Do High Debt Payments Hinder Household Consumption Smoothing?

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ABSTRACT

Over the past fifteen years, U.S. households have committed a rising share of their disposable personal income to required principal and interest payments on household debt such as mortgages, automobile loans and credit card balances. This rise in the household debt service ratio (DSR) has generated interest of late because it could potentially cause households to cut back on their spending. This direct link between household debt and consumption has been studied in the literature, but the results of these studies are mixed—perhaps because debt may not have a direct effect on consumption growth, but rather may alter the relationship between consumption and income. We explore this possibility by comparing the consumption smoothing behavior of households in the Consumer Expenditure Survey over the DSR distribution. Our approach has two advantages relative to the existing literature. First, it avoids the most obvious source of endogeneity between debt and spending by studying the indirect effect of the DSR on the ability to smooth consumption through income fluctuations. Second, this approach is to our knowledge the first serious look at household-level DSRs, which vary substantially both across time and households. Our results indicate that households with relatively high DSRs are no less able to smooth through income fluctuations than other households. Rather, households with low or zero DSRs appear least able to smooth. This finding suggests that recent rises in the aggregate DSR could be welfare-enhancing to the extent they were the result of increased credit access to low-income households documented elsewhere.

Introduction

Over the past fifteen years, U.S. households have committed a rising share of their disposable personal income to required principal and interest payments on household debt such as mortgages, automobile loans and credit card balances. This share, also known as the debt service ratio (DSR), equaled 14 ½ percent at the end of 2006, 3 ½ percentage points higher than it was at the end of 1991 (chart 1). What caused this rise and what are the potential consequences? First, the DSR rose in part because declines in interest rates over the decade ending in 2006 spurred the demand for debt, which all else equal will raise the DSR.[1] Second, the increase in the DSR may reflect the extension of mortgage and consumer credit to households who could not previously qualify (Johnson, 2005; Dynan, Johnson and Pence, 2003). Finally, the increase in the DSR may reflect changes in the credit card market. As more households use their credit cards as a convenient payment method, the increase in short-term, interest-free loans associated with convenience use may increase the DSR (Johnson, 2007).

Chart 1. Household Debt Service Ratio

[1] For a given level of debt, a fall in the interest rate will also reduce the debt payment, but this effect is small relative to the effect of a rise in debt on debt payments.

This rise in the DSR has generated interest of late because it could potentially cause households to cut back on their spending. This hypothesized link has been studied in the literature, but the results of these studies are mixed. Some researchers examined the link between aggregate household debt and consumption (Bachetta and Gerlach, 1997 and Ludvigson, 1999) and found that a rise in the growth of household debt raises the growth of consumption. However, over a more recent time period, Johnson (2007) found that a rise in the growth of revolving consumer debt reduces the growth of consumption. Other researchers focused on the link between aggregate payments on debt and consumption. Mishkin (1976) and McCarthy (1997) find that a rise in debt payments leads to lower expenditures on durable goods, but McCarthy (1997) and Maki (2002) conclude that it does not lead to lower overall spending. Finally, some looked at this link at the household level, studying the effect of exogenous changes in debt payments on household consumption, but their work is also inconclusive. Stephens (2005) concludes that non-durable expenditures respond to the repayment of a vehicle loan, whereas Coulibaly and Li (2006) conclude that only durable goods expenditure—such as household furnishings—respond to the repayment of a mortgage loan.

One reason for these seemingly contradictory results may be that debt does not have a direct effect on consumption growth, but rather may alter the relationship between consumption and income. In this paper, we explore this possibility by comparing the consumption smoothing behavior of households across the distribution of their DSRs. Importantly, this paper does not attempt to test whether household consumption is excessively sensitive to changes in income. Rather, we take the degree of consumption smoothing observed in the data as given and ask whether a high DSR hinders a household's ability to smooth through income fluctuations relative to a low DSR. To answer this question, we use the Consumer Expenditure Survey (CEX) because it contains comprehensive data on household-level consumption supplemented with information on household balance sheets.

Our approach has two advantages relative to the existing literature: First, because household credit is used to finance consumption, credit and consumption are jointly

determined. Previous studies of the relationship between aggregate credit and consumption generally addressed endogeneity with instrumental variables; studies at the household level viewed the maturing of a loan as a plausibly exogenous source of debt payment variation. Our approach avoids this most obvious source of endogeneity by studying the indirect effect of the DSR on the ability to smooth consumption through income fluctuations.

Second, to our knowledge, this approach is the first serious look at household-level DSRs, which vary both across time and households. Although the average DSR in our data fluctuates no more than the aggregate DSR, this smoothness masks a considerable amount of heterogeneity. This cross-section variation provides better identification than regressions using aggregate data and permits us to control for a variety of household characteristics. Also, by looking at the effect over different cross-sections of households, we can better understand the relationship between household debt and consumption.

Our results indicate that households with relatively high DSRs are no less able to smooth through income fluctuations than other households. Rather, households with low or zero DSRs appear least able to smooth. This finding suggests that recent rises in the aggregate DSR could be welfare-enhancing to the extent they were the result of increased credit access to low-income households documented elsewhere (Johnson, 2005; Dynan, Johnson and Pence, 2003).

Related Literature

The literature to date presents conflicting evidence about the link between household debt and consumption. Some studies have found a relationship between certain measures of debt and certain measures of consumption. Others have found no relationship at all. This literature has generally taken one of three perspectives.

The first set of papers took an economy-wide perspective and involved regressing the expected growth in various measures of aggregate household debt on the growth in various measures of aggregate consumption. Bacchetta and Gerlach (1997) observed that expected growth in mortgage and consumer credit, as well as the wedge between

borrowing and lending rates in the United States, are positively correlated with the growth in nondurable goods and services expenditures. They suggest that consumption therefore plays an important role in the transmission of monetary policy because it is influenced by the cost and availability of credit. Similarly, Ludvigson (1999) discovered that a one percentage point rise in anticipated consumer credit growth is correlated with a 0.1 percentage point rise in the growth of nondurable goods and services expenditures. She also demonstrates how her finding may be consistent with significant variation in consumer credit ceilings. On the other hand, McCarthy (1997) found only a negligible link between household credit and nondurable goods and service expenditures, but a more significant link between credit and durable goods expenditures. Johnson (2007) also observed a negligible link between household credit and total expenditures, and a negative link between growth in credit card debt and total household expenditures.

The second set of papers also took an economy-wide perspective, but focused on debt payments rather than levels of debt. The conclusions of these papers are more consistent and in general are that debt payments influence expenditures on durable goods, but these effects are not large enough to show through to overall spending. Maki (2002) ascertained that the DSR does not add information to a model of the growth of consumption that includes past growth of consumption, the growth of income, wealth and the real federal funds rate as regressors. McCarthy (1997) learned it does enter significantly into a similar model of the growth in expenditures on durable goods. In this specification, a one basis point rise in the DSR leads to a 5 basis point decline in the annual rate of growth in durable goods expenditures in the following period. Mishkin (1976) also finds a negative relationship between consumer liabilities and durable expenditures in a stock adjustment model.

The final perspective taken in the literature is that of the individual household, and here the evidence is more mixed. Stephens (2005) found that "an anticipated 10 percent increase in discretionary income due to [an auto] loan repayment leads to a 2 to 3 percent increase in non-durable consumption." In contrast, Coulibaly and Li (2006) observe that households do not increase their non-durable consumption following the retirement of

their mortgage, but do increase durable goods consumption, such as home furnishings and entertainment equipment.

The evidence in the literature to date is not only contradictory, but hard to interpret because of the number of different ways debt payments may affect consumption. First, interest rates help jointly determine both debt payments and consumption. When interest rates fall, households borrow more to pull forward a portion of future consumption, creating a positive relationship between debt payments and consumption. For a given level of debt, a fall in the interest rate will also reduce the debt payment, but given the maturity of most household loans, this effect is small relative to the effect of a rise in debt on payments.

Second, debt payments may be correlated with household consumption because they are an indicator of expected future income growth. As households become more confident that their income will rise in the future, they become more willing to commit themselves to future debt repayment. Under this hypothesis, the relationship between debt payments and future consumption is also positive.

The third and fourth channels relate to durable goods. A rise in a household's debt payments raises the probability that a household will find itself in financial distress and need to sell its durable good assets for less than their full value. Thus, households with higher debt payments should be less willing to hold durable goods and more willing to hold liquid financial assets, creating a negative relationship between debt payments and durable goods expenditures. Also, many households finance durable goods purchases with consumer credit, which allows households to better match the payment stream for these durables with the consumption of their services. Because durable goods purchases are lumpy, a surge in expenditures in one period, which in turn leads to higher debt payments, will likely result in a decline in expenditures in the following period. Thus, under this hypothesis, debt payments and durable goods expenditures are negatively related.

In the final channel, household debt payments may also be correlated with household consumption because some households are borrowing constrained. Borrowing

constraints, it has been argued, can create either a positive or a negative relationship between the DSR and consumption. Some have argued that a rise in the DSR suggests that some households have reached their borrowing limit and cannot increase their consumption as rapidly as they had in the past. Others argue that a rise in DSR suggests a relaxation of credit constraints so that some households can increase their consumption more than in the past.

The five channels through which debt payments can influence consumption are summarized in table 1.

Table 1: Channels through which Debt Payments may affect Consumption

Channel	Implied relationship
Interest rates	Positive
Expectations of future income growth	Positive
Durable goods	
Potential financial distress	Negative
Infrequent purchases	Negative
Liquidity constraints	Positive or Negative

Rather than attempt to reconcile these disparate findings, we will take a perspective not yet taken by the literature. We will explore the possibility that debt payments may not have a direct effect on consumption growth, but rather may alter the relationship between consumption and income. The framework we will use to study this indirect effect is outlined below.

Conceptual Framework and Model Specification

Assume households maximize discounted sum of lifetime utility,

(1) $$\max \sum_{t=0}^{\infty} \delta^t U(C_t,\ \theta_t),$$

subject to the constraint

(2) $$A_{t+1} = A_t(1+r) + Y_t - C_t \qquad -\infty < A_t < +\infty,$$

and a transversality condition

(3) $\lim_{T \to \infty} A_T \geq 0$,

where $\delta < 1$ is the discount factor, C_t is period t consumption, θ_t is a scalar function of a household demographic characteristics vector that would affect the marginal utility, A_t is net assets, which are negative if the household is a net borrower, and Y_t is labor income. Further assume that households have constant relative risk aversion (CRRA) preference and the utility function is given by

(4) $U(C_t,\ \theta_t) = \frac{C_t^{1-\rho}}{1-\rho} \times e^{\theta_t}$,

In an economy with complete information and perfect financial markets, the first order condition of households can be written as the Euler equation

(5) $\Delta \log(C_t) = \alpha + \beta\ \Delta\theta_t$,

where α and β are linear functions of the parameter in equations (1) – (4). Although these assumptions imply that consumption growth is correlated only with demographic changes and not with income growth, econometricians have typically studied the model below that nests equation (5) as a special case.

(6) $\Delta \log(C_t) = \alpha + \beta\ \Delta\theta_t + \gamma\ \Delta \log(Y_t) + \varepsilon_t$.

The coefficient γ reflects the degree that consumption is sensitive to fluctuations in current income. According to the permanent income hypothesis, $\gamma = 0$ because consumption is sensitive only to news about permanent income, and not to changes in current income. However, if the complete information and perfect financial market assumptions are not satisfied, γ can deviate from 0. For example, $\Delta\log(Y_t)$ may contain new and unanticipated information about permanent income. The response of consumption depends on the persistence of the income changes. Typically, consumption reacts more to a persistent income change than to a transitory income change. In the extreme case, if the income shock is permanent, consumption should respond one-to-one to the income change. Consumption changes may also be sensitive to income changes because financial markets may not be perfect. A borrowing-constrained household will

react even to anticipated changes in income because it cannot borrow to smooth consumption against the changes.

In this work, we recognize that household consumption can react to changes in current income for various reasons and ask whether the size of this reaction depends on the household's current debt payments. According to one hypothesis, increases in debt render households more sensitive to shocks to income (Debelle, 2004). As a household increases unalterable expenditures on debt payments, a smaller share of its income is discretionary, and it must cut back consumption in response to even small drops in income. Although the household has borrowed to finance consumption in the past, this hypothesis presumes it has reached it borrowing limit. The presumption that some households are approaching a borrowing limit is not unreasonable. By one estimate, fourteen percent of bankcard accounts have less than ten percent of their credit card limit available (Gross and Souleles, 2002). In addition, about fifteen percent of mortgages in 2006 were within ten percent of the value of the mortgaged property (Cagan, 2007).

Have some households reached a level of borrowing that hinders their ability to smooth through future income fluctuations? To answer this question, we must change several aspects of equation (6). First, the parameters will be estimated using household-level data, so the variables will be indexed by households, rather than by time. Second, the equation includes dummy variables for the year and month of the household's observation to capture any effect of macroeconomic and seasonal factors on consumption growth. Third, the change in income is interacted with a variable that measures the household level of debt payments. These changes result in equation (6') below:

$$(6') \quad \Delta\log(C^i) = \alpha + \beta\ \Delta\theta^i + \sum_{q=1}^{Q}(\gamma_q \times D_q^{\ i})\ \Delta\log(Y^i) + \xi \times Year^i + \eta \times Month^i + \varepsilon_i,$$

where D_q^i is a dummy variable that is equal to one if and only if the DSR of household i belongs to the qth ranked group, and equal to zero otherwise. γ_q is the qth DSR group-specific sensitivity to current income changes. We rank household DSRs in ascending order. For example, households in group 2 have a higher DSR than households in group

1. Thus, if a higher DSR hinders the household's ability to smooth consumption, we will observe:

(7) $\gamma_{q_1} > \gamma_{q_2}$ if $q_1 > q_2$,

suggesting that consumption is more responsive to current income fluctuations for households with a higher DSR.

Households will be segregated into DSR group according to their ex ante DSR. That is, if consumption growth is calculated as $C_{t+1} - C_t$, we use the DSR measured at time t, rather than at time $t+1$, to rank the households. Using the ex ante DSR alleviates the problem of the endogeneity between debt and consumption.

Importantly, this paper does not attempt to test whether household consumption is excessively sensitive to changes in income, so we will not distinguish temporary income changes from permanent income changes. We will assume that all households share the same income processes and all shocks to income are drawn from the same distribution. Thus, every income change that we observe has the same expected persistence, regardless of the identity of the household or its income history. With these assumptions, we can identify the effect of the DSR on the response of consumption changes to income changes.

Finally, we focus on the response of nondurable goods consumption to changes in income because our data measures expenditures on these goods, which, unlike durable goods, closely approximates their consumption.

Data and Empirical Issues[2]

We will estimate equation (6') using data from the Consumer Expenditure Survey (CEX) Interview Survey. The CEX has been conducted since the early 1980's by the Bureau of Labor Statistics to provide weights for the market basket used to construct the Consumer Price Index. We restrict our sample to households interviewed after 1990 because prior surveys did not collect data on auto loans or credit card debt, which are important to calculate the DSR for each household. In the most recent waves of the

[2] See the data appendix for a full description of each of the variables used in the following analysis.

quarterly interview survey, the BLS collected data from more than 7,500 non-institutionalized households on their monthly out-of-pocket expenditures. Each household is given an initial (first) interview that collects basic information and is subsequently interviewed once per quarter for four consecutive quarters. To estimate equation (6'), we will use the debt payment data collected during the second interview and the change in household income and consumption collected in the second and the fifth interviews.

Measurement of debt payments in the Consumer Expenditure Survey

As part of its expenditure data collection, the BLS asks households to report its payments on household debt, including mortgages, vehicle loans and other consumer debt, which will make up the majority of debt payments in our measure. Mortgage debt payments accounts for close to 60 percent of total debt payments, vehicle debt accounts for about 20 percent and the remainder is accounted for by credit card debt.

As noted by the BLS, "consumer expenditure surveys are specialized studies in which the primary emphasis is on collected data related to family expenditures for goods and services used in day-to-day living." (BLS 2006) As such, many studies validating the CEX data focused on its ability to replicate aggregate measures of consumption, such as personal consumption expenditures (PCE) reported quarterly by the Bureau of Economic Analysis (BEA). In general, these validation studies (see for example, Gieseman, 1987; Branch, 1994) conclude that aggregate expenditures reported in the CEX are below those reported by the BEA, but this underreporting appears fairly constant over time so that changes in consumption at the aggregate level appear to be well-captured by the CEX. That said, changes in consumption at the household level vary considerably from household to household, perhaps a result of measurement error. To the extent that this measurement error is uncorrelated with the regressors in equation (6'), it will be captured by the error term of the equation and will not bias our estimates of β.

Although validation studies have been conducted on the consumption data in the CEX, we are unaware of any study that validated the CEX liability data. Thus, before

proceeding, we compare household debt payments measured in the CEX with that measured in the Survey of Consumer Finances (SCF). The SCF is a triennial survey conducted by the Federal Reserve System that collects high-quality data on household wealth holding and debt balance and payments as well as very rich covariates such as household demographics and income data. We presume the accuracy of the SCF data and compare its debt payment information with that of the CEX. In general, this exercise has increased our confidence that debt payments for the major types of household debt are measured reasonably well in the CEX.

Debt payments in the CEX and the SCF

Many of the types of debt covered by the CEX have similar counterparts in the SCF (table 2). Both the CEX and the SCF report payments on first mortgages, home equity loans and lines of credit on the household's primary residence. However, for debt collateralized by other properties, the SCF reports only total payments, while the CEX breaks these payments down by loan type (first lien, home equity loan, etc.). Both the CEX and the SCF includes payments on vehicle loans, and the amount of credit card debt, which can be used to estimate its required monthly payment.[3] Finally, for other types of loans, the CEX reports only total payments on "other personal loans", whereas the SCF provides more detail, breaking payments down by loan type (student loans, installment loans, other lines of credit and personal loans). Because it is difficult to reconcile both the concept and measurement of the "other loans" category between the two surveys, we include only payments on loans secured by real estate and automobiles, and credit card loans in our measure of debt payments.

[3] We do not use household's reported payments on credit card debt in part because respondents are asked to include only interest payments. Thus, debt service on credit card debt is calculated using the concept employed by the Federal Reserve System in their aggregate DSR measure. That is, households are assumed subject to a minimum credit card payment of 2 ½ percent of their outstanding credit card balance.

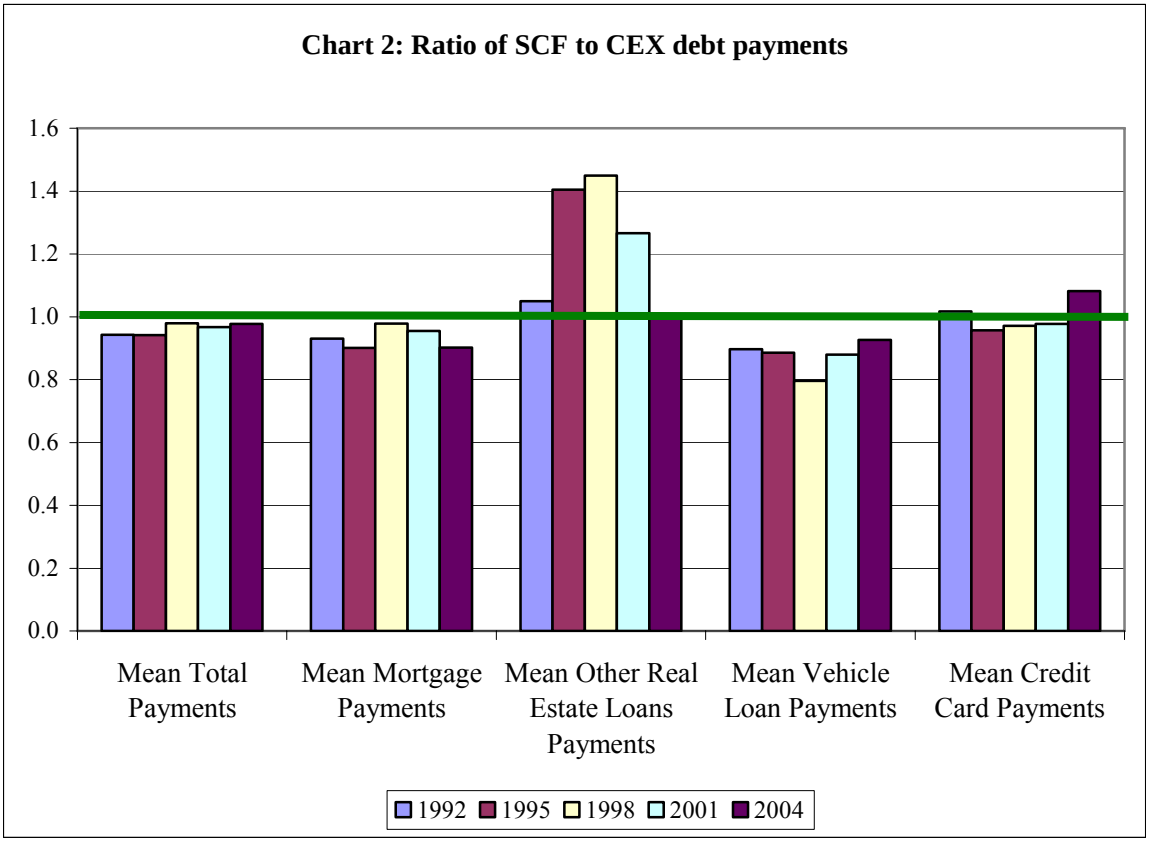
Table 2: Summary of Debt Payment Variables in the SCF and CEX

SCF Debt Payment Variables	CEX Debt Payment Variables
1. Primary residence mortgages	Primary residence mortgages
2. Home equity loans secured by primary residence	Home equity loans secured by primary residence
3. Lines of credit secured by primary residence	Lines of credit secured by primary residence
4. Mortgages, home equity loans and lines of credit on vacation homes and other properties	Mortgages, home equity loans and lines of credit on vacation homes and other properties a. Mortgages on vacation homes and other properties b. Home equity loans on vacation homes and other properties c. Lines of credit on vacation homes and other properties
5. Vehicle loans	Vehicle loans
6. Credit cards	Credit cards
7. Other consumer loans a. Student loans b. Installment loans c. Other lines of credit d. Personal loans	Other consumer loans

Broadly speaking, the level of total household debt payments for these three types of debt calculated from the CEX sample lines up fairly well with that calculated from the SCF sample (chart 2).[4] For each wave of the SCF from 1992 through 2004, the mean of total household debt payments calculated from the CEX sample is within about 5 percent of the mean from the SCF sample for the corresponding year, with an average gap over the five SCF waves of about 3 percent.[5]

[4] CEX respondents report payments for each quarter, whereas SCF respondents report average monthly debt payments so all payments were converted to an annual rate. In addition, we compared the CEX respondents who were first interviewed in the year corresponding to a SCF wave. Because CEX respondents were interviewed for several successive quarters, this implies that some of the CEX debt payment data may have been collected in the following year. Underlying data are shown in appendix table A1.

[5] Each of the means are weighted using sampling weights and thus represent the average debt payment for all households in the United States. For a full discussion of the sampling weights in each of the surveys, see Kennickell and Woodburn (1997) and Bureau of Labor Statistics (2007).



Much of the accuracy in the CEX data reflects mortgage payments on primary residences; on average over the four SCF waves, the mean of debt payments on primary residence mortgages calculated from the CEX sample is within 6 percent of that calculated from the SCF sample. The SCF data, in turn, aligns closely with that from the Residential Finance Survey, a survey in which chosen households are required by law to participate and incorporates information from lenders (Bucks and Pence, 2006). This alignment strongly suggests the mortgage payment data in the CEX are reported accurately, consistent with Froncznek and Koons (1976).

Loans for real estate other than the household's primary residence and for automobiles align less closely between the CEX and SCF. The gap between loans for other real estate calculated from the CEX and that calculated from the SCF is about 22 percent, but payments on these loans account for only about 10 percent of total payments. The gap between payments on automobile loans measured by the two surveys, which

account for about 20 percent of total payments, is only about 12 percent. Finally, minimum required payments on credit cards are closely aligned between the two surveys, with a gap of less than one percent over the five waves of the survey.[6]

Debt payments measured by the CEX sample also display patterns across demographic groups similar to patterns in debt payments measured by the SCF sample. Many of these differences across demographic groups mirror those of household income. Total debt payments in the CEX rise with the age of the household head until around age 45 and then fall steadily—a pattern mimicked by all types of debt (table 3). Households whose head is white have higher debt payments on average than those whose head is nonwhite. Debt payments also rise with education—households whose head has at least a college degree had nearly 4 ½ times more debt payments than those whose household head has less education. Finally, married households had over twice the debt payments of unmarried households. Each of these patterns is also evident in debt payments measured by the SCF sample.

Table 3: Debt Payments, by demographics and household survey

	Total Debt Payments		Mortgage		Other Real Estate		Vehicle		Credit Card	
	SCF	CEX	SCF	CEX	SCF	CEX	SCF	CEX	SCF	CEX
Age < 35	7093	7863	3879	4634	544	344	2071	2260	599	625
35 - 45	11452	12073	7705	7961	717	810	2329	2664	701	638
45 - 55	12002	11392	7912	7256	1432	1120	2021	2237	637	779
55 - 65	9441	9652	5639	5739	1858	1414	1437	1954	508	546
65 - 75	5453	5210	3226	3461	1098	513	670	953	459	284
Age > 75	1350	2676	711	1924	232	127	303	399	104	226
White	9374	9265	5932	5873	1130	803	1740	2009	571	581
Nonwhite	6295	5952	3759	3523	468	463	1578	1469	490	497
Lower than HS	3001	3720	1679	2300	231	163	913	1013	178	243
HS	6373	7164	3536	4166	626	718	1703	1814	508	467
Some College	8324	9220	4962	5463	704	669	1957	2428	702	659
College and Above	13514	13399	9123	9301	1774	1249	1931	2098	686	752
Married	11509	11815	7383	7597	1309	993	2190	2565	627	661
Unmarried	4219	5288	2380	3221	446	475	957	1149	435	443

Overall, debt payments in the CEX appear to be fairly accurately measured relative to those in the SCF, with debt payments for primary mortgages and for credit cards the most

[6] Because credit card debt service is a constant share of credit card debt outstanding, the congruence between required debt payments in the two surveys reflects that of credit card debt outstanding.

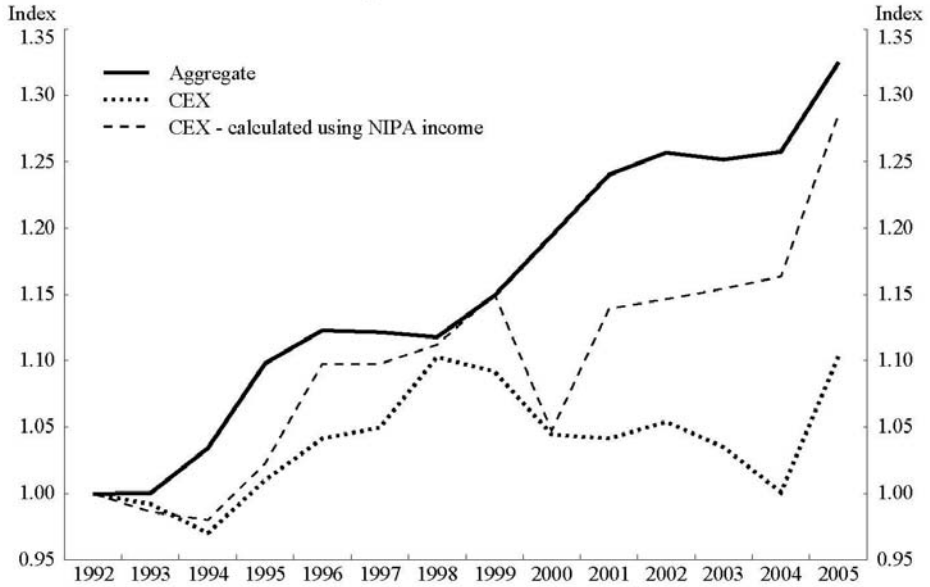
similar between the two surveys and those for mortgages on other real estate and automobile loans less similar.

Debt payments in the CEX and in the aggregate

Over the period covered by our CEX sample (1992-2005), the aggregate DSR rose 35 percent, whereas the ratio of total debt payments in the CEX to total income rose only modestly (chart 3). Much of this discrepancy is owing to differences in income between the CEX and National Income and Product Accounts (NIPA); movements in debt payments calculated from the CEX data compare favorably to the aggregate measure. Average debt payments in the CEX divided by NIPA income per household rose by nearly as much as the aggregate DSR, although the variation over time was much greater. This suggests that our measure of CEX income grew faster than NIPA income, perhaps owing to differences in income concept or measurement. [7]

[7] For example, NIPA income includes employer contributions to pensions and insurance. One CEX validation study suggested that several sources of household income are underreported relative to data from the Current Population Survey, including property income, unemployment compensation, workers' compensation, and veterans' benefits (Branch, 1994).

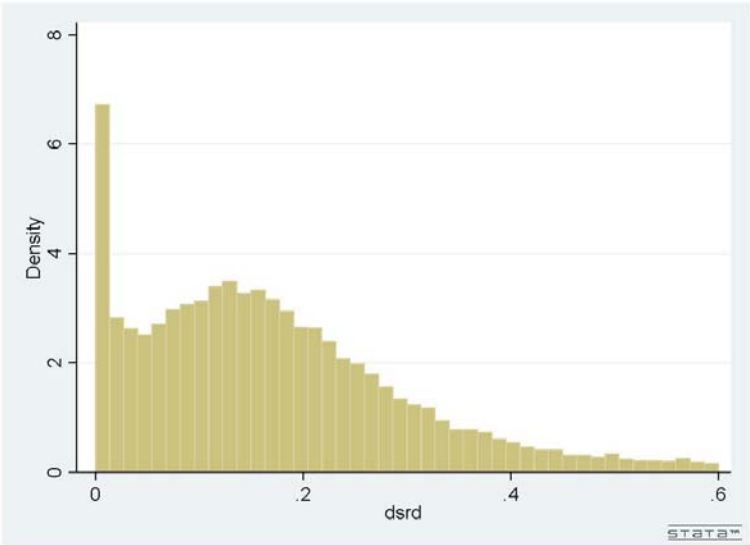
Chart 3. Aggregate and Household-level Debt Service Ratios, growth since 1992



One of the difficulties in detecting a relationship between the aggregate DSR and consumption is that the aggregate DSR has very little quarter to quarter variation; the standard deviation of the quarterly DSR is only one percentage point and its average absolute change is only 12 basis points.

The average DSR calculated from the CEX data has a standard deviation over time that is half that of the aggregate, but this smoothness masks a considerable amount of cross section variation (chart 4). Thus, any affect of debt payments on consumption will likely be identified from cross-section, rather than time series variation.

Chart 4. Distribution of DSR in Consumer Expenditure Survey



Measurement of income in the Consumer Expenditure Survey

Another concern is the measurement of income in the CEX. Although no study has validated individual household income in the CEX, studies of other surveys suggest that individual income is subject to substantial over- and under-reporting (Bound, et. al., 2001). Relevant to our analysis, differencing income increases the variance due to measurement error. If the measurement error is correlated with measured income then ordinary least squares (OLS) estimates of γ, the coefficient on income growth, will be biased towards zero, suggesting that all households well-smooth consumption through future income fluctuations.

Several studies suggest that measurement error in income growth is non-classical, so the standard correction using instrumental variable (IV) estimation is invalid. In general, these studies find that measurement error in income growth violates the classical error-in-variables assumption that the error is independent of true income growth. Gervais and Klein (2006) point out that this violation can be induced by the structure of the CEX. They argue that in a model of consumption smoothing, "true" income growth is measured over the same time period as consumption growth. However, in each CEX interview, consumption includes expenditures made over the previous quarter, while income

includes earnings over the previous four quarters, so measured income growth in the CEX is only an approximation of true income growth. The particular asynchronicity between consumption growth and income growth can be shown to imply that under some income processes, the error in approximation may be negatively correlated with true income growth.[8] In addition, income validation studies of other surveys, such as the Current Population Survey (Bound and Krueger, 1991) and the Panel Study of Income Dynamics (Bound, et.al., 1994), suggest that measurement error in income growth is mean-reverting, rather than independent of the true value of income growth.

These validation studies also suggest that the bias caused by measurement error in income growth is not overwhelming. Bound and Krueger (1991) regress the "true" value of income growth on the measured value; their results imply a 23 percent downward bias in OLS estimates for men and a 15 percent downward bias for women. A similar regression in Bound, et.al (1994) imply a 23 percent downward bias in OLS estimates. Because measurement error in income is non-classical, we will estimate equation (6') using OLS rather than use an IV technique, but will keep in mind the effects of measurement error on our estimates. We will, however, maintain the assumption that the measurement error in income is independent of the household DSR.

To help ensure that the measurement error in income is independent of the DSR, we will use expected household income in the denominator of the DSR. Expected income equals fitted income from a regression of the average income from each household's second and fifth interview on the age of the reference person, age squared, age cubed, and dummy variables for non-white reference person, high school graduates, and college graduates. Using fitted income will also help ensure that our DSR measure is independent of the household's subsequent growth in income. To see this, suppose the DSR were calculated using debt payments and income collected during the second interview. If income is mean-reverting, households with temporarily low income would

[8] Whether this asynchronicity is an issue depends on households' income process. If income growth is constant over time (for example $y_t = \alpha y_{t-1}$), the CEX approximation will equal true income growth and measurement error equals zero. However, if income growth is time-dependent (for example: $y_t = \alpha^{t-1} y_{t-1}$) the measurement error will be negatively correlated with true income growth.

have both a high DSR and high income growth, creating a positive relationship between the DSR and income growth. Using expected income avoids this problem.

Sample and Variables in Regression Analysis

Our sample is based upon all respondents to the 1991 through 2004 Consumer Expenditure Survey. We restricted our sample to observations that included valid information for consumption, income, selected household demographics and debt payments to income. Because our debt payments variable had some fairly large outliers, we dropped the observations in the highest and lowest one percent of the debt service ratio distribution. Finally, we eliminated most households whose head is a student or a retiree by choosing households whose head is between 25 and 64 years of age. Our final sample included 24,664 observations.

In the final sample, a bit more than half of the household heads earned only a high school diploma, a third earned a college degree, and the remainder had not completed high school (table 4).[9] Household heads in the sample are on average 42 years old, about 65 percent are married and 10 percent are black. The households in the sample had between two and three members, on average; they earned $58,000 in total income the year of their interview and spent approximately $38,000 on consumption goods.

[9] The proportions and means presented in this section are intended to paint a picture of the sample used for estimation, and as such are not weighted by the CEX population weights.

Table 4: Mean Characteristics of CEX Respondents

Characteristics	CEX Sample	U.S. Households 1995 - 2002
Characteristics of household head		
Distribution by educational attainment		
Did not complete high school	10.58	17.01
High school graduate	56.11	57.68
College graduate	33.30	25.32
Age	42.03	48.56
Married	64.15	52.99
Black	9.47	12.08
Household size	2.94	2.62
After-tax household income	58,172	48,572

Note: Income for U.S. households is averaged over 1991 - 2002.
Expenditures exclude debt payments.
Source: Consumer Expenditure Survey, U.S. Census Bureau Current Population Survey, Federal Reserve

Although we dropped observations with incomplete data, and those with exceptionally high or low debt service ratios, the final sample is not unlike the overall population of U.S. households. The educational attainment of the head of household is distributed quite similarly, although a lower proportion did not complete high school and a slightly higher proportion completed college. Heads of households in the CEX sample are about six years younger than those in the U.S. population, a higher proportion of them are married and a lower proportion are black than heads of households in the population, but each of these differences is fairly small. Finally, the households in the sample earned about $10,000 more than the average household in the U.S. population from 1991 to 2002. Some of this difference may be owing to the measurement of income taxes in the CEX. Most of these differences are explained by the restriction of the sample to 25-64 years old; removing this restriction brings the CEX averages quite close to those in the U.S. population.

Smoothing variation in income

Basic result on consumption smoothing

Recall our baseline specification:

$$(6') \quad \Delta\log(C^i) = \alpha + \beta\ \Delta\theta^i + \sum_{q=1}^{Q}(\gamma_q \times D_q^{\ i})\ \Delta\log(Y^i) + \xi \times Year^i + \eta \times Month^i + \varepsilon_i$$

with the vector $\Delta\theta^i$ comprised of the household demographic characteristics listing in table 4. As shown in Table 5, the OLS parameters, estimated using our CEX data, appear sensible. The estimated sensitivity of consumption to income is similar to that found by Dynarski and Gruber (1997); a one percentage point rise in income leads to a 7 – 10 basis point rise in consumption.[10] Other coefficients have intuitive signs; with each additional family member, consumption grows about 6 basis points faster. Consumption grows a touch slower among households with a nonwhite household head and slightly faster among married households and households whose head earned a high school or college diploma.

[10] This estimate is likely attenuated by measurement error, so that in all future tables, we will report both the OLS and IV estimates of the Euler equation parameters.

Table 5: Growth in Household Consumer Expenditures and the DSR.
(standard errors below parameter estimates)

	Nondurable
Growth in income	0.066 **
	0.005
Age of the household head	-0.019
	0.063
agesq/100	0.087
	0.224
agecu/10000	-0.171
	0.343
agefo/1000000	0.120
	0.192
Change in family size	0.067 **
	0.004
Non-white	-0.014 *
	0.007
High school graduate	0.016 **
	0.007
College Graduate	0.021 **
	0.007
Married	0.016 **
	0.005

**5 percent; * 10 percent

Heterogeneity in consumption smoothing, by access to credit

Next, households with different debt service ratios are allowed to smooth consumption differently. Households are placed into one of three groups: the first group includes households who have no debt payments, the second group includes households whose debt service ratio is below the 75th percentile of the distribution of positive debt

service ratio and the third and final group includes households whose debt service ratio is above the 75th percentile.

The first group composes about 13 percent of the CEX sample, but only 6 percent of total income and about 7 ½ percent of total consumption in the sample (table 6). The lack of debt among households in this group appears to reflect a lack of supply, rather than a lack of demand. The demographic and financial characteristics of this group resemble those of households with a high probability of being turned down for credit (Jappelli, 1990). Twenty percent of households with no debt payments have a non-white household head, compared to about nine percent of households with positive debt payments. The head of a household with no debt payments is more than twice as likely to be without a high school diploma, and is only half as likely to be married as the head of a household with positive debt payments. Finally, households with no debt payments earn significantly less income, on average, and have less than half the liquid assets of households with positive debt payments.

Table 6: Characteristics of 2003 CEX Sample, by DSR group

	DSR = 0	< 75 percentile	> 75 percentile
Share of sample	12.82	65.35	21.83
Share of total income	5.98	72.46	21.56
Share of total consumption	7.48	67.60	24.92
Yearly Consumption ($)			
Food	4,194	5,835	5,919
Nondurable	10,148	17,078	17,495
Total	21,386	37,902	41,826
Demographic and Finanical Characteristics			
Age	47.10	51.80	49.10
Non-white (percent)	20.40	8.88	8.75
Less than highschool education	30.33	13.57	13.56
Highschool education	53.32	55.70	59.71
College diploma	16.35	30.73	26.73
Married	30.50	61.39	58.90
Income	25,963	61,727	54,999
Liquid assets	4,826	21,141	14,750

The third group of households represents about 22 percent of the sample, and although they earn their share of the income, they account for more than their share of total consumption. In most aspects, they resemble households with lower debt service ratios. The head of a household with a high debt service ratio is as likely to be non-white,

have a high school or college diploma and be married as the head of a household with a low debt service ratio. They are a touch younger than the head of a household with a low debt service ratio, which may explain why they earn less income, on average. Clearly, households in this group have assumed debt in order to consume at levels comparable to similar households who earn higher incomes.

Although households with a high debt service ratio have easily assumed debt in the past, is there a limit to the amount of debt they can borrow? Would such a limit impede their ability to smooth consumption relative to households with lower debt service ratios? The answer to the latter question appears to be no, households with high debt service ratios can smooth consumption as easily as other households. The OLS estimates suggest that among households with no or low debt service ratio, consumption growth will rise about 8 basis points for every percentage point rise in income growth; but among households with a high debt service ratio, this estimate is 4 basis points (Table 7).

Table 7: Sensitivity of Consumption Growth to Changes in Income Growth, by DSR group
(standard errors below parameter estimates)

	DSR = 0	< 75 percentile	> 75 percentile
Nondurables	0.08 **	0.07 **	0.04 **
	0.01	0.01	0.01

**5 percent; * 10 percent

These differences are more pronounced among low to middle-income households (Table 8). Households in each third of the income distribution were grouped according to their DSR within the income group. In the lower two income groups, the nondurable good consumption of households with no debt payments was the most sensitive to income, and the consumption of households with a high debt service ratio was the least sensitive.

Table 8: Sensitivity of nondurable consumption growth to changes in income growth, by DSR group
(standard errors below parameter estimates)

	Ordinary Least Squares		
	DSR = 0	**< 75 percentile**	**> 75 percentile**
Income Group			
Lowest Third	0.08 **	0.05 **	0.03 **
	0.01	0.01	0.01
Mid Third	0.14 **	0.09 **	0.07 **
	0.04	0.01	0.02
Highest Third	-0.05	0.08 **	0.06 **
	0.06	0.01	0.03
Education group			
Without College	0.08 **	0.08 **	0.02
	0.01	0.01	0.02
With College	0.08 **	0.07 **	0.06 **
	0.02	0.01	0.01

**5 percent; * 10 percent

The results are also consistent across education groups. Households without a college education were grouped according to their DSR within this group. Among households without a college education, the nondurable goods consumption of households without debt service was four times more sensitive to change in income growth than that of households with a high debt service ratio. Among households with a college education, the consumption of no-debt-service households was only slightly more sensitive as those with a high debt service ratio.

Conclusion

Over the last fifteen years, the significant rise in the aggregate debt service ratio has raised concern that households have become overburdened with debt, and that this debt will in turn dampen households' future consumption growth. In this paper, we ask whether households who have high debt service relative to their incomes are less able to

smooth consumption than other households. We find some evidence against this hypothesis, finding quite the opposite; that households with no debt service may be more sensitive to income fluctuations than other households. Because households with no debt service appear similar to households who are likely to be turned down for credit, we conclude that the undersupply of credit, rather than its oversupply, likely hinders households from smoothing consumption through income fluctuations.

Several studies have documented an increase in the supply of credit to households (Bostic, 2002; Johnson, 2005). The CEX data also suggest that over time more households have been given access to credit; the share of households with zero debt payments has fallen from about 16 percent in 1992 to about 12 ½ percent in 2004, although this may be owing to an increase in homeownership (chart 5). Increased access to credit has been linked to the rise in the aggregate DSR by both Johnson (2005) and Dynan, Johnson and Pence (2002). Taken together, these findings suggest that the rise in the DSR over the past fifteen years may indicate an increased ability of households to smooth consumption.

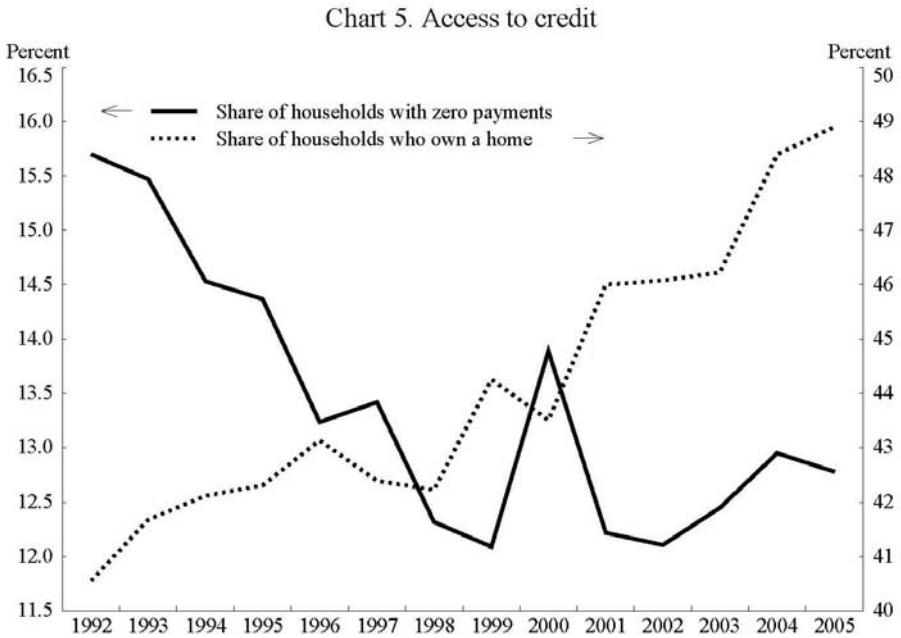


Chart 5. Access to credit
Percent
Percent
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
50
49
48
47
46
45
44
43
42
41
40
Share of households with zero payments
Share of households who own a home
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005

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Data Appendix – Variable definitions

Consumer Unit (CU) – a consumer unit comprises either: (1) all members of a particular household who are related by blood, marriage, adoption or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in a permanent living quarters in a hotel or motel, but who is financial independent; or (3) two or more persons living together who use their income to make joint expenditures. Financial independence is determined by the three major expense categories: housing, food and other living expenses. To be considered financially independent, at least two of the three major expense categories have to be provided entirely or in part by the respondent.

Reference person – The first member mentioned by the respondent when asked to "Start with the name of the person or one of the persons who owns or rents the home." It is with respect to this person that the relationship of other CU members is determined.

Consumption –Calculated from data reported in the Monthly Expenditures (MTAB) file. In the MTAB file, expenditures reported by a CU are identified by UCC and month in which the expenditure occurred.

Consumption is assumed to equal expenditures on nondurable goods as defined in Lusardi (1996). Nondurable goods expenditure includes those on food, alcoholic beverages, public transportation, utilities, household operations, gasoline, personal care, tobacco, apparel, health care products, reading materials, educational expenses and miscellaneous from the following UCC codes:
190904, 790220, 790230, 190901, 190902, 190903, 790410, 790430, 200900, 790310, 790320, 790420, 530110-530902, 250111-270214, 270411-270904, 330511, 340210-340530, 340620-340901, 340906-340908, 340903, 670310, 690113, 470111-470212, 640130-650900, 630110-630210, 680110-680902, 620112, 710110, 790600, 880210, 360110-430120, 440110-440900, 540000-480902, 590110-590230, 660110-660210, 660900-670210, 670901-670902.

Income before taxes – Reported on the Consumer Unit Characteristics and Income (FMLY) file. The combined income earned by all CU members 14 years old or over during the 12 months preceding the interview. The components of income are: Wage and salary income before deductions, income or loss from non-farm business, income or loss from farm, Social Security income and Supplemental Security Income, unemployment compensation, worker's compensation and veterans' benefits, public assistance, interest on savings accounts and bonds, income from dividends royalties and trusts, pensions and annuities, income from boarders or rental units, child support, alimony, scholarships, etc., food stamps.

Debt payments – Payments on mortgage, auto loans and home equity loans from the MTAB file plus payments on credit card loans. In the MTAB files, debt payments

include principal and interest expenditures associated with the UCC codes for each type of secured debt. For example, auto loans debt payments include UCC codes:

850100 Reduction of principal on vehicle loan
870103 Finance charges on loans for new cars, trucks, or vans
870203 Finance charges on loans for used cars, trucks, or vans
870803 Interest, other vehicle, financed

Payments on credit card loans equal 2 ½ percent of the outstanding balance reported in the FMLY file.

Debt service ratio – The ratio of debt payments to expected income. Expected income equals fitted income from a regression of the average income from each household's second and fifth interview on the age of the reference person, age squared, age cubed, and dummy variables for non-white reference person, high school graduates, and college graduates.

Age – Age of the CU reference person.

Change in family size – Change in the number of members in the CU.

Non-white – Race of the reference person Black, Native American, Asian, Pacific Islander or Multi-race.

High school graduate – Reference person earned a high school diploma and may have some college education but did not earn a degree.

College graduate – Reference person earned an Associate's, Bachelor's, Master's, Professional or Doctorate degree.

Married – Marital status of reference person is married.

Sample selection procedure –

- keep only households with uninterrupted debt payments, i.e. the households have not stopped paying for one or two quarters then started paying again
- delete households living in student housing facilities
- delete households with non-positive income
- trim off the top and bottom 1 percent of log income and expenditure growth
- head of household older than 25, but younger than 64 (inclusive)
- DSR lower than 2
- valid data for family size , race, education and marital

The final sample includes 28,811 households.

Appendix Tables

Table A1 Debt Balance and Payments by year and survey

Year	1992		1995		1998		2001		2004	
Survey	SCF	CEX	SCF	CEX	SCF	CEX	SCF	CEX	SCF	CEX
Mean Total Payments	5572	5912	6137	6523	7618	7783	8616	8912	10131	10366
Mean Total Debt Balance	29158	27554	33518	34392	42701	38106	50342	46889	74045	66092
Mean Mortgage Payments	3485	3749	3788	4203	4657	4761	5397	5651	6240	6918
Mean Mortgage Balance	24959	22796	28637	28993	36153	30880	42673	39192	62600	56931
Ratio of Mortgage > 0	38.22%	39.45%	39.39%	42.07%	41.16%	41.58%	42.28%	44.26%	44.91%	48.30%
Mean Other Real Estate Loans Payments	747	712	711	506	1015	701	966	763	747	745
Mean Other Real Estate Loans Balance	1170	1710	863	1194	1360	1975	1904	2149	4270	2360
Ratio of Other Real Estate Loans > 0	13.19%	10.86%	11.41%	9.66%	14.13%	12.64%	12.26%	12.64%	14.93%	11.71%
Mean Vehicle Loan Payments	1036	1155	1214	1371	1401	1761	1700	1935	1895	2046
Mean Vehicle Loan Balance	2018	2055	2605	2728	3371	3382	3927	3669	4804	4612
Ratio of Vehicle Loan > 0	29.47%	34.76%	31.56%	35.75%	31.24%	40.32%	34.81%	38.47%	35.60%	40.07%
Mean Credit Card Payments	303	298	424	443	545	561	551	564	711	657
Mean Credit Card Balance	1011	994	1413	1476	1817	1869	1837	1879	2372	2190
Ratio of Credit Card > 0	43.70%	45.26%	47.26%	48.20%	44.10%	49.72%	44.38%	44.91%	46.17%	42.12%