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The Effect Of Household Debt Servicing Costs On Expenditure Growth

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THE EFFECT OF HOUSEHOLD DEBT SERVICING COSTS ON EXPENDITURE GROWTH

by

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This thesis, submitted by Jared Alexander Michel in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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This thesis is being submitted by the appointed advisory committee as having met all of the requirements of the School of Graduate Studies at the University of North Dakota and is hereby approved.

Dr. Grant McGimpsey

Dean of the School of Graduate Studies

May 1, 2017

Date

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Jared Michel

May 3, 2017

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ABSTRACT

This study examines the effect of debt-servicing costs on subsequent expenditure growth. Quarterly expenditure data on US households from the US Labor Department's Consumer Expenditure Survey are utilized in a typical regression framework, and an emphasis is placed on determining the effect of a positive change in a household's debt-servicing costs on expenditure growth. Initial results reaffirm the literature in showing a negative relationship between leverage and expenditure growth. However, upon controlling for the change in each household's debt-servicing costs, the strong relationship disappears, and instead, a strong negative relationship between positive changes in a household's debt-servicing costs and subsequent expenditure growth is found to be the dominant force at play. Further work shows that the main results are robust across years of the sample and across groups of varying levels of liquidity constraint.

Chapter I

Introduction

An important element to understand within the realm of household microeconomics is the role that personal debt plays in determining economic outcomes. Proper understanding of debt and its consequences can help shape economic policy, which in turn can help to promote stronger economic growth with less volatility. Yet, the complex intricacies of how debt interacts with other economic components are not fully understood, and so there is an ongoing need for continued research.

Still, progress has been made in recent years to understand the connections between personal debt and economic outcomes. For example, the view that households with more leverage at the onset of the 2007-08 financial crisis experienced larger spending declines during the subsequent recession has a strong empirical foothold. However, there is not complete agreement as to the mechanism behind it. One possible explanation is that tight credit conditions have limited households' access to liquidity, and as a result, expenditure growth has suffered. Likewise, it could also be the case that households have taken part in voluntary deleveraging due to precautionary concerns such as worries about future access to credit. Both of these explanations imply a causal relationship between high debt and lower future expenditure growth. Yet, it is still possible the strong negative association reflects an alternate reality. The households

with greater leverage might also be the households that experienced a greater change in their debt balances prior to the crisis. For example, a household that takes out a new mortgage potentially exhibits both a large change in debt and a large absolute level of debt. Thus, the negative relationship between high leverage and expenditure growth might instead reflect a negative relationship between large changes in debt and subsequent expenditure growth.

The main purpose of this paper is to explicitly investigate the alternate explanation noted above. The results will first reconfirm the earlier literature that shows households with a higher degree of leverage experience a lower level of expenditure growth relative to low leverage households. Then it will be demonstrated that controlling for each household's change in debt obligations eliminates the statistical significance between a household's high leverage status and future expenditure growth. Meanwhile, a strong, significant negative relationship between a positive change in a household's debt balance and future expenditure growth will be garnered from the data instead. Finally, robustness checks will reveal that the main results hold across various years and across groups of households that are more or less likely to be liquidity constrained.

The analysis of this paper will be performed using quarterly US household-level data. A series of ordinary least-squares regressions will be employed to compare expenditure growth rates between households of high and low leverage and between households of high and low debt growth. This strategy will be very similar to one used in earlier research that examined Danish households before and after the financial crisis

(Andersen, Duus, and Jensen 2016). That study found that the negative relationship between high leverage and future expenditure growth disappeared upon controlling for the change in each household's debt level, and in addition, the results showed a strong negative association between positive changes in household debt and subsequent future expenditure growth. The authors also demonstrated that the results held across various years and across groups more or less likely to be liquidity constrained. Thus, the results of this paper very closely mirror yet extend the conclusions reached by Andersen, Duus, and Jensen (2016). Specifically, this paper uses data from a different country examining a different time period and applies a distinct measure of debt unique from Andersen, Duus, and Jensen (2016), yet it will be shown that the resulting conclusions are very similar. This extension of results is the main source of this paper's value.

The remaining portions of this paper will proceed as follows. Section II will provide a more in-depth look at past literature and how it ties into this paper's story. This will be followed up by Section III which will discuss the data source and construction of key variables. Section IV will share the models and empirical analysis. Sections V and VI will be devoted to robustness checks and implications of the results, and Section VII will finish with some concluding remarks.

Chapter II

Literature Review

Significant progress has been made in recent years to understand the real connections between personal debt and economic outcomes. For example, research has revealed a strong negative correlation between household leverage prior to the 2007-08 financial crisis and subsequent spending growth during the recession. Using credit card data, Mian and Sufi (2010, 2011) found that households in US counties with larger amounts of leverage prior to the recession experienced sharper expenditure declines during and after. This was then extended upon in their later work (Mian, Rao, and Sufi 2013) where they concluded that households reduced spending by 5-7 cents for every $1 of housing wealth lost during the financial crisis. Thus, more leveraged households exhibited sharper spending declines.

The case for this conclusion is further bolstered by the fact that other authors have made very similar conclusions using a variety of other data sets. Dynan (2012), for one, utilized the Panel Study of Income Dynamics to demonstrate households that were more leveraged in 2007 experienced larger declines in spending between 2007 and 2009. Subsequently, Dynan and Edelberg (2013) utilized the Federal Reserve's Survey of Consumer Finances to show households with more leverage in 2007 were more likely to self-report spending cutbacks over the next two years. Also, studies from abroad

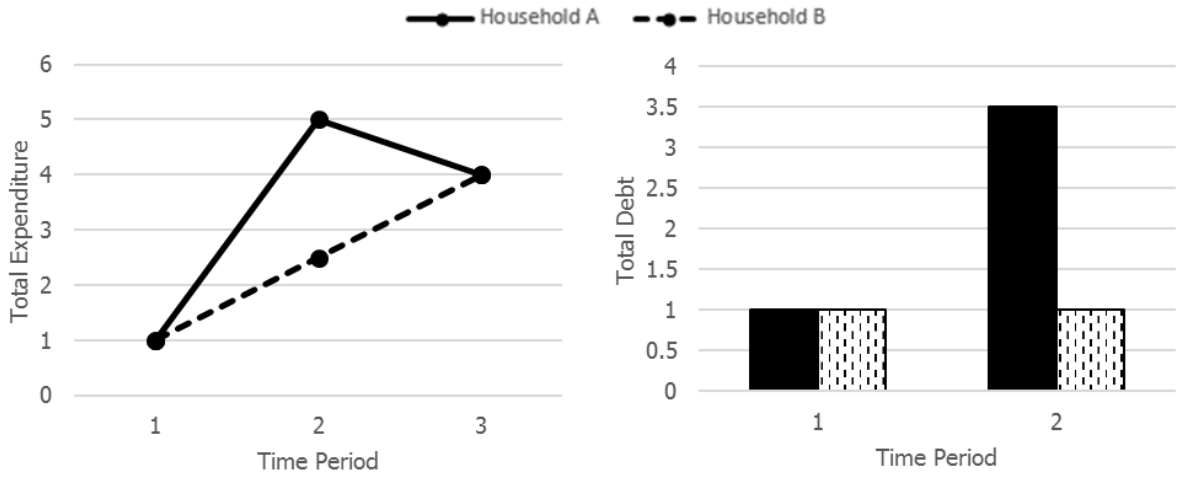
(Bunn and Rostom 2015; Andersen, Duus, and Jensen 2016) have confirmed this notion of a negative relationship between leverage and expenditure growth.

Despite this widespread agreement, ambiguity still exists as to the mechanism causing the correlation. There are two predominant arguments in the literature. One theory suggests that credit constraints limit credit access to those households with higher leverage, and therefore, a negative causal relationship develops between leverage and future spending. The other theory is that households with higher leverage voluntarily reduce their debt level due to worries about future access to credit and future ability to smooth expenditure. Most authors, however, admit that the explanation is multi-faceted. Brown, Haughwout, Lee, and van der Klaauw (2013), for example, found that both tightened lending conditions and voluntary reductions in debt have contributed to the drop in overall household leverage since the financial crisis. Both of these explanations imply a causal relationship between the magnitude of a household's debt level and future expenditure growth. Although, this implication could be masking the true connection between debt and future expenditure growth.

It is quite possible that households with larger debt balances are also the ones that experience larger absolute *changes* in their debt balances. Consequently, it might be the case that a strong relationship between high debt balances and future expenditure growth just reflects the positive correlation between high debt balances and large changes in debt. Thus, the true debt-expenditure-growth relationship might be driven by a household's *change* in debt level rather than the magnitude of it. This alternate view is consistent with the spending normalization hypothesis put forth by

Andersen, Duus, and Jensen (2016). Specifically, the authors suggest that some households temporarily exhibit debt-financed above average spending growth for a time and then must slow their expenditure growth in order to return to a "normal" level of spending.

Figure 1: Visualization of the Spending Normalization Hypothesis



This figure provides a simple illustration of the spending normalization hypothesis; it depicts two households that are identical as of time period 1. Household A increases its total expenditure through debt-financed spending between time periods 1 and 2 whereas Household B just experiences smooth, natural expenditure growth due to factors such as wage increase. Household A subsequently experiences slower expenditure growth relative to Household B. The spending normalization hypothesis argues that this reflects the negative relationship between changes in a household's debt level and subsequent expenditure growth.

A simple illustration of this idea is provided in Figure 1. The chart represents two households that are identical as of the first time period, and both households experience the same growth in disposable income throughout. However, Household A increases its total expenditure by 4 units between time periods 1 and 2, and Household B increases its total expenditure by just 1.5 units over the same time frame. The difference in growth can be explained by the fact that Household A borrowed 2.5 units in order to increase its total expenditure by more than its growth in disposable income.

Subsequently, Household A reduces its total expenditure by 1 unit between time periods 2 and 3 in order to return to a "normal" level of spending after its temporary, debt-financed boost while Household B increases its own by 1.5 units due to continued disposable income growth. Therefore, Household A experiences relatively slower expenditure growth. Someone with data from just time periods 2 and 3 would conclude that a negative correlation exists between debt balances and expenditure growth. This is because Household A exhibited both a relatively higher debt balance in time period 2 and relatively smaller expenditure growth between time periods 2 and 3. Although, this analysis would be missing half of the story. In reality, it is Household A's relatively large change in debt between time periods 1 and 2 that causes the household to experience relatively smaller growth in total expenditure. Thus, the computed negative correlation between debt balances and expenditure growth is simply reflective of the fact that debt balances are positively correlated with changes in debt. This is the essence of the spending normalization hypothesis: it makes the distinction that a household's change in debt level is most important for the debt-expenditure-growth relationship.

Importantly, a number of studies have already confirmed a connection between change in debt and future expenditure. Ekici and Dunn (2010) and Stephens (2008), for example, both find that spending responds to a change in a household's debt level. A $1000 increase in credit card debt in one quarter is associated with a subsequent decline in quarterly expenditure of about 2% (Ekici and Dunn 2010). Stephens, though, shows that expenditure responds to changes in debt in the opposite direction as well. Households experiencing a 10% increase in discretionary income due to exogenous loan

repayment were found to increase nondurable expenditure by about 2-3%. Thus, both studies offer ample evidence that a relationship does in fact exist between a household's change in its debt obligations and its future expenditure growth.

Likewise, the results shared by Andersen et al. (2016) expand the current discussion on changes in household debt. Using detailed asset and imputed spending data of 500,000 Danish households between 2002 and 2011, Andersen et al. (2016) were able to study how both the magnitude and change in debt affect expenditure growth. They were able to confirm the earlier literature by finding a strong negative correlation between leverage and expenditure growth before and after the financial crisis. Although, upon controlling for each household's change in debt, they found that the negative correlation between each household's debt level and its subsequent expenditure growth disappeared. Consequently, this result proposes that the smaller expenditure growth witnessed among high leverage households in the wake of the financial crisis was, in fact, driven by those households' positive change in debt levels prior to the crisis.

This is a novel conclusion, and it is somewhat surprising this view has not received more attention till recently since it is consistent with the idea that borrowing a large amount in one time period pulls future demand forward. More importantly, one should note that the paper also found that the relationship between a positive change in debt and expenditure growth also held in other years and across groups that are more or less likely to be borrowing constrained. This suggests that credit availability during the financial crisis years was not special in some way such that it was the dominant

driver of the drop in personal expenditure for households during that period. Rather, the results along with the spending normalization hypothesis instead suggest that the widespread drops in personal expenditure indicate that more households than normal exhibited above average, debt-financed spending increases prior to the crisis, and by extension, more households than normal experienced spending normalization simultaneously once the crisis set in. This implication will be explored further later in the paper.

To summarize, this paper is motivated by a few main ideas from the literature. First, evidence exists showing that households with more leverage prior to the financial crisis experienced sharper spending declines during and after. Many authors have interpreted this as a causal relationship where a high amount of debt leads to lower consumption growth due to credit constraints or voluntary deleveraging. However, the spending normalization hypothesis put forth in the literature counters this by arguing that the negative relationship between debt balances and expenditure growth simply reflects the high positive correlation between debt balances and changes in debt. Meanwhile, empirical studies have shown that changes in household debt affect expenditure growth. Therefore, the goal of this paper is to provide additional evidence towards the spending normalization hypothesis by arguing that changes in a household's debt obligations have a real impact on household expenditure growth and are more important than the actual size of a household's outstanding debt level. As a result, this analysis will essentially extend the work of Andersen et al. (2016) by using a new data set with a new measure of debt which will be introduced in the next section.

Chapter III

Data

The data for this paper comes from the US Labor Department's Consumer Expenditure Survey (CEX) from the years 1997 to 2013. This rotating panel survey allows for detailed tracking of American household spending and, therefore, offers an ample way to study factors that might affect expenditure choices. Data is collected quarterly on a weighted sample of several thousand households that is constructed to represent the entire US population. Each chosen household is included in the sample for a period of five quarters. The first survey round collects demographic and general information about each household, and this is followed up by four rounds of expenditure data collection. In the context of the current paper, it is also important to note that income information pertaining to the past 12 months is collected during the second survey round.

This structure of the CEX survey was used to construct the sample for this paper. Each household's five survey rounds of data were consolidated into a single observation representing that household. So, each observation in this paper's sample was comprised of general demographic and income data as well as four quarters of detailed expenditure data for a specific household. The quarterly expenditure data available for each household consisted of detailed spending data broken down by the CEX's universal

classification codes (UCCs). This made it possible to calculate both a household's total spending and spending within sub-categories for each quarter.

Table 1: Universal Classification Codes Used in Debt Service Ratio Construction	
Debt Payment Type	**CEX UCCs**
Primary Residence Mortgages	220311, 830201
Home Equity Loans Secured by Primary Residence	220313, 830203
Lines of Credit Secured by Primary Residence	880110, 880120
Mortgages, Home Equity Loans, Lines of Credit Secured by Vacation Homes and other Property	220314, 790940, 830204, 220312, 790920, 830202, 880210, 880220, 880310, 880320
Vehicle Loans	850100, 870103, 870203, 870803

List of universal classification codes identifying specific payments in the CEX survey used to construct this paper's debt service ratio measure.

The main variable of interest in this study is each household's debt service ratio (DSR). This measure aims to capture the ratio of expenditure on debt servicing to regular income[1]. Examining this debt metric is especially interesting compared to a standard debt balance because it more accurately reflects the burden that outstanding debt places on a household. For example, if a household has a high debt balance yet the monthly payment is relatively low then the high debt balance alone might not provide as much information as a DSR would about how that debt affects the expenditure choices of the household. Moreover, the DSR is constructed based on criteria set forth by Johnson and Li (2010) and includes all typical amounts paid towards principal and interest on automobile and mortgage debt. This includes payments toward

[1] After-tax income was utilized here and throughout this paper.

both primary and secondary mortgage debt as well as home equity debt. Table 1 lists the CEX universal classification codes used in the construction of the DSR.

Unlike Johnson and Li (2010), however, the DSR constructed in this paper does not include payments on consumer credit debt. This is because consumer credit information is only collected from households during their second and fifth interviews. Therefore, it is impossible to calculate a change in these debt levels and still relate it to a household's future expenditure. This difference in the construction of the DSR should not be seen as improper, though, since Johnson and Li (2010) assumed payments on consumer credit to be 2.5% of the total balance which equates to a small percentage of total monthly debt service payments for most households. Also, one should realize that Johnson and Li (2010) focused on typical debt payments rather than required payments since earlier research (Bucks and Pence 2008) has shown households remember their loan payments more accurately than their loan terms when completing surveys.

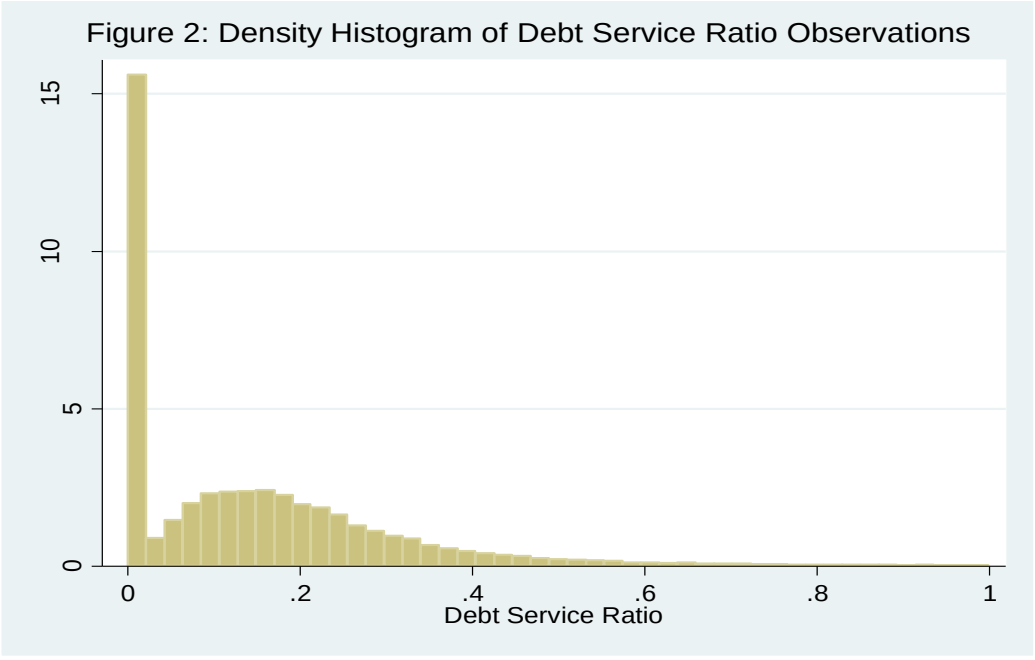
Figure 2 illustrates the distribution of DSRs in this paper's sample. Notably, the tall bar on the far left of the histogram reflects the large number of households that do not have any debt payments and, therefore, have a zero debt service ratio. Otherwise, the distribution of DSRs seems to be very smooth and skewed right with the most common DSR coming in at about 0.15. These characteristics make sense since it is reasonable to believe that most households pay around 15% of their typical income to servicing debt, and few households pay a majority of their income towards debt servicing.

Furthermore, parts of the analysis compared the effects of a high DSR on household expenditure growth. Thus, it was necessary to define what constitutes a high DSR. To accomplish this, households with a nonzero DSR were sorted into quintiles and those with a zero DSR were placed into their own zeroth bin. Then, observations within the third, fourth, and fifth quintile bins were defined as high DSR households. Next, the change in each household's DSR was computed by subtracting the initial DSR in one quarter from the final DSR in a later quarter as shown in equation 1 below:

$$\Delta DSR_{1-2,h} = DSR_{2,h} - DSR_{1,h} \quad (1)$$

The notation in the equation indicates that the change in household h's DSR between time periods 1 and 2 is calculated by subtracting the household's first period DSR from its second period DSR.

Figure 2: Density Histogram of Debt Service Ratio Observations



This figure provides an illustration of the distribution of debt service ratios across the sample of this paper. The large density of observations on the left represents the large number of households with no debt payments and, therefore, a zero debt service ratio. A few outliers to the right are not included in this chart to avoid zooming too far out from the distribution's main features.

What is more, a number of control variables were constructed based on general household information in the dataset—some of which applies to the head of household exclusively. These controls included age, age-squared, high school and college graduation status, race, gender, marriage status, family size, state of residence, town population size, housing status, and number of automobiles[2].

A majority of these control variables with the exception of state of residence, town population size, and number of automobiles were constructed following the example set by Johnson and Li (2010) in order to control for any effect general household characteristics might play in determining expenditure growth. Indicators for state of residence and town population size were defined in order to control for any differences in expenditure growth across different regions of the US. Likewise, information regarding the number of automobiles a household owns was included to compliment the housing status control. Johnson and Li (2010) originally included an indicator for home ownership as an imperfect way to control for household net worth. Thus, controlling for the number of automobiles a household owns is done with the same purpose in mind. In addition, households were sorted into income and expenditure-to-income deciles to control for non-linear income and initial expenditure-to-income effects.

Measures of liquidity relative to income for each household were constructed based on checking and savings account balances reported in the fifth survey. Since

[2] A table of some key summary statistics can be found in the Appendix.

these balances are only collected in the fifth survey, it is assumed each household holds a similar balance in earlier quarters in order to control for liquidity. This assumption is supported by the fact that about 77% of households reported that their checking account balance was about the same as a year ago, and about 65% of households reported their savings account balance was about the same as a year ago. Also, the results of this study change a negligible amount when each of the specifications is rerun only including households that report both their checking and savings account balances are about the same as the year prior. Furthermore, observations were then categorized into high and low liquidity households where a low liquidity household was defined as one with a liquid-asset-to-income ratio of less than 2.5%. This is consistent with the low liquid asset indicator presented by Johnson and Li (2010). Finally, controls for time fixed-effects were also constructed based on the month each survey interview was completed, and all monetary figures were deflated to real 2000 dollars.

At this point it is also important to note the lack of a net-worth variable in this study. A lack of data prevents construction of this sort of variable. However, there are two reasons why this likely does not matter. First, the coefficients of interest in the results of Andersen et al. (2016)—which this paper's results closely follow—changed very little before and after controlling for net-worth. This suggests that the results shared below should be robust across groups of more or less net-worth. Even so, controlling for each household's housing status and number of automobiles owned—as was mentioned previously—should offer a partial solution to the problem. Status of home ownership with no mortgage, for example, rather than status of home ownership

with a mortgage or renting should be positively correlated with net-worth, and in a similar fashion, the number of automobiles owned should at least be partially correlated with net-worth.

Observations in the sample were necessarily filtered. Households with nonsensical DSR or expenditure data were dropped from the sample, and likewise, households reporting zero or negative income were dropped as well[3]. Finally, households with heads aged less than 21 or greater than 65 were dropped to eliminate students and retirees from the sample (Johnson and Li 2010). This process identified a sample consisting of about 45,000 households.

[3] Observations with a change in their DSR or expenditure level less than the 1st percentile or greater than the 99th percentile, respectively, were dropped. This resulted in 1238 dropped observations. This was done since several observations had changes in their DSR which implied their debt service payments increased or decreased by an amount equal to many times larger than their quarterly income. Likewise, observations were eliminated due to computed changes in expenditure level that were many factors larger than the household's respective income. Both of these problems can likely be attributed to partially inaccurate income data since households were asked to report their income from the prior 12 months rather than their current income. This should not be a huge concern for the vast majority of observations, though, since most households have steady income from year to year.

Chapter IV

Models and Empirical Analysis

The crux of this study is to examine the effects of debt and changes in debt on expenditure growth. Naturally, therefore, the dependent variable in each of the following models is the change in expenditure for each household from one quarter to the next. The change in expenditure is measured relative to income following the example set by Andersen et al. (2016) to ensure households of different levels of income can be compared. It is important to keep this in mind later when interpreting results.

The first goal of this analysis was to replicate results from the literature that have demonstrated a negative relationship between household leverage and subsequent expenditure growth. To do this, a simple equation of the following form was constructed:

$$\Delta E_{3-4,h} = \beta_0 + \beta_1 * T + \beta_2 * X_h + \beta_3 * HighDSR_{3,h} + \epsilon \quad (2)$$

In this equation, $\Delta E_{3-4,h}$ is computed by subtracting total expenditure of household h in survey three from total expenditure in survey four and then dividing by quarterly income. Thus, the variable represents a change in expenditure relative to income from survey three to survey four for household h. Similarly, $HighDSR_{3,h}$ is an indicator for whether household h has a DSR in the third, fourth, or fifth quintiles of all DSR

Table 2: Effect of a Household's Debt Service Ratio on Expenditure Growth

	(1)	(2)
High Debt Service Ratio	-0.0376***	-0.0101
	(0.0101)	(0.0100)
Positive Change in Debt Service Ratio		-0.1558***
		(0.0116)
Age	0.0028	0.0022
	(0.0032)	(0.0032)
Age Squared	-0.00002	-0.00002
	(0.00004)	(0.00004)
High School Graduate	-0.0208	-0.0204
	(0.0171)	(0.0171)
College Graduate	-0.0144	-0.0162*
	(0.0093)	(0.0092)
Female	0.0127	0.0123
	(0.0085)	(0.0084)
Married	0.0109	0.0103
	(0.0113)	(0.0113)
Family Size	0.0050	0.0055
	(0.0034)	(0.0034)
Low Liquidity	-0.0210**	-0.0204**
	(0.0101)	(0.0089)
Other Categorical Controls Included	Yes	Yes
Monthly Time Controls Included	Yes	Yes
Observations	45,123	45,123
Adjusted R-squared	0.0168	0.0220

*The dependent variable in both Columns 1 and 2 is household expenditure change from survey 3 to survey 4 relative to income. Other categorical controls include race, state of residence, town population size, housing status, number of automobiles, income decile, and initial expenditure-to-income decile. Results for these variables are suppressed due to the unreasonable amount of space that would be required to show them all. In addition, monthly dummies were included to control for time fixed effects. *Significance at the 10% level, **Significance at the 5% level, ***Significance at the 1% level.*

observations as of the third survey[4], X_h is a vector of household controls, and T is a vector of time period controls. Column 1 of Table 2 shares the corresponding regression results.

Consistent with earlier literature, the coefficient estimate on the high DSR indicator in column 1 is significant, and it implies that households with a DSR in the third, fourth, or fifth quintiles in the third survey period experienced smaller expenditure growth relative to households with a zero or first or second quintile DSR. Essentially, the coefficient represents a difference in difference estimate comparing changes in expenditure between high and low DSR households.

Also, since $\Delta E_{3-4,h}$ was constructed by dividing change in expenditure between surveys three and four by quarterly income, the coefficient estimate can be interpreted as a difference in income percentage points. Thus, the coefficient estimate of -0.0376 indicates that high DSR households increased expenditure by 3.76 fewer income percentage points than low DSR households. That is to say, if hypothetical households A and B are identical in every way except household A is a high DSR household and household B is not, then household A might increase its expenditure by an amount equal to 10% of its typical quarterly income whereas household B would only be expected to increase its expenditure by an amount equal to 6.24% of its quarterly income. The 10% figure was arbitrarily chosen for illustration purposes, but the bottom line is that the coefficient estimate implies that expenditure growth for households with

[4] Criteria laid out in the data section of this paper defined a household as having a high DSR if its DSR was in the third, fourth, or fifth DSR quintile bins.

a DSR in the third, fourth, or fifth quintiles is expected to be smaller by an amount equal to about 3.76% of their income relative to their expected expenditure growth if they had a zero or first or second quintile DSR instead.

The results in Column 1 reaffirm findings from prior literature that a negative correlation exists between leverage and subsequent expenditure growth. This is notable because it lays the foundation required to fully examine the spending normalization hypothesis. In fact, the next step towards investigating the hypothesis was to add a control for changes in a household's DSR to determine how the estimated coefficient on the high DSR indicator might change. This is important because the hypothesis suggests that the negative correlation between leverage and expenditure growth reflects the positive correlation between positive changes in debt and high levels of leverage.

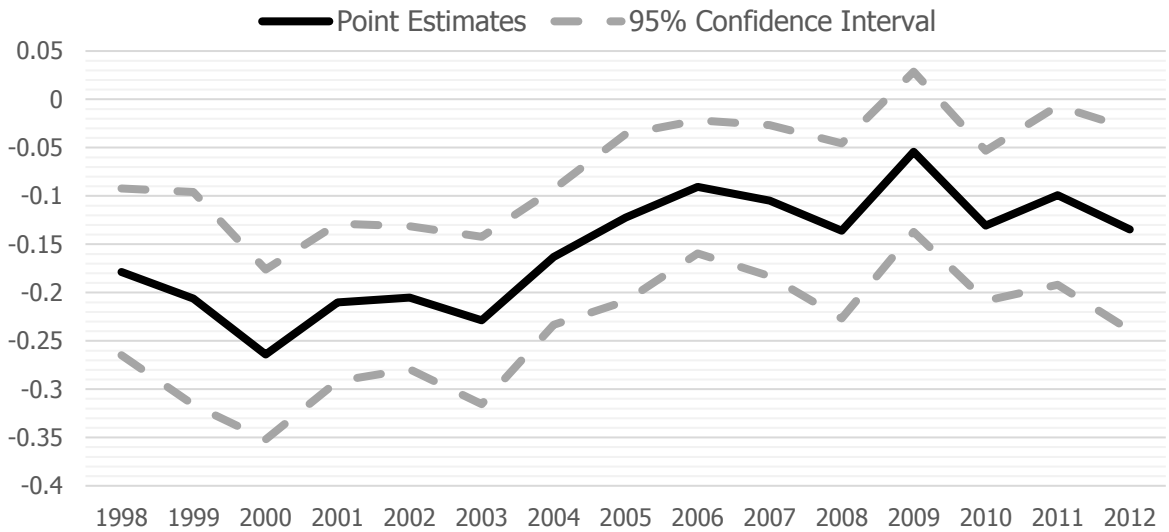
The equation 2 model was rerun with an additional indicator variable specifying whether or not each household increased its DSR from the second to third surveys. Column 2 of Table 2 presents results for this modified analysis. The magnitude of the high DSR coefficient is now much smaller than it was previously, and the estimate is insignificant. Meanwhile, the estimated coefficient on the indicator variable for a positive DSR change is highly significant and negative. Taken together, these observations imply that households of higher or lower DSRs experienced similar expenditure growth rates, and instead, households that increased their DSR experienced smaller subsequent expenditure growth relative to those with consistent or declining DSRs.

Notably, column 2 is consistent with early results shared by Andersen et al. (2016) and succeeds in providing initial evidence towards the spending normalization hypothesis. This is because the -0.1558 coefficient on the positive DSR change indicator implies that households who experienced an increase in their DSR increased their future expenditure by 15.58 income percentage points *less* than households that decreased or maintained their DSR levels. The spending normalization hypothesis rationalizes this by arguing that households who increase their expenditure through debt-financed spending in one time period return to a more "normal" level of spending in a later time period. Thus, a parallel interpretation of the Table 2 results is that households who increased their DSR between surveys two and three necessarily experienced smaller expenditure growth in the subsequent time period in order to return to a "normal" level of spending.

A natural question that arises from the results of Table 2 is whether or not the coefficient estimate on the positive DSR change indicator varies over time. This is an important topic to investigate because one might argue that debt has played a larger role in some years more than others. This is especially true of the years surrounding the financial crisis. For instance, it might be natural to think that increases in debt might have mattered less to future expenditure growth in the pre-crisis "bubble" years when households were increasing their leverage at historic rates. On the other hand, it might also be natural to believe and the literature has suggested that increases in leverage may have weighed more heavily on future expenditure growth in the years since the financial crisis due to increased credit constraints or voluntary deleveraging. Therefore, the model presented in equation 2 was tweaked slightly in order to explore these

avenues. The positive DSR change indicator was interacted with yearly dummy variables to evaluate changes across time. The coefficient estimates and their 95% confidence intervals for each year are presented in Figure 3.

Figure 3: Positive Change in Debt Service Ratio Indicator Coefficient Estimate Across Time



Coefficient estimates of positive DSR change indicator variable across time.

An informal eye test of Figure 1 suggests that the coefficient estimate may have actually decreased in magnitude sometime in the middle 2000s. To be sure, a formal test of this phenomenon is presented in Table 3 where equation 2 was reanalyzed with an additional positive DSR change indicator interacted with a dummy variable specifying households after 2005 (Column 1) or after 2007 (Column 2).

Both the 2005 and 2007 coefficients in the two models are positive and highly statistically significant. This is strong evidence pointing to a change in the relationship across time; it essentially implies that increases in a household's DSR weighed more

Table 3: Effect of a Positive Change in a Household's Debt Service Ratio on Expenditure Growth—Changes Across Time		
	(1)	**(2)**
Positive Change in Debt Service Ratio	-0.1998***	-0.1782***
	(0.0159)	(0.0139)
Positive Change in Debt Service Ratio x After 2005	0.0926***	
	(0.0223)	
Positive Change in Debt Service Ratio x After 2007		0.0669***
		(0.0241)
Controls Included	Yes	Yes
Observations	45,123	45,123
Adjusted R-squared	0.0225	0.0222

*The dependent variable in both Columns 1 and 2 is household expenditure change from survey 3 to survey 4 relative to income. Controls are the same as specified in Table 2. *Significance at the 10% level, **Significance at the 5% level, ***Significance at the 1% level.*

Table 4: Effect of a Positive Change in a Household's Debt Service Ratio on Expenditure Growth—Controlling for Size of the Change		
	(1)	**(2)**
High Debt Service Ratio	-0.0078	-0.0078
	(0.0102)	(0.0102)
Positive Change in Debt Service Ratio x Size of Debt Service Ratio Change	-0.7783***	-0.7724***
	(0.0875)	(0.0946)
Positive Change in Debt Service Ratio x Size of Debt Service Ratio Change x After 2007		-0.0190
		(0.2063)
Controls Included	Yes	Yes
Observations	45,123	45,123
Adjusted R-squared	0.0243	0.0244

*The dependent variable in both Columns 1 and 2 is household expenditure change from survey 3 to survey 4 relative to income. Controls are the same as specified in Table 2. *Significance at the 10% level, **Significance at the 5% level, ***Significance at the 1% level.*

heavily on expenditure growth in the earlier years of this data set. However, this doesn't seem likely since it contradicts the logic used earlier. Instead, it is possible this difference in the coefficients across time reflects the fact that households increased their DSR at a faster rate in the earlier years of the data set. If this is the case and if expenditure responses are proportional to the magnitude of a given DSR increase then controlling for the size of that increase should eliminate the difference in the coefficients across time.

Controlling for the size of each household's change in DSR requires an additional alteration to equation 2. Equation 3 reflects that alteration:

$$\Delta E_{3-4,h} = \beta_0 + \beta_1 * T + \beta_2 * X_h + \beta_3 * HighDSR_{3,h} + \beta_4 * Positive\Delta DSR_{2-3,h} * \Delta DSR_{2-3,h} + \epsilon \quad (3)$$

The only difference with this new model is the interaction of $\Delta DSR_{2-3,h}$ with the previously defined $Positive\Delta DSR_{2-3,h}$. With this interaction in place, the model now controls for the actual size of household h's change in DSR. Column 1 of Table 4 features results from this updated equation.

There are a number of notable takeaways from this new set of results. First and foremost, the basic concepts established in earlier discussion still hold. The lack of any significance on the high DSR indicator means that households with high and low DSRs still have similar expenditure growth after controlling for changes in the household's DSR. Also, the coefficient on the interaction term is negative and highly significant. Its estimated value of -0.7783 implies that households that increase their DSR increase

their subsequent expenditure by about 7.78 fewer income percentage points than households with consistent or declining DSRs for each increase in their DSR equal to 10% of their income. Put more simply, households who increase their DSR by a large amount will lag the non-increasing households in expenditure growth more than households who increase their DSR by a small amount.

Next, the coefficient was tested for heterogeneity across time. It is possible that controlling for the size of each DSR change eliminated the estimated coefficient differences demonstrated earlier in Table 3. Like earlier, the interaction term was multiplied by a dummy variable specifying if a household was interviewed after 2007. The coefficient on this term—in column 2 of Table 4—is found to be highly insignificant; this implies that the interaction term did not change across the sample period. In addition, this restructured model helps defend the argument used earlier to explain the varying coefficient estimates across time (Table 3). Once the size of each DSR change was controlled for (Table 4), the coefficient estimate was robust across the various years. Therefore, the relationship between DSR changes and expenditure growth did not change across time. Rather, households were, in general, increasing their DSRs by larger magnitudes in the earlier years of this survey.

Chapter V

Robustness Checks

This section devotes itself to checking the robustness of the results shared so far; this is done in two steps. First, an analysis is performed to check the role that supply side factors play in this paper's models. This is important because a rapid rise in a household's DSR can affect its subsequent expenditure change due to choices made by the household or due to supply side factors such as a limit on access to capital. Thus, this part of the sensitivity analysis will examine coefficient estimates across groups of households of varying levels of supply-side constraint. Furthermore, the second part of the robustness section will check to ensure that the results presented up to now are not sensitive to the period of examination for DSR changes. Each household's change in DSR will be recalculated over a two quarter time frame rather than a single quarter time frame, and the models will be rerun.

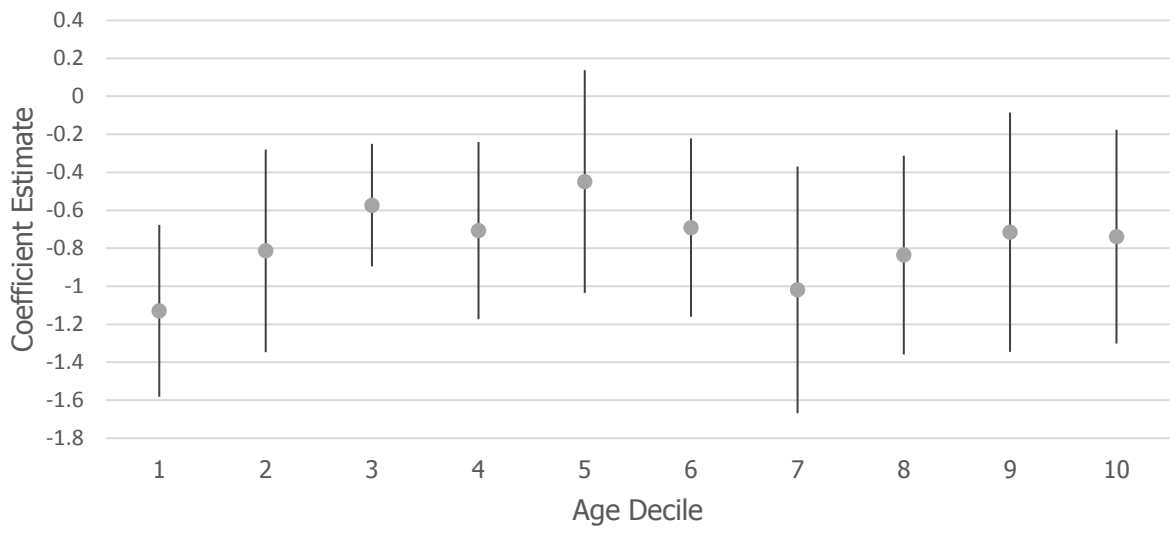
Therefore, the first goal of this robustness section will be to explore the possibility that the estimated coefficient on the interaction between the positive DSR change indicator and the size of the DSR change variable differs across groups that are more or less likely to be constrained in their access to liquidity. This is important because it might be the case that constrained households are the ones driving the results derived so far. If this is the case, then it would be evidence aligning with prior

studies arguing that credit constraints have played a strong role in the lack of borrowing and therefore have been a cause of lackluster expenditure growth. Two of the ways Andersen et al. (2016) performed this check was by sorting households into both age and liquid-asset-to-income ratio deciles and then investigating if the target coefficient varied across the bins of each decile sorting. This is an appropriate way to check the estimated coefficient across groups of varying levels of constraint because one might expect younger and less liquid households to be more constrained.

An almost identical exercise is performed in this study to compare coefficient estimates of the interacted term for different aged and liquid households. The estimates were constructed by interacting the age and income decile indicators with the interaction term from equation 3. Thus, a point estimate and 95% confidence interval for each age and income decile was constructed. These estimates are illustrated in Figures 3 and 4, respectively. There appears to be little evidence that the target coefficient varies over the different age and liquidity groupings. The estimated coefficient is found to be similar for younger and older households, and likewise, it is about the same for more and less liquid households too. There are very few groups that are statistically distinct from one another, and so, overall it would seem that the estimated coefficient is not different across groups traditionally thought to have more or less access to liquidity.

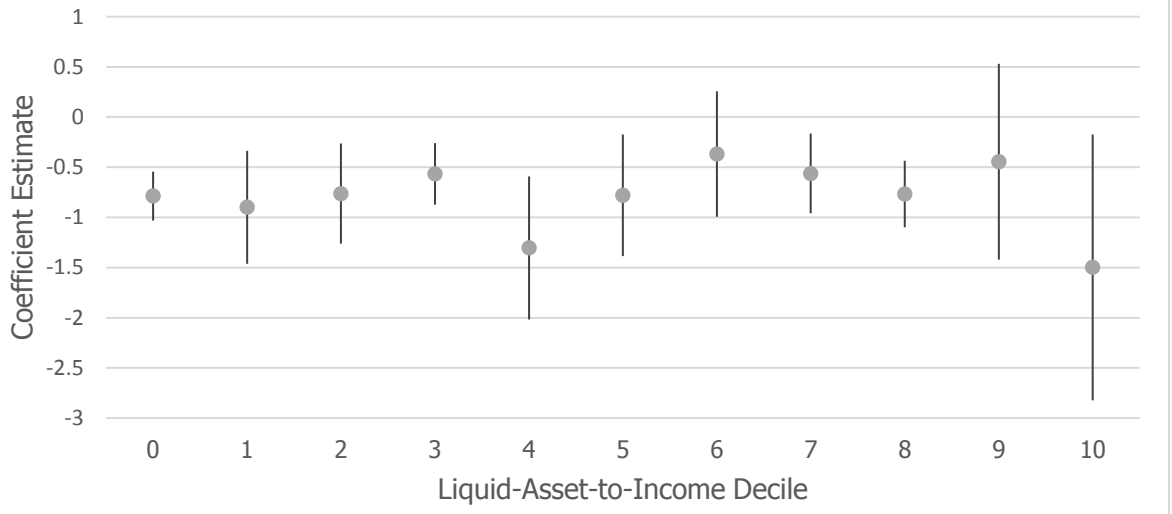
This study, however, further verifies the claim that the estimated coefficient does not vary across groups of households that are more or less likely to be constrained based on evidence presented by Johnson and Li (2010). In that paper, the authors

Figure 4: Heterogeneity of Coefficient Estimates across Age Deciles



The coefficient estimate and 95% confidence interval for the target coefficient of each decile bin.

Figure 5: Heterogeneity of Coefficient Estimates across Liquid-Asset-to-Income Deciles



The coefficient estimate and 95% confidence interval for the target coefficient of each decile bin. Note: The liquid-asset-to-income decile sorting was contingent upon each household having a nonzero reported savings or checking account balance. If the household reported a zero balance for both account types then it was placed into the zero bin.

present evidence that expenditure of households within the CEX who have a DSR in either the fourth or fifth quintile and have low liquidity is sensitive to past income. According to the authors, the fact that the expenditures of this chosen group of households are sensitive to past income is evidence that they are in fact liquidity constrained because it hints at the fact that a higher level of income would be associated with a relaxation of the constraints. This presents an excellent alternate opportunity to study differences in the estimated coefficient between two groups of varying liquidity constraint.

A constrained indicator variable was constructed based on the criteria shared in Johnson and Li (2010). Households with a DSR in the fourth or fifth quintile of DSRs and with less than 2.5% of their monthly income in liquid assets are defined as constrained. It should be noted that Johnson and Li (2010) do not make the argument that households excluded from the constrained group are in fact free of constraints. Rather, there is just a high degree of certainty based on their evidence that the households in the constrained group are relatively more liquidity constrained. Furthermore, the constrained indicator variable is interacted with the positive DSR change indicator term and added to an amended version of equation 3 shown below:

$$\Delta E_{3-4,h} = \beta_0 + \beta_1 * T + \beta_2 * X_h + \beta_3 * Positive\Delta DSR_{2-3,h} * \Delta DSR_{2-3,h} * Constrained_h + \epsilon \quad (4)$$

Results from equation 4 are presented in Table 5. The coefficients for constrained and unconstrained households are found to be statistically indistinguishable from each other.

Table 5: Comparing Constrained and Unconstrained Households		
Positive Change in Debt Service Ratio x Size of Debt Service Ratio Change x "Constrained" Indicator	Constrained = 0	-0.8006*** (0.1219)
	Constrained = 1	-0.7676*** (0.1208)
Controls Included		Yes
Observations		45,123
Adjusted R-squared		0.0243

*This table compares coefficients between groups of households shown to have varying levels of constraint placed on them according to Johnson and Li (2010). A household is defined as a constrained household if it has a DSR in the fourth or fifth quintiles and has a total liquid-asset-to-income ratio of less than 0.025. The dependent variable is household expenditure change from survey 3 to survey 4 relative to income. Controls are the same as specified in Table 2.*Significance at the 10% level, **Significance at the 5% level, ***Significance at the 1% level.*

Table 6: Examining Alternative Time Frames	
High Debt Service Ratio	-0.0032 (0.0101)
Positive Change in Debt Service Ratio x Size of Debt Service Ratio Change	-0.6034*** (0.1199)
Controls Included	Yes
Observations	44,779
Adjusted R-squared	0.0253

*The dependent variable is household expenditure change from survey 4 to survey 5 relative to income. Controls are the same as specified in Table 2.*Significance at the 10% level, **Significance at the 5% level, ***Significance at the 1% level.*

This means that constrained households do not experience a more profound expenditure response than unconstrained households.

Therefore, the robustness checks so far are consistent in that they all suggest liquidity limitations are not the most likely explanation for the negative correlation between positive changes in a household's DSR and its subsequent expenditure growth. However, it should be made clear that this does not mean factors such as credit constraints do not matter, but rather, they are less important in the models examined in

this paper. This gives additional rise to explanations such as the spending normalization hypothesis.

Moreover, one might also wonder if the results generated in Table 4 are sensitive to the somewhat arbitrary choice of quarterly DSR changes. To investigate this, equation 3 is altered slightly:

$$\Delta E_{4-5,h} = \beta_0 + \beta_1 * T + \beta_2 * X_h + \beta_3 * HighDSR_{4,h} \quad (5)$$
$$+\beta_4 * Positive\Delta DSR_{2-4,h} * \Delta DSR_{2-4,h} + \epsilon$$

The $Positive\Delta DSR_{2-4,h}$, $\Delta DSR_{2-4,h}$, and $HighDSR_{4,h}$ variables have all been changed to consider each household's DSR as of the fourth survey and how it is has changed since the second. Likewise, the dependent variable now measures each household's expenditure growth between surveys 4 and 5 instead. This slightly changed version of equation 3 is reanalyzed, and its results are demonstrated in Table 6. The estimated coefficients are found to be consistent with earlier results. The high DSR indicator coefficient is found to be statistically insignificant while a large negative relationship is reconfirmed for the interacted term. Thus, Table 6 increases the confidence held in this paper's earlier results, and more broadly, this section has demonstrated that the estimated negative relationship between positive changes in household DSRs and expenditure growth is robust across groups of varying levels of liquidity and across an alternate period of inspection for changes in a household's DSR.

Chapter VI

Extension of Results

The analysis of this paper has worked towards demonstrating the role that a rise in debt servicing obligations has on future expenditure. In doing so, the distinction was made that an increase in a household's DSR is more important than the actual magnitude of the DSR. It was shown that households that increased their DSR from one quarter to the next subsequently experienced smaller expenditure growth than households that maintained or decreased their obligations. Then it was shown that changes in household DSRs produced similar outcomes across the years of this dataset and for households more or less likely to be liquidity constrained.

These results align very closely to the conclusions of Andersen et al. (2016). This is a significant observation for a number of reasons. Notably, the prior paper used annual Danish data to come to their conclusions. The fact that this study was able to replicate similar results using quarterly American data eliminates the possibility that the conclusions reached by Andersen and others were a fluke caused by time-period or country level specific factors.

On the other hand, the results of the current paper used a different measure of debt than Andersen et al. (2016). This paper used a measure of payment obligations whereas Andersen and others utilized detailed total debt measures. Awareness of this

difference is both interesting and important. It is interesting because we are able to see that similar conclusions can be drawn from either measure of debt. It is important because total debt only increases when a household engages in new borrowing. This is dissimilar from a household's DSR which can instead increase for two reasons. A household could either participate in new borrowing or the interest rate could increase on existing debt balances. For example, a household could take out a new mortgage, or it could have an adjustable-rate mortgage where the interest rate increases. Either way, the hypothetical mortgage-holding household increased its DSR.

Unfortunately, the households in the CEX do not report enough interest rate information in order to study which avenue is the most predominant driving force behind the negative relationship derived in this paper. This potentially presents opportunity for future study, but in the interim, it is important to consider that these facts suggest either an increase in debt balances or a jump in interest rates on adjustable-rate debt can lead to relatively smaller expenditure growth.

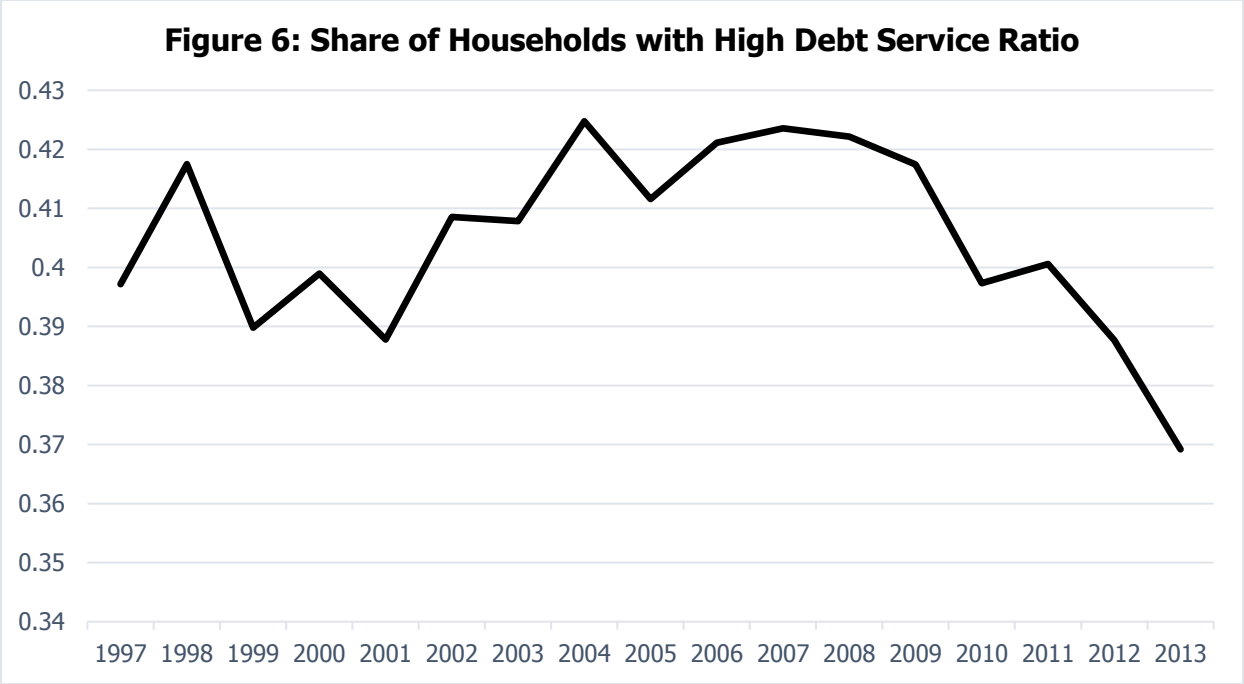
Furthermore, tying together the conclusions drawn so far potentially helps to explain the severity of the 2007-2009 financial crisis and the subsequent, lackluster recovery. It is easily verified that one of the largest components in the overall decline in economic activity during that period was the fall in personal consumption expenditures. In fact, real personal consumption expenditures per capita declined 3.55% year over year (U.S. Bureau of Economic Analysis) in the midst of the crisis. This was the worst decline since at least 1951, and it took relatively longer than past economic recoveries

for the year over year measure to sustainably return to its long-term average of 2.1% growth.

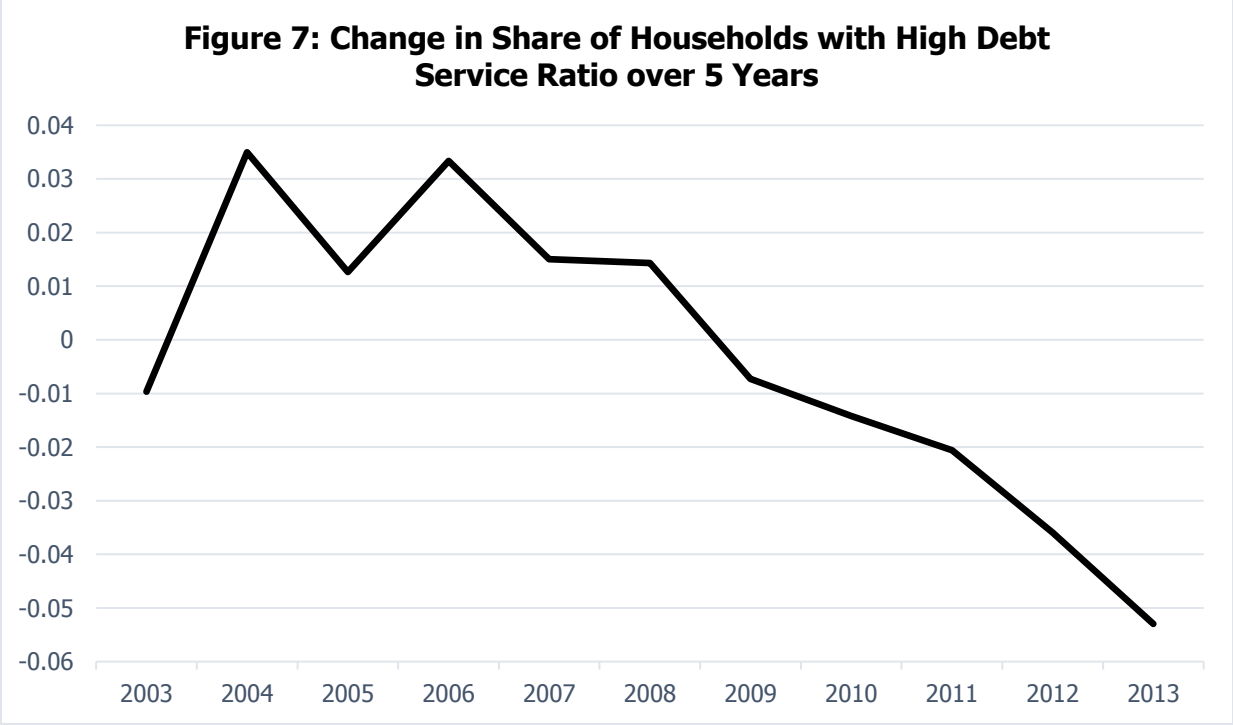
These facts naturally raise two questions: "why did real per capita expenditure fall so dramatically?" and "why has the subsequent recovery been so slow?" As was discussed in the introduction and literature discussion, lots of studies have attempted to address the role that debt plays in answering these questions including suggestions of credit constraints and voluntary debt reduction weighing on increases in expenditure. However, very few have taken the perspective of the spending normalization hypothesis to answer the questions. The remainder of this section will attempt to do just that.

The consistency of this paper's results using quarterly data along with the results of Andersen et al. (2016) using annual data suggests that similar results might also be found over other time periods as well. For instance, increases in household debt or debt service obligations over several years might lead to smaller expenditure growth for those same households over a similar period of subsequent years. Aggregate data, in fact, contends this may be true. Glick and Lansing (2010) compared increases in household leverage across countries of the world from 1997 to 2007. They found that countries that experienced larger increases in leverage during that time period also experienced more profound drops in expenditure during the financial crisis years.

Unfortunately, I am unaware of any household level studies of this type over such a long time period, and so, we are left scientifically speculating. However, if indeed the results of this paper hold over much longer time periods then the spending



A household is defined as having a high debt service ratio if its computed DSR is in the top three quintiles of all debt service ratios.



This chart was computed by taking a 5-year first difference of the data presented in Figure 4.

normalization hypothesis could easily apply to the years before and after the financial crisis. Figures 6 and 7 help illustrate this point. Figure 6 depicts the share of households within each year with a high DSR. The share measure was about 0.395 in the late 1990s and early 2000s and increased to about 0.42 by the middle 2000s. Using the Federal Reserve's count of households from the 2001 and 2007 rounds of the Survey of Consumer Finances, this amounts to about a 7.9 million increase in high DSR households between those years. An imperfect illustration of this increase is depicted in Figure 7 where it is easy to see that aggregately a large number of households switched from low to high DSR status in the early-to-late 2000s. One potential explanation of the severe drop in personal expenditure, therefore, is that a large share of households took part in debt-financed above average spending or experienced large increases in adjustable-rate debt payment obligations over a period of several years leading up to the financial crisis. If the spending normalization hypothesis holds over such long time periods then the negative correlation between a positive DSR change and subsequent expenditure growth defended in this paper would lead to the conclusion that a large number of households necessarily had to underspend during and after the financial crisis in order to return to "normal" levels of spending.

Chapter VII

Conclusion

This paper utilized household level data from the US Department of Labor's Consumer Expenditure Survey to investigate the connection between a household's debt service ratio and quarterly expenditure growth. A strong negative correlation was found to exist between a household's DSR and subsequent quarterly expenditure growth. This confirmed earlier results of the literature. Most notably, however, this paper showed that conditioning on a household's change in its DSR nullifies the statistical significance of the relationship. Instead, a very strong negative relationship between positive changes in household DSRs and succeeding expenditure growth was found to be the driver of the former relationship. This newly found outcome implies that households that increase their DSR from one quarter to the next increase their subsequent quarterly spending by fewer income percentage points than households with consistent or declining DSRs.

A number of smaller details were investigated in addition to this broader result. First, expenditure responses were found to be proportional to the actual size of a household's DSR change. This was followed up by work demonstrating that the effect of DSR changes was stable across time and across groups of households more or less

likely to be liquidity constrained. Also, the negative relationship held when the inspection period of DSR changes was changed from one to two quarters.

Altogether, this paper's results were consistent with earlier work by Andersen et al. (2016). This is notable because this paper's approach was unique in a few different ways. First, this paper used quarterly American data versus annual Danish data. This eliminated the possibility that the results of Andersen and others were due to some time-period length or country specific factors. In addition, each household's debt service ratio was utilized in the current paper in contrast to a total debt level. This is notable because it increases the overall level of robustness and confidence in the conclusions reached in both studies.

Furthermore, there are a few policy implications of this paper's results. Since the results demonstrate that increases in debt servicing obligations lead to relatively smaller expenditure growth rates, this implies that policy makers should pay close attention to the growth rate of debt as well as the rapid rise in servicing costs due to a rapid increase in interest rates. Doing so could help reduce overall economic volatility. Specifically, throttling the rapid growth of debt servicing costs relative to income could help prevent extreme drops in expenditures. Policy could, therefore, devote itself to educating the public on the consequences of overextending themselves in a short time period. Similarly, regulators could work with lenders to temper rapid debt binges, and bodies such as the Federal Reserve should be more aware of the consequences of raising benchmark interest rates when there is a large amount of adjustable-rate debt outstanding.

In the future, more attention should be given to studying how changes in debt affect future expenditure growth. More evidence is needed to better understand the consequences of pulling future demand forward. This is especially true over longer time frames. Future micro-level studies should examine whether or not spending normalization is supported in data over periods of several years. In addition, future researchers could study the cross-product heterogeneity of changes in a household's DSR on various different categories of expenditures. It might be the case, for example, that durable expenditures are affected more than nondurable expenditures since households are less likely to cut back on necessary spending on items such as food and housing.

Appendix

Appendix A
Table of Summary Statistics

Appendix Table 1: Summary Statistics	
	Average (SD)
Age	44.83 (11.41)
High School Graduate	0.88 (0.32)
College Graduate	0.42 (0.49)
Female	0.48 (0.50)
Married	0.60 (0.49)
Family Size	2.80 (1.52)
Number of Automobiles	1.05 (0.94)
Low Liquidity Household	0.40 (0.49)
Monthly Income (2000 $s)	4466.23 (4006.02)
Change in Expenditure (Survey 3 to Survey 4)	-0.01 (0.84)
Debt Service Ratio	0.23 (0.75)
High Debt Service Ratio	0.40 (0.49)
Change in Debt Service Ratio (Survey 2 to Survey 3)	0.004 (0.13)
Positive Change in Debt Service Ratio (Survey 2 to Survey 3)	0.21 (0.41)

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