoretical prediction: consumer debts grow with mortgage payment.

While of interest, OLS does not take into account the censoring issue and may thus fail to produce consistent estimates of the effects of mortgage payment on consumer debts. We therefore turn to our Tobit results. These results in Table (2) are the marginal effects on the observable debts (i.e. $\frac{\partial \mathbb{E}[ln(y)]}{\partial x_j}$) evaluated at the means. The elasticity of total debt on durable goods with respect to mortgage payment is .063 ($s.e. = 0.01$), whereas the elasticity of total debt on other types of consumption goods with respect to mortgage payment is 0.128 ($s.e. = 0.012$); the former is larger than its OLS counterpart, and the latter is smaller than its comparable OLS result. Similarly, the housing effects is .051 on monthly payment on durable goods and .140 on monthly payment on other debts. The Tobit results confirm the OLS estimates, pointing to a positive association between mortgage payment and consumer debts. Moreover, the housing effect on other types of consumer debt is at least twice as large as the housing effect on durable goods, regardless of the measures used.

The results for other variables are broadly consistent with the literature. Several findings are worth noting. First, age profile has a significant, both economically and statistically, impact on the level of consumer debt. In particular, younger cohorts (aged 16-34) accumulate more debts on both durable goods and other consumption goods, relative to the older cohorts. Such a result may reflect that young individuals who are in the beginning of their careers may in general have greater needs for consumption goods but have less resources of their own, and that they thus need to seek external resources to finance their consumption. Second, race also plays an important role in determining household indebtedness across all four specifications. A white household head is more likely to have at least 20% more consumer debts than a household head from other ethnic groups. This finding is consonant with the findings in Duca and Rosenthal (1993), suggesting that white families may have greater access to credit

and are less credit constrained than minorities. Third, as in Brown and Taylor (2008), we find that being employed is positively associated with household debts, regardless of the measures used. Finally, it is evident that some characteristics have different impacts on car loans and other types of debts. For example, being married with a spouse increases the debts on durable goods, but is uncorrelated with other debts. This finding highlights the importance in distinguishing between two measures.

5.2. Sensitivity Analysis

As noted above, for the Tobit estimates to be consistent, the error term has to be normally distributed with homoskedastic variance. To assess these requirements, we provide results from several specification tests (the conditional moment tests), as well as the results from the informal approach proposed in Wooldridge (2008), in Tables (3) and (4). The first panel in Table (3) display the test of normality. P-values based on asymptotic distributions are in parentheses. Asymptotic inference could, however, lead to severe size distortions (Skeels and Vella, 1997). We also implement a parametric bootstrap method proposed by Drukker (2002) to correct the size distortion; corresponding critical values are presented beneath the asymptotic p-values. We easily reject the null of normally distributed error term at $p \leq 0.05$ level across all four specifications. The test of homoskedasticity presented in the second panel in Table (3) also leads to a strong rejection of the null hypothesis of homoskedastic variance ($p \leq 0.01$) in all specifications.

Table (4) presents the results for the informal test proposed in Wooldridge (2008). The idea is that, if the departure from these assumption is not substantial, the estimates from the probit model, where the dependent variable equals one if $ln(y) > 0$ and zero otherwise, ought to be similar to the coefficients from the Tobit model divided by the estimates of σ. Unsurprisingly, we find some discrepancies between these two models. For example, the probit coefficient β^{probit} of being in a household with total household income between 25th-50th percentile is twice as large as the coefficient constructed from the Tobit model β^{tobit}/σ. However, for most variables, the coefficients from these two models are close to each other; it

implies that, although the assumptions are not certainly satisfied, the departure from these assumptions may not be severe.

We now turn to the results for CLAD and SCLS estimation. To facilitate the comparison, we also present the Tobit coefficients comparable to CLAD and SCLS results in Table (5). These coefficients are the elasticities of *latent* consumer debt with respect to mortgage payments,i.e. $\frac{\partial \mathbb{E}[ln(y')]}{\partial x_j}$. The estimates for other covariates are similar and thus omitted, but available from authors upon request. Examination of the results yields two findings. First, the effects of mortgage payment on consumer debt drop considerably, with the large decrease being about .16 percentage points (Tobit model v.s. CLAD model in the first column); the discrepancies between Tobit and two semi-parametric models are, as expected, consistent with the results of specification tests. Second, in spite of differences in the coefficients, the qualitative conclusion remains unchanged. We again find that there exists a large, positive impact of mortgage payment on consumer debt across all four specifications. For example, an increase of one percentage point in monthly mortgage loan is associated with an increase of nineteen percentage points in monthly payment on other debts. Moreover, we continue to find that the effects of mortgage payment on other debts are larger than those on car loans.

As discussed above, we are concerned with extremely high level of consumer debts. Thus, we report the results for the censored quantile regression at selective quantiles ($\tau = .60, .65, .70, .75, .80, .85$), controlling for the same set of covariates discussed above, in Table (6). In parenthesis are bootstrapped standard errors based on 500 replications. These results allow us to ask how different the effects of mortgage payment are on consumer debts at different quantile. Two findings stand out. First, we again find that mortgage payment is positively associated with consumer debts at every quantile, regardless of measures used. In addition, the effects of mortgage payments on other debts are always larger than those on debts on durable goods at every quantile. Second, the elasticities of consumer debts with respect to mortgage payment a monotonically decrease monotonically as the quantile increases. And the decrease is particularly large for other debts. In particular, the estimates

decrease from .086 to .034 for total debts on other types of consumption goods.

In sum, while both semi-parametric and distributional results indicate that the Tobit estimates tend to overestimate the association between mortgage payment and consumer debts, the qualitative conclusion from the Tobit estimates remain unchanged.

5.3. International Evidence

To further assess the robustness of our results, we also utilize the British Household Panel Survey (BHPS), Wave 15 (2005). While also providing rich information on household characteristics, many of which are comparable to PSID, BHIP does not ask the respondents of actual amount of other loans; instead it asks whether or not a respondent has any loans for a specific type. That is, we can estimate only the effects of mortgage payment payments on the propensity to having more debts. Here, we use two measures of consumer debts: one is whether one has any car loan and the other whether one has any other types of debts. These are binary variables, and thus we estimate the effects of mortgage payment via probit model estimation. The marginal effects of mortgage payment evaluated at means are reported in Table (7) for both U.S. and U.K.. Two things are noteworthy. First, the effects remain positive and are statistically significant. However, relative to the U.S. results, the UK estimates are generally very small. This actually suggests that while the debts-on-debts process exists in the U.K. as well, the effects are less severe. Second, we again find that the effects of mortgage payment on other types of debts are in general larger than those on durable goods, in line with the U.S. results.

6. Conclusion

The existing empirical studies of the determinants of household debts typically focus on the effects of household characteristics on household indebtedness and fail to distinguish different types of debts and to investigate the interrelationship among them. On the other hand, the existing literature on housing wealth effects has extensively studied the potential link between housing values or mortgage on household's consumption level, instead of debt

on consumption goods. Moreover, these empirical studies are in general limited to regression analysis. Such results at best provide evidence of *average* effects of mortgage.

This paper sets out to bring together these two strands of literature, investigating the impact of mortgages on consumer debt and on debt on durable goods. Moreover, we complement the existing literature by employing censored quantile regression approach; this method allows us to look beyond the *average* effects and thus to provide a more complete picture of the effects of mortgages on different types of household debts. The analysis herein yields three main conclusions. First, we find strong evidence supporting a positive association between mortgage loans and consumer debts, regardless of the measures used, the control variables used, and the methods used. Second, we find that the effects of mortgages on the debt on durable goods are in general smaller than the effects of mortgages on other types of debts. Third, our distributional analysis reveals an interesting pattern of the effects on consumer debt of mortgage over the distribution. Specifically, the effects decrease monotonically as the quantile increase, with the smallest effects being in the upper tail of the distribution.

While these findings are striking, future research is necessary to further assess the robustness of our results. As discussed above, while we are able to include a rich set of covariates in our estimation, there could still be unobservable determinants of consumer debts and debts on durable goods are correlated with mortgage payment. How robust are the results to the relaxation of the assumption of "selection-on-observables"? The question remains open, and answering such a question is important for a deeper understanding of the process of household debt formation.

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Table 1: OLS Model

	Model 1 ln(Car Loan) (Total)	Model 2 ln(Other Debts) (Total)	Model 3 ln(Car Loan) (Monthly)	Model 4 ln(Other Debts) (Monthly)
ln(Mortgage)	0.075***	0.116***		
(Total)	(0.011)	(0.011)		
ln(Mortgage)			0.063***	0.127***
(Monthly)			(0.01)	(0.012)
Age of head of household	1.442***	2.256***	0.822***	1.669***
16 - 24 years	(0.221)	(0.226)	(0.124)	(0.162)
Age of head of household	1.388***	2.820***	0.861***	2.129***
25 - 34 years	(0.179)	(0.182)	(0.1)	(0.131)
Age of head of household	0.562**	1.848***	0.352***	1.400***
35 - 44 years	(0.184)	(0.19)	(0.101)	(0.136)
Age of head of household	0.765***	1.475***	0.472***	1.098***
45 - 54 years	(0.172)	(0.177)	(0.095)	(0.126)
Age of head of household	0.430*	1.329***	0.229	1.015***
55 - 60 years	(0.214)	(0.214)	(0.119)	(0.154)
Total household income	-2.127***	-0.362	-1.230***	-0.409**
0-25th percentile	(0.192)	(0.193)	(0.11)	(0.14)
Total household income	-0.987***	0.089	-0.662***	-0.052
25-50th percentile	(0.176)	(0.164)	(0.101)	(0.119)
Total household income	-0.183	0.544***	-0.197*	0.309**
50-75th percentile	(0.167)	(0.149)	(0.096)	(0.108)
Education Level 2	0.152	0.532**	0.082	0.384**
	(0.173)	(0.18)	(0.095)	(0.126)
Education Level 3	-0.023	1.760***	-0.015	1.272***
	(0.183)	(0.189)	(0.102)	(0.134)
Region 2	0.306	-0.199	0.207*	-0.132
	(0.164)	(0.161)	(0.094)	(0.117)
Region 3	0.704***	-0.224	0.460***	-0.177
	(0.156)	(0.153)	(0.089)	(0.111)
Region 4	0.146	-0.405*	0.12	-0.298*
	(0.18)	(0.175)	(0.102)	(0.126)
Married	0.791***	0.005	0.454***	0.009
	(0.126)	(0.119)	(0.071)	(0.086)
White	0.2	0.394***	0.237***	0.296***
	(0.115)	(0.113)	(0.064)	(0.081)
No. of Children	0.051	-0.159***	0.052	-0.120***
	(0.048)	(0.048)	(0.028)	(0.034)
Currently Employed	0.810***	0.603***	0.465***	0.384***
	(0.13)	(0.141)	(0.071)	(0.102)
Health Status	-0.157	-0.414**	-0.085	-0.334***
	(0.135)	(0.137)	(0.074)	(0.098)
Constant	1.237***	1.115***	0.541**	0.896***
	(0.298)	(0.301)	(0.167)	(0.217)
No. of Obs	7604	7481	7677	7735

[1] Source: Panel Study of Income Dynamics, Wave 2005.

[2] Robust standard errors are in parentheses. *** significant at 1% level;** significant at 5% level;* significant at 10% level;

Table 2: Tobit Model (Marginal Effects Evaluated at Mean)

	Model 1 ln(Car Loan) (Total)	Model 2 ln(Other Debts) (Total)	Model 3 ln(Car Loan) (Monthly)	Model 4 ln(Other Debts) (Monthly)
ln(Mortgage)	0.063***	0.128***		
(Total)	(0.01)	(0.012)		
ln(Mortgage)			0.051***	0.140***
(Monthly)			(0.009)	(0.013)
Age of head of household	2.512***	3.209***	1.442***	2.362***
16 - 24 years	(0.418)	(0.362)	(0.247)	(0.261)
Age of head of household	1.885***	3.606***	1.124***	2.692***
25 - 34 years	(0.273)	(0.269)	(0.16)	(0.193)
Age of head of household	0.922***	2.430***	0.549***	1.817***
35 - 44 years	(0.253)	(0.268)	(0.145)	(0.191)
Age of head of household	1.191***	2.034***	0.710***	1.501***
45 - 54 years	(0.246)	(0.247)	(0.142)	(0.176)
Age of head of household	0.869**	1.912***	0.491**	1.444***
55 - 60 years	(0.286)	(0.301)	(0.164)	(0.216)
Total household income	-1.998***	-0.379	-1.111***	-0.407**
0-25th percentile	(0.139)	(0.21)	(0.076)	(0.147)
Total household income	-0.645***	0.219	-0.417***	0.059
25-50th percentile	(0.142)	(0.184)	(0.077)	(0.129)
Total household income	-0.068	0.660***	-0.087	0.401***
50-75th percentile	(0.134)	(0.166)	(0.073)	(0.117)
Education Level 2	0.258	0.944***	0.153	0.687***
	(0.237)	(0.255)	(0.135)	(0.181)
Education Level 3	0.12	2.219***	0.082	1.592***
	(0.238)	(0.254)	(0.135)	(0.18)
Region 2	0.305	-0.23	0.188	-0.152
	(0.176)	(0.179)	(0.101)	(0.129)
Region 3	0.727***	-0.24	0.450***	-0.188
	(0.165)	(0.172)	(0.093)	(0.123)
Region 4	0.195	-0.376*	0.142	-0.272*
	(0.186)	(0.187)	(0.106)	(0.134)
Married	0.789***	-0.023	0.446***	-0.016
	(0.122)	(0.136)	(0.068)	(0.096)
White	0.264*	0.436***	0.236***	0.327***
	(0.114)	(0.125)	(0.063)	(0.089)
No. of Children	0.063	-0.160**	0.053*	-0.119**
	(0.048)	(0.054)	(0.027)	(0.038)
Currently Employed	0.997***	0.793***	0.555***	0.524***
	(0.134)	(0.155)	(0.075)	(0.111)
Health Status	-0.125	-0.489**	-0.054	-0.393**
	(0.161)	(0.174)	(0.09)	(0.124)
N. of Obs	7604	7481	7677	7735

[1] Source: Panel Study of Income Dynamics, Wave 2005.

[2] Robust standard errors are in parentheses. *** significant at 1% level;** significant at 5% level;* significant at 10% level;

[3] Marginal Effects $\frac{\partial \mathbb{E}[ln(y)|ln(M),X]}{\partial x_j}$ are evaluated at the mean.

Table 3: Specification Tests of Normality and Homoskedasticity Assumptions of Tobit Models

	Model 1 ln(Car Loan) (Annual)	Model 2 ln(Other Debts) (Annual)	Model 3 ln(Car Loan) (Monthly)	Model 4 ln(Other Debts) (Monthly)
	(1)	(2)	(3)	(4)
Test of Normality				
Test Statistic	2048.313	4213.098	2083	3828.944
	(0.000)	(0.000)	(0.000)	(0.000)
	7.336	7.003	6.669	7.215
Test of Homoskedasticity				
Test Statistic	5488.287	6492.9	5892.421	6160.425
	(0.000)	(0.000)	(0.000)	(0.000)

[1] Source: Panel Study of Income Dynamics, Wave 2005.
[2] P-values are in parentheses. All the standard errors and critical values are based on 500 bootstraps.

Table 4: Informal Tests of Normality and Homoskedasticity Assumptions of Tobit Models

	Model 1		Model 2		Model 3		Model 4	
	β^{tobit}/σ	β^{probit}	β^{tobit}/σ	β^{probit}	β^{tobit}/σ	β^{probit}	β^{tobit}/σ	β^{probit}
ln(Mortgage)	0.018	0.021	0.03	0.035	0.027	0.03	0.045	0.052
Age of head of household 16 - 24 years	0.566	0.614	0.639	0.656	0.577	0.61	0.647	0.656
Age of head of household 25 - 34 years	0.476	0.529	0.746	0.776	0.505	0.542	0.766	0.782
Age of head of household 35 - 44 years	0.248	0.261	0.516	0.504	0.265	0.271	0.532	0.51
Age of head of household 45 - 54 years	0.315	0.337	0.438	0.425	0.336	0.348	0.446	0.429
Age of head of household 55 - 60 years	0.228	0.235	0.401	0.377	0.232	0.232	0.417	0.387
Total household income 0-25th percentile	-0.706	-0.693	-0.089	-0.031	-0.72	-0.711	-0.133	-0.07
Total household income 25-50th percentile	-0.199	-0.198	0.05	0.108	-0.237	-0.235	0.019	0.085
Total household income 50-75th percentile	-0.02	-0.017	0.149	0.214	-0.047	-0.035	0.126	0.193
Education Level 2	0.075	0.076	0.216	0.206	0.08	0.084	0.218	0.21
Education Level 3	0.035	0.03	0.514	0.52	0.044	0.04	0.51	0.506
Region 2	0.087	0.106	-0.054	-0.061	0.097	0.11	-0.049	-0.056
Region 3	0.208	0.229	-0.056	-0.063	0.233	0.245	-0.06	-0.069
Region 4	0.056	0.056	-0.089	-0.104	0.073	0.073	-0.089	-0.1
Married	0.23	0.244	-0.005	-0.022	0.236	0.252	-0.005	-0.025
White	0.078	0.102	0.102	0.129	0.127	0.141	0.106	0.136
No. of Children	0.018	0.023	-0.037	-0.042	0.028	0.03	-0.038	-0.044
Currently Employed	0.318	0.332	0.189	0.205	0.322	0.328	0.173	0.192
Health Status	-0.036	-0.042	-0.111	-0.117	-0.028	-0.034	-0.123	-0.129
Constant	-1.212	-1.387	-0.767	-1.039	-1.358	-1.5	-0.739	-0.987

[1] Source: Panel Study of Income Dynamics, Wave 2005.

Table 5: Tobit, CLAD and SCLS Models (Coefficients)

	Model 1 ln(Car Loan) (Total)	Model 2 ln(Other Debts) (Total)	Model 3 ln(Car Loan) (Monthly)	Model 4 ln(Other Debts) (Monthly)
Tobit Model	0.205***	0.215***	0.184***	0.238***
	(0.034)	(0.02)	(0.034)	(0.023)
CLAD Model	0.046***	0.142***	0.036**	0.199***
	(0.015)	(0.025)	(0.018)	(0.033)
SCLS Model	0.087**	0.137**	0.065**	0.144**
	(0.029)	(0.02)	(0.03)	(0.024)

[1] Source: Panel Study of Income Dynamics, Wave 2005.

[2] Standard errors are in parentheses. The standard errors for Tobit models are robust standard errors.All the standard errors for CLAD and SCLS models are based on 500 bootstraps. *** significant at 1% level;** significant at 5% level;* significant at 10% level;

Table 6: Censored Quantile Regression Results

	Model 1 ln(Car Loan) (Total)	Model 2 ln(Other Debts) (Total)	Model 3 ln(Car Loan) (Monthly)	Model 4 ln(Other Debts) (Monthly)
$\alpha = .60$	0.037***	0.086***	0.024**	0.136***
	(0.008)	(0.013)	(0.01)	(0.021)
$\alpha = .65$	0.032***	0.072***	0.023***	0.124***
	(0.006)	(0.01)	(0.007)	(0.016)
$\alpha = .70$	0.025***	0.07***	0.02***	0.107***
	(0.005)	(0.01)	(0.006)	(0.013)
$\alpha = .75$	0.02***	0.056***	0.017***	0.084***
	(0.005)	(0.008)	(0.006)	(0.012)
$\alpha = .80$	0.015***	0.044***	0.017***	0.069***
	(0.005)	(0.007)	(0.006)	(0.012)
$\alpha = .85$	0.011**	0.034***	0.012**	0.057***
	(0.005)	(0.007)	(0.006)	(0.011)

[1] Source: Panel Study of Income Dynamics, Wave 2005.
[2] All the standard errors are based on 500 bootstraps. *** significant at 1% level;** significant at 5% level;* significant at 10% level;

Table 7: International Comparison: Probit Models (Marginal Effects evaluated at mean)

	Model 1 Any Car Loan (Total) (1)	Model 2 Any Other Debts (Total) (2)	Model 3 Any Car Loan (Monthly) (3)	Model 4 Any Other Debts (Monthly) (4)
		Panel A: U.S. PSID Data		
ln(Mortgage)	0.007***	0.014***		
(Total)	(0.001)	(0.001)		
ln(Mortgage)			0.015***	0.030***
(Monthly)			(0.003)	(0.003)
N. of Obs	7604	7481	7875	7735
		Panel B: U.K. BHPS Data		
ln(Mortgage)	.0004***	.006***		
(Annual)	(0.000)	(0.000)		
ln(Mortgage)			.001*	.001***
(Monthly)			(0.000)	(0.001)
N. of Obs	10708	12839	10708	12839

[1] Source: Panel Study of Income Dynamics and British Household Panel Survey, Wave 2005.
[2] Robust standard errors are in parentheses. *** significant at 1% level;** significant at 5% level;* significant at 10% level;

Table A1: Summary Statistics

Variable	Mean	Std. Dev.	Obs
ln(Car Loan) (Total)	40062.52	195863.4	7947
ln(Other Debts) (Total)	7988.88	34624.45	7803
ln(Car Loan) (Monthly)	120.84	449.95	7748
ln(Other Debts) (Monthly)	665.74	2885.37	7803
ln(Mortgage) (Total)	51784.42	93243.99	7668
ln(Mortgage) (Monthly)	1631.2	11081.01	7947
Age of head of household 16 - 24 years	0.08	0.26	7947
Age of head of household 25 - 34 years	0.23	0.42	7947
Age of head of household 35 - 44 years	0.22	0.41	7947
Age of head of household 45 - 54 years	0.22	0.42	7947
Age of head of household 55 - 60 years	0.09	0.28	7947
Age of head of household 60 and above years	0.16	0.37	7947
Total household income 0-25th percentile	0.25	0.43	7947
Total household income 25-50th percentile	0.25	0.43	7947
Total household income 50-75th percentile	0.25	0.43	7947
Total household income 75th and above percentile	0.25	0.43	7947
Education Level 1	0.08	0.26	7947
Education Level 2	0.43	0.49	7947
Education Level 3	0.5	0.5	7947
Northeast	0.14	0.34	7947
North Central	0.25	0.43	7947
South	0.43	0.5	7947
West	0.18	0.39	7947
Married	0.5	0.5	7946
White	0.61	0.49	7889
No. of Children	0.86	1.16	7947
Currently Employed	0.75	0.44	7940
Health Status	0.83	0.38	7909

[1] Source: Panel Study of Income Dynamics, Wave 2005.

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