AN INDEX TO TRACK CREDIT CARD DEBT AND PREDICT CONSUMPTION

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ABSTRACT

This paper presents the methodology for a new economic index that measures and tracks critical aspects of consumers' credit card debt. It also tests the predictive power of the index for consumption expenditures. The index utilizes original data from a monthly household survey and incorporates some variables which have generally been unavailable to researchers. The paper details the rationale and computation of measures used in the index. An examination of the index over an initial 66-month period shows that it exhibits a pattern that is consistent with well-established economic phenomena. Its predictive power is tested in a consumption function where lagged values of the index explain up to 14 percent of consumer durable expenditures.

JEL: D12, C81

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I. Introduction

This paper presents a new economic index to measure various aspects of consumers' credit card debt situation. Credit card use has become one of the most pervasive aspects of financial life in the U.S., with approximately three-quarters of all households owning at least one credit card.[1] The index described here is designed not only to capture the amount of credit card debt outstanding or the service burden of that debt, but also broader aspects of the consumers' ability to manage their debt, including default behavior, credit utilization rates, and types of stress associated with debt. The index uses an original data set, designed specifically for its construction, which measures and tracks consumer credit card debt use and condition on an ongoing, monthly basis. Some of the variables incorporated into the index – such the number of cards actually used in a month, the number of cards on which a consumer has reached the borrowing limit, total minimum payments from all cards, and the number of missed payments in the last 6 months – have not previously been publicly available to the researchers. The index has some advantages over the most commonly used measures of debt and is shown here to have predictive power for the growth of durable consumption expenditures.

Dramatic increases in personal bankruptcy filing and bank credit-card defaults have focused attention on the need for regular indicators of consumer debt condition (Domowitz and Eovaldi, 1993; Wilke, 1997, Domowitz and Sartain, 1999; Gross and Souleles, 2002). Data on consumer debt in the U.S. are available from the Federal Reserve Board of Governors and the American Bankers' Association. These data are highly aggregate in nature and are usually published with a lag of up to a few months.

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[1] *The Survey of Consumer Finances*, 1998.

Several measures of consumer debt condition utilizing these types of data have been used in previous research. Most commonly, some variant of the Debt Service Ratio (DSR) released by the Federal Reserve is used (Dunkelberg, 1989; Garner, 1996; Morgan & Toll, 1997; McCarthy, 1997; Murphy, 1998, 2000; Maki, 2000). The DSR estimates the required payments on consumer debt obligations such as mortgages, auto loans, and credit cards using bank data, assuming a 2.5 percent repayment rate. However, consumers may be behind on their payments and thus the estimated payments do not necessarily reflect the true payment situation. Furthermore, some consumers use their credit cards to pay off their mortgage or auto loans, and hence the DSR will be an overestimate in this case.[2] Delinquency or default rates on debt have also been used (Garner, 1996; Morgan & Toll, 1997; McCarthy, 1997). The Federal Reserve revolving credit series is another possible measure, but it captures only how much credit has been made available and not how consumers are taking and managing that credit (Ludvigson, 1999; Maki, 2000).

While these measures are useful, their level of aggregation masks much of the underlying consumer dynamics. Individual household information that takes into account all credit cards used and *actual* payments is needed for an accurate assessment of the consumer's debt condition. The Survey of Consumer Finances collects more disaggregate information on individual household debt, including credit card debt. These data have been examined by Jappelli (1990); Kennickell and Starr-McCluer (1994); Calem and Mester (1995); Yoo (1997); Ludvigson (1999); Min and Kim (2003); and Kerr

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[2] The Federal Reserve has recently undertaken revisions to the DSR to make the process used in calculating it more in line with recent changes in financial markets and consumer behavior. However, the DSR still reflects overall debt at an aggregate level and does not capture many subtle behavioral aspects (Dynan et. al. 2003).

and Dunn (2004). However, this survey is only implemented at three-year intervals, and hence its usefulness for tracking short-term trends is limited.

The Consumer Debt Index (CDI) presented here represents an advance over existing banking indicators in that it is based on behavioral survey data at the level of the individual. Also, it is computed and published on a on a monthly basis which provides high frequency of observation. The index and its individual components should provide insights into such issues as the sensitivity of credit card use to interest rates, seasonal trends in the transactions motive for credit card use, and the macroeconomic impact of credit card use on retail sales and other consumer phenomena (Brito and Hartley, 1995; Ausubel, 1991).

Finally, one component of the CDI is a stand-alone index designed to measure the psycho-sociological impact of debt on the American family. This unique indicator – known as the Debt Stress Index (DSI) – assesses the effects of debt on the psychological well being of households. A number of authors have addressed the social and psychological background of debt (e.g., Sullivan et. al., (1989); Lunt & Livingstone, (1992); and Lea et al., (1993, 1995)). However, to our knowledge, no one has previously developed a systematic measure of the underlying stress that debt levels cause a household, although among health care professionals there is growing evidence of the adverse effects of debt on marriage, family and home life, and job performance. The Debt Stress Index is one of nine sub-components of the overall CDI.

In Section II through IV below, we present the construction features of the overall Consumer Debt Index. In Section V we evaluate the index using Fisher's component reversal and time reversal tests (Fisher, 1927). Finally, we fit a consumption function to the index using 66 months of data and find that the Index explains up to 14 percent of durable spending growth.

II. The Survey and Index Components

The data for our index come from a monthly household telephone survey conducted in the state of Ohio, a major test market area in the U.S. [3] (Appendix C demonstrates that the socioeconomic and demographic characteristics of the Ohio sample and the sample used for the 1998 *Survey of Consumer Finances* are very close.) The index was initiated in November 1996. A simple random sample is taken each month, and the completed sample size is at least 500 adult household members. The CDI is computed from 13 different survey questions that are specifically directed at credit card usage and debt, plus income information. All quantitative variables used in the computation of the index components, including household income, are continuous numerical values. The sub-component stress index is derived from four survey questions directed at psychological aspects of debt from *all* sources, including car loans, mortgage debt, etc. since it is difficult for respondents to distinguish stress from different debt sources. The exact wording of the survey questions is presented in Appendix C.

Components of the CDI constructed from these survey questions are given below. Note that some components are based on averages over individual household responses (# 3-5 and 7 below), and some represent percentages of the combined sample (# 1-2, 6, and 8). All components have a *positive* impact on the index, raising the level of index when their quantitative value rises. While most of the components are self-explanatory, discussion of some items is useful. For example, Component # 1, measures the percentage of the sample that has used more than two credit cards in the past month. The number "two" was chosen because this has been found to be the modal number of cards charged on in a month.

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[3] The survey will be moved to the national level in 2005.

Component #3 is designed to capture the change in household monthly credit card balance. A build-up in the value of this component would indicate one of two possible circumstances: (1) either households were charging beyond their ability to pay off balances; or (2) households were deliberately choosing an inter-temporal consumption shift within the framework of a rational plan for future debt repayment. Either way, the household has used some credit line and has become more credit-constrained at the current moment.

Individual Components of the CDI

Component	Name
1. Percentage of sample who charged on more than two credit cards in the previous month	*Number of Cards Used (greater than sample mode)*
2. Percentage of sample who carried a credit card balance forward from most recent statements	*Carrying a Balance*
3. Total unpaid (or carried) balance for current month taken as percent of total amount owed for each household	*Unpaid Balance to Amount Owed*
4. Total amount owed on all credit cards taken as a percent of annual household income for each household	*Amount Owed to Household Income*
5. Percentage of total available credit line which has been used by each household	*Amount Owed to Total Credit Line*
6. Percentage of sample who have missed making the minimum payment on a credit card at least once in last six months	*Missed Payment*
7. Minimum Payment owed on all credit cards as a percent of monthly household income	*Minimum Payment to Monthly Household Income*
8. Percentage of sample who have reached the borrowing limit on at least one card.[4]	*Maxed Cards*
9. The Debt Stress Index (DSI)	*Debt Stress Index*

Component #5 indicates how much credit is available for consumers to use for future consumption. The component is useful for gauging the potential for future increases in consumer spending beyond the usual constraint of income received.

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[4] Collection of data for this component began in February 1998 and it was first used in the Index in April 1999.

Component #9 is directed at measuring the more abstract concept of the stress a household feels from the debt levels they are carrying. The construction of the Debt Stress Index from four separate survey questions is detailed in Appendix A.

III. Index Computation

In this section, we specify the method for computing the debt index. Denote the observations by $y_{i,j,t}$ where $i = 1, 5, n_t$ refers to an individual respondent, $j = 1, 5, 9$ refers to a component of the debt index, and t refers to the time period (month) of the survey.

For each component of the index where the individual observation is a continuous variable (*Unpaid Balance to Amount Owed*, *Amount Owed to Household Income*, *Amount Owed to Total Credit Line*, and *Minimum Payment to Monthly Household Income*), compute $y_{j,t}$ as the sample mean of component j in month t, i.e.,

$$y_{j,t} = \frac{1}{n_t} \sum_{i=1}^{n_t} y_{i,j,t} .$$ (1)

For each component of the index where the individual observation is a dummy variable (*Carrying a Balance, Number of Cards Used,* and *Missed Payment, Maxed Cards*), compute $y_{j,t}$ as the percentage of the sample with $y_{i,j,t} = 1$, i.e.,

$$y_{j,t} = 100 \frac{1}{n_t} \sum_{i=1}^{n_t} y_{i,j,t}$$ (2)

The remaining component of the debt index, $y_{j,t}$ with $j = 9$, is the *Debt Stress Index*, computed as described in Appendix A.

For each j, the time-series standard deviation σ_j is computed and used as a weight for that component. The index was initially constructed using the first 24 months of data, and thus we have for the 24-month period

$$\sigma_j = \left(\frac{1}{23} \sum_{t=t_0}^{t_0+23} (y_{j,t} - \bar{y}_j)^2 \right)^{1/2} \tag{3}$$

where $\bar{y}_j$ is the sample mean of $y_{j,t}$ for the same 24-month period, and t_0 is the month of the initial survey, November 1996.

Starting with the data for October 1999, the time-series standard deviation for each of the individual components is recalculated annually with the addition of the monthly means for the past 12 months, i.e., using all data accumulated up to the point of the revision. This updates each time-series standard deviation so that if certain components become more volatile over time, this higher volatility is not what is driving the index. The component $y_{j,t}$ is weighted by the inverse of its time-series standard deviation σ_j. This is called the *standardized component*, denoted by $C_{j,t}$.

Next, the nine standardized components for a given month are averaged to obtain the preliminary debt index,

$$\text{Prelim } CDI_t = \frac{1}{9} \sum_{j=1}^{9} C_{j,t} \tag{4}$$

The last step necessary to obtain the CDI is to choose a base period and scale the remaining months by this base period. The base period chosen is January 1997, and the preliminary debt index is rescaled so that the base period value of the CDI is set to equal 100.

$$CDI_t = \frac{\text{Prelim} CDI_t}{\text{Prelim} CDI_{0197}} \cdot 100 \tag{5}$$

A further re-weighting of the CDI is necessary when the time-series standard deviations are recalculated annually, in order to prevent artificial shifts in the CDI when the newly computed standard deviations are used.

Seasonal adjustment of the index will be considered at a future date when enough data have been collected to make a decision on this issue. Seasonal adjustment will allow a decomposition of the time-series so that the short and long-term behavior of the series can be studied more clearly.

IV. Considerations in Constructing the Consumer Debt Index

Next we will address considerations involved in the choices of (a) standardization, (b) aggregation, and (c) base period as presented above.

(a) Standardization

First, it was necessary to standardize the disparate individual components so they could be aggregated into a single composite index. The individual components are a mixture of percentages of sample responses and means of combinations of sample questions. The components, *Carrying a Balance*, *Number of Cards Used*, and *Missed Payments* are percentages, while *Unpaid Balance to Amount Owed*, Amount *Owed to Household Income*, Amount *Owed to Total Credit Line*, and *Minimum Payment to Monthly Household Income* are ratios of dollar-denominated values. The Debt Stress Index, as noted, is an index in its own right and a unit-less number. To avoid adding scale-dependent components, the components must be standardized. The choice of a standardizing factor requires a specification of exactly how movements in individual components will be allowed to affect the index. Two choices were considered: (1) standardizing (i.e., dividing) each component by its time-series standard deviation, or (2) standardizing each component by its time-series mean. If the first method is used, each component's variance then equals one, so that each affects the variability of the overall

index equally but comprises an unequal proportion of the index. This insures that the more volatile components do not dominate movements in the index by the mere fact that they are more volatile. Under the second method, the magnitude of each component would be standardized so that each makes up roughly the same percentage of the overall index, but more volatile components would have a greater impact on the overall index. Since there is no inherent reason to assume that the more volatile components are the best gauge of the consumers' debt condition, the first method (i.e., standardization by time-series standard deviation) was adopted.

As a check for robustness of the index to the two different possible specifications, the CDI was calculated using both method #1 (equal variability) and method #2 (equal representation) for the first 27 months of data collection. (See Figure B1 in Appendix B for a plot of the index computed under both methods.) The correlation between the indices computed by the two different methods is 0.9527 with a RMSE of 2.75.[5] The directional changes are the same under both methods in 23 out of the first 27 months checked. Since we have constructed the index so that the volatility across components is equalized over time, we feel that changes in the CDI can be attributed to meaningful changes in its components rather than to movements in the most volatile components.

 (b) Aggregation Method

In deciding how to aggregate the standardized components, the issue of weighting was considered. The CDI incorporates both traditional and non-traditional information with respect to the consumers' credit card debt burden, and there is no *a priori* reason to think that any of the individual components is a better measure of a household's debt condition than any other component. Hence we chose not to weight the CDI components relative to some macroeconomic measure as is done with the Indices of Leading, Coincident, and Lagging Indicators (U.S. Commerce Department,

1984), where each component is weighted to reflect its overall performance score as a cyclical indicator. Each component of the CDI is therefore equally weighted in the aggregation, entering the index with a weight of one.

We considered two possible methods for aggregation – arithmetic addition or geometric addition. The arithmetic and geometric methods can be represented respectively by:

$$OCDI_t = 100 \sum_{j=1}^{9} C_{jt} \Big/ \sum_{j=1}^{9} C_{jB} \text{ and } OCDI_t = 100 \sqrt[9]{\prod_{j=1}^{9} C_{jt}} \Big/ \sqrt[9]{\prod_{j=1}^{9} C_{jB}}$$

where C_{jt} is component j at time t and C_{jB} is component j in base period B.

The index has been compared using both of these methods. The correlation between the indices computed under the two different methods is 0.9103, the RMSE is 3.26, and the directional changes are the same in 22 of the first 27 months used in examining construction features. The correlation between the first differences of the two aggregation methods is 0.8776. Figure B2 in Appendix B reveals very similar indices using either the geometric aggregation method or the arithmetic aggregation method. The variance ratio of the arithmetic method to the geometric method is 0.6953 indicating a lower variability with the arithmetic method. Given the similarity between the two methods and the slightly higher variability of the geometric method, the arithmetic aggregation method was adopted.

(c) Base Period

Incorporating a base period into the construction of an index is critical for allowing a given period's index value to be compared to the value of the index from another period of interest. For example, the Index of Consumer Sentiment computed by the Survey Research Center at the University of Michigan chooses 1966 (a period of

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[5] A correlation of the first differences of the two methods for standardizing the indices is 0.9145.

high consumer confidence) as its base year and constructs its index to have a value of 100 in that year. For the CDI, January 1997 was chosen as the base period. January is a peak month for outstanding debt since consumers have just gone through the end-of-year holiday shopping season. The index is constructed to have a value of 100 in that month, and its value in subsequent months is referenced to that time.

In considering the incorporation of a base period for the CDI, we chose to use a simple aggregative method, taking the average of the components in time period t and dividing them by the average of the components in the base period.   This method specifies the CDI as: $CDI_t = \dfrac{\sum_{j=1}^{8} C_{jt}}{\sum_{j=1}^{8} C_{jB}})$, where C_{jt} is component j in month t and C_{jB} is component j in the base period.

An alternative method of incorporating a base period would have been to use a simple arithmetic method, first dividing each component at time t by its respective base period component and then taking the average of these ratios. This method was not used because it would merely change the standardization adopted in step (a) above.

In summary, the CDI is an index in which each component is standardized by its time-series standard deviation. This insures that each component has equal variability, but allows each to contribute a different proportion of the overall CDI. The components are aggregated using an arithmetic averaging method that avoids the additional volatility introduced by geometric averaging. Thus our index construction is in line with other indices frequently used by researchers, such as the Index of Leading Indicators. [6]

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[6] A formula for the sample variance of the Consumer Debt Index using a first order Taylor series approximation is available from the authors upon request.

V. Evaluating the Index

Lastly, it is important to critically evaluate the index methodology used in constructing the CDI. We have seen thus far that the desirable features of the CDI are: (1) the variability of each component is equal; (2) the CDI is homogenous of degree one in its components; and (3) the value of the CDI is directly comparable across months, i.e., it is an ordinal scale. In this section, we use Irving Fisher's (1927) classic work on desirable properties for an index to assess the appropriateness of the CDI. While Fisher was mainly concerned with indices which aggregated economic prices and goods and services, two of the important properties that he proposed for a well-constructed index are applicable to the type of index presented here. They are the component reversal test and the time reversal test. We next consider these Fisher index properties tests in turn.

(a) The Component Reversal Test. This test, which is easily passed by most indices, requires that the ordering of components within the index should not affect its overall value. In the context of the CDI, this means that component 1 can be aggregated first with component 2 and then the rest of the components, and the value of the overall index should be the same as if component 1 was aggregated first with component 3 and then the rest in any arbitrary order desired. With the arithmetic method of aggregation used in constructing the CDI, the overall index value is indeed invariant to the ordering of the components.

(b) The Time Reversal Test. This test requires that the formula for calculating an index number should give the same ratio between one point of comparison and any other point regardless of which is taken as the base. In other words, the "forward index number" (where the base period is prior to the period of interest) multiplied by the "backward index number" (where the period of interest is now the base period and the former base period is now the period of interest) should equal one. A simple example

that Fisher gives where an index fails this second test is one where the index is computed as a simple arithmetic average of price relatives (where a price relative is defined as the ratio of the price of a commodity in the period of interest to the price of that commodity in the base period (Fisher, 1927, pg. 64)). Since the CDI is the ratio of the raw index value in the period of interest divided by the raw index value in the base period, the forward index number multiplied by the backward index number will be one.

VI. Patterns of the Consumer Debt Index

Figure 1 below plots the CDI for the 66-month period beginning November 1996. A plot of the sub-component Debt Stress Index is presented in Appendix A. We see from the figure that the CDI displays a seasonal pattern that conforms to well-documented economic behaviors, suggesting that the index is indeed capturing the basic conditions that it is designed to track. In particular, the CDI rises in December with holiday spending. January/February, following the major holiday shopping and charging season, therefore typically represents a high value for credit card debt incidence. Such seasonal changes in the index presumably represent rational actions by consumers as they use debt to adjust their timing of consumption, and no pejorative meaning is attached to them. The Federal Reserve's Total Revolving Consumer Credit series shows the same holiday season shopping spikes as our index. In general, however, the Fed series does not exhibit the same overall pattern since as noted, it captures only how much credit has been made available and not the behavioral issue of how consumers are taking and managing that credit. The index falls after the first of the year as consumers begin to pay off holiday credit card balances. The rapidity with which the unpaid balance-to-total debt ratio subcomponent falls is an indicator of degree to which charges represent the so-called "convenience use" of credit cards rather than a longer-term debt vehicle. There is another upturn in the debt index in the spring, conforming to

the widely observed phenomenon that many households resort to heavy credit card use and save cash when income taxes are due. The index then generally tapers off until the back-to-school buying season arrives in late summer/early fall.

CDI (Nine Components)
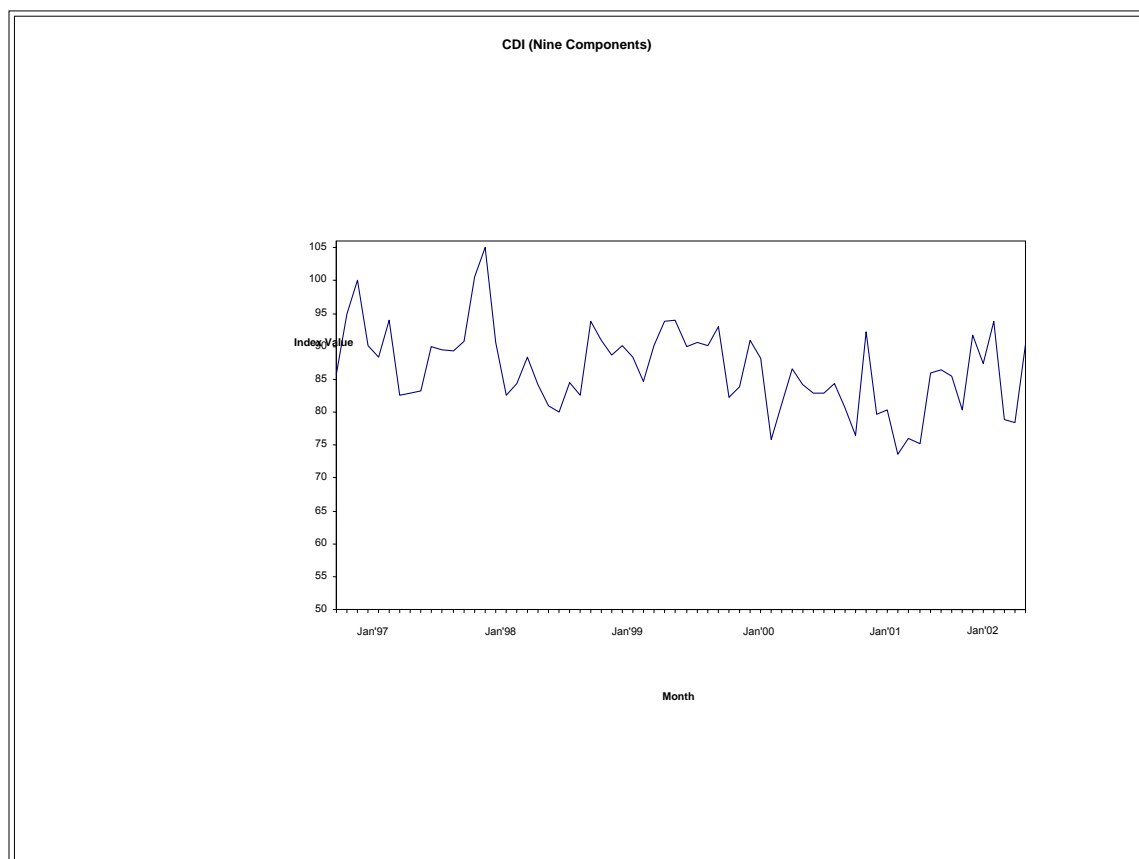
VII. The Index's Predictive Power for Consumption

Background

Finally, we examine the question of whether this index has predictive power for consumption expenditures.[7] There is some existing empirical evidence that suggests a link between household debt and household consumption, although basic theoretical models (e.g., life-cycle model and permanent income hypothesis) predict that contemporaneous variables such as consumer credit should not play a role in

consumption growth. Most previous published studies have used data series from the Federal Reserve Board as their measure of aggregate debt levels – usually the Debt Service Ratio (DSR) and total revolving credit. There is a variation in previous findings. Maki (2000) finds that changes in consumer credit and delinquencies, but not the DSR, are related to consumption growth. Ludvigson (1999) finds that changes in total installment credit and revolving credit are significantly related to consumption growth. Carroll and Dunn (1997) and McCarthy (1997) have studied the relationship between household debt growth and durable consumption and also find a positive and significant relationship between these variables. McCarthy explains his findings by arguing that the rise in consumer debt is probably due to higher income expectations in the future which makes consumers more willing to take on debt to finance their expenditures. On the other hand, Murphy (2000), using different control variables, finds a negative relationship between lagged values of the DSR and spending on durable goods and services.

Although the previous research in general establishes a relationship between household indebtedness and consumption, the important question of how to best capture the critical aspects of household debt behavior that underlie consumption patterns remains. The measures that have been used in the literature thus far are highly aggregate and may not be capturing subtle aspects of the debt burden of individual households. Since credit cards have become a major debt instrument for financing consumption in the U.S., it can be argued that their use may hold a special salience for consumers among the various types of household debt that are contained in aggregate government statistics. In addition, there are particular aspects of credit card debt that make it especially relevant for predicting consumption – for example, the amount of unused credit line may be important to consumers when making consumption choices.

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[7] Some individual components have also been shown to predict credit card default (Dunn and Kim, 1999).

These are some of the concerns which motivated the construction of the Consumer Debt Index presented here. We now turn to the estimation of a consumption function which tests whether the CDI can predict aggregate durable spending growth.

Empirical Investigation

In our empirical estimation, we have fit simple models of consumption similar to those used by Carroll, Fuhrer, and Wilcox (1994) in their investigation of the ability of a consumer confidence index to predict various categories of consumption expenditures. The first fitted equation has the form

$$\Delta \text{ Ln } C_{t+1} = \alpha_0 + \Sigma_i \beta_i D_{t-i} + \epsilon_t \qquad (1)$$

Where D_i is the CDI. This equation tests whether lagged values of the CDI alone have predictive power for aggregate consumption growth. We will use monthly spending on durables as the measure of consumption for the period November 1996 through April 2002.

We estimate equation (1) using different lag specifications. The results are presented in Table 1, where adjusted R-squares are presented. The numbers in parentheses correspond to the p-value of testing if beta's are jointly significantly different from zero. As seen in the table, lagged values of CDI can explain between 7 and 12 percent of the durable consumption growth for different specifications of the lags. The coefficients are jointly significantly different from zero at the 7 percent level for two cases and just under the 10 percent level in the 4 lag case.

Table 1. Reduced Form Evidence: Adjusted R^2's

Dependent Variable	3 Lags (p-value)	4 Lags (p-value)	6 Lags (p-value)
Durable Spending	0.07 (0.07)	0.10 (0.11)	0.12 (0.07)

Next we have fit the same equation including lagged values of the growth rate of real disposable personal income and lagged values of the dependent variable as control variables.[8]   We estimate equation (2) below

$$\Delta\, Ln\, C_{t+1} = \alpha_0 + \Sigma_i\beta_i D_{t-i} + \Sigma_i\beta_i Z_{t-i} + \epsilon_t \qquad\qquad (2)$$

where Z_t includes the control variables. The results are presented in Table 2 and show that even after controlling for other variables, the CDI is still a significant predictor of the growth rate of durable spending. For durable consumption, the additional predictive power for the index ranges between 10-14 percent. The p-values also reveal that the coefficients are jointly significantly different from zero at 10% or better.

Table 2. Incremental Adjusted R^2 after Adding Other Control Variables

Dependent Variable	3 Lags (p-value)	4 Lags (p-value)	6 Lags (p-value)
Durable Spending	0.10 (0.03)	0.11 (0.07)	0.14 (0.10)

Thus the CDI has predictive power for durable spending even when controls for income and past consumption are included.

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[8] The disposable income and consumption values are all seasonally adjusted values (chained 2000 dollars). These control variables are two lags of the dependent variable and two lags of the growth of real disposable income.

VIII. Conclusions

This paper has presented and tested the methodology for constructing a Consumer Debt Index (CDI) to measure consumers' credit card debt burden and their ability to manage those debts. The index incorporates timely and accurate information about a variety of credit card aspects, such as consumers' total minimum required payment across all cards, number of missed payments, cards on which the borrowing limit has been reached, and stress caused by debt. The data for the index come from a new monthly household telephone survey designed specifically for its construction. Much of this information has generally been unavailable to researchers through existing public sources. The index tracks secular trends in consumer credit card use as well as identifying seasonal variations. Since it is based on disaggregate household data aimed at credit card use, it captures the behavioral phenomena underlying consumer debt in a way that that is unavailable through other time series measures such as the Debt Service Ratio or the Federal Reserve's revolving credit series. The CDI also contains as one of its 9 components, a stand-alone Debt Stress Index. This allows researchers to specifically identify the psychological stress associated with debt, which is a growing concern among health care professionals for the areas of family function and job performance.

The predictive power of the CDI is tested in a fit of a consumption function. The results show that using up to 6 monthly lags, the CDI by itself explains 7-12 percent of the growth of durable expenditure. After controlling for income growth and lagged values of consumption growth, the CDI is found to predict 10-14 percent of durable expenditure growth.

Given the widespread and rapidly growing use of credit cards use in the U.S. in recent years, their incorporation into traditional macroeconomic models has become

critical to a full understanding of consumer behavior. The CDI should provide one tool for economic analysts and policy-makers to use toward this end.

APPENDIX A
The Calculation of the Debt Stress Index

The Debt Stress Index measures the level of stress created for a household by the total amount of debt it has undertaken. Four survey items were developed to tap different aspects of the stress from debt. They use different response-choice categories in order to eliminate possible methodological artifact inherent in repetitive choosing.

The component survey questions for the DSI are presented in Appendix C. They measure the household's (1) amount of worry about debt; (2) amount of stress from debt; (3) perceived problem from their debt over the next five years; and (4) concern that they will never be able to pay off the debt. Each component is measured on a five-point scale. All four of the components have a positive effect on the index, causing it to rise when the worry/stress/concern of the household rises.

All four components have a high level of internal consistency, as well as strong "face validity." Factor analysis shows each of the items with a factor loading near or above 0.90, with a one-factor solution accounting for 80% of their common variance. Bolstering these findings is a Cronbach's Alpha of 0.87 for the three-item additive index.

The Debt Stress Index is computed by adding the responses from each item (which are scored from 0 to 4, with zero indicating no stress and 4 indicating high stress). Each value for the households in the sample is multiplied by 6.25 to distribute the index across a 0–100 scale, with high scores indicating high stress. For certain analyses, the index also can be collapsed into six categories of stress levels: None/Low/ Medium/Medium High/High/Extreme.[9]

For the first 22 months of gathering data on this index, the average score per month has been 29.08, which we define as being in the *Medium Stress* range. The average monthly distribution of stress levels among respondents has been 27% *None*, 17% *Low*, 21% *Medium*, 21% *Medium High*, 8% *High*, and 6% *Extreme*.

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[9] The ranges of values for these categories are as follows: None 0; Low 1-20; Medium 21-40; Medium High 41-60; High 61-80; Extreme 81-100.

Those sample members with the highest average debt stress as a group are younger women who do not live with another adult, who have at least one dependent child, low educational attainment (not a high school grad), and low household income (< $20K). The average Debt Stress Index score of this group is 49.5. On the other hand, those sample members with the lowest average debt stress as a group are older, retired, married men, with no dependent children, who have high educational attainment (college grads) and high household incomes (> $50K). The average debt stress index score of this latter group is 3.3.

The Debt Stress Index for the period November 1996 through April 2002 is presented in the diagram below. It should be remembered that the Debt Stress Index captures stress from *all* sources, not just credit card charges since it is difficult for households to distinguish stress from different sources of debt. Hence it would not be expected to move perfectly in step with the overall CDI.

DSI
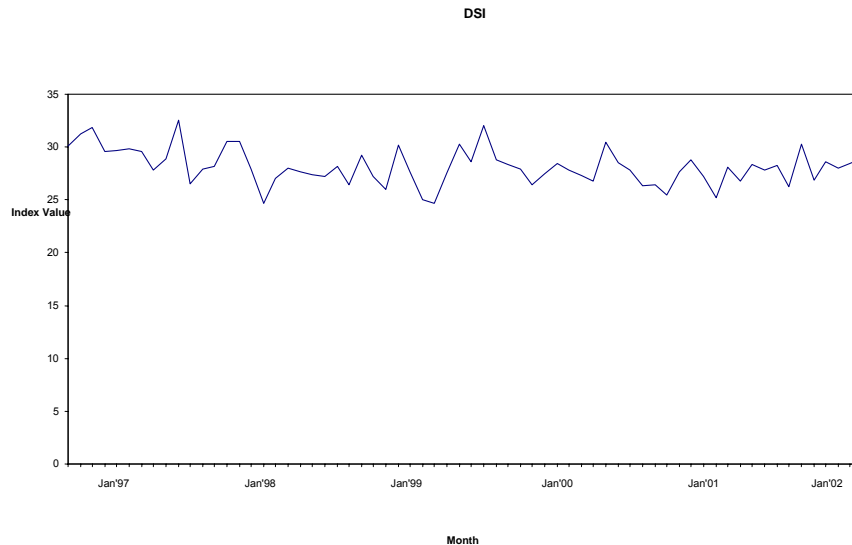
APPENDIX B

Figure B1: Two Methods of Standardizing the Components of the Overall Index
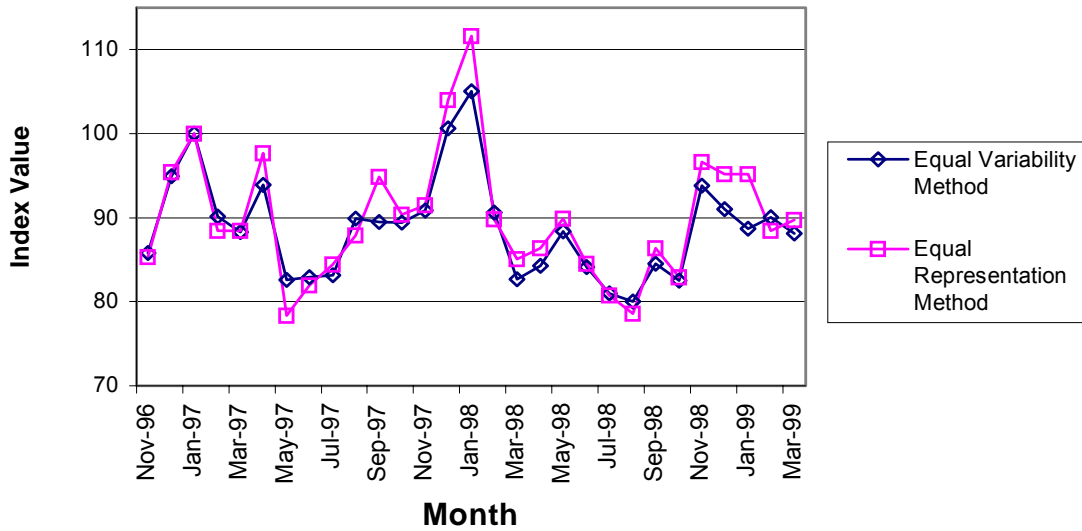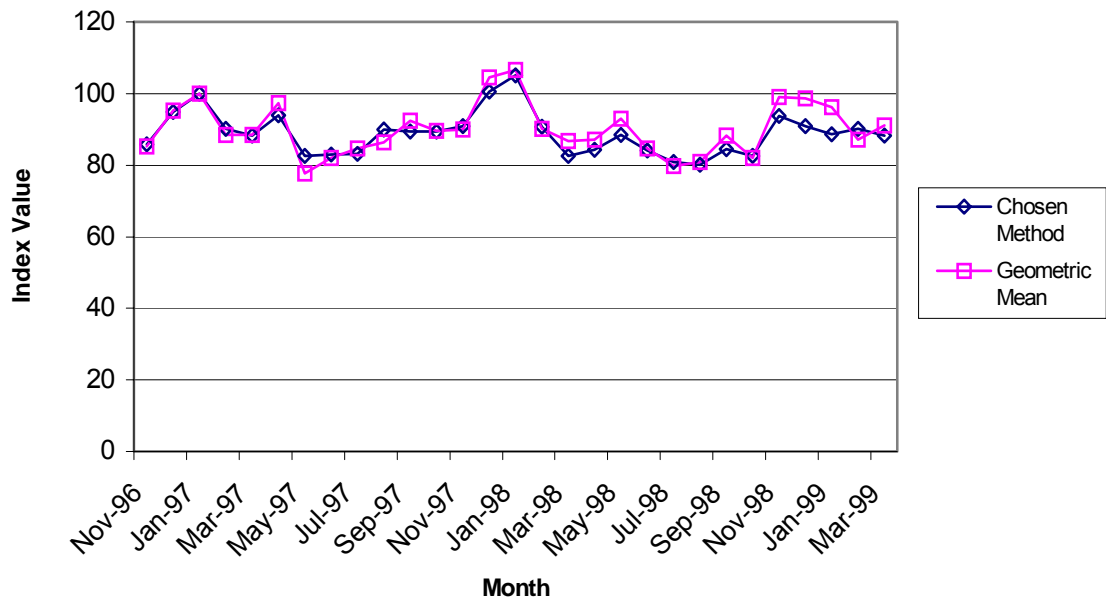

Figure B2: Two Methods of Aggregating the Overall Index Components

APPENDIX C

The Survey, Sample, Response, and Data Quality

The data for this research are collected in a monthly household telephone survey administered by the Ohio State University Center for Survey Research beginning in November of 1996 using the latest technology available in the survey area. A simple random sample is taken each month, and the sample size is at least 500 adult household members. The Random-Digit-Dialing method of sample selection is used to select a statewide sample. To account for possible non-response error, the results are weighted to take into account the number of telephone lines in each household and to adjust for variations in the sample from the population related to gender, age, racial background, education, and presence of children.

Respondents are encouraged to consult their most recent credit card statements in order to facilitate the recall of the credit card information. This may include terminating the current phone call with the scheduling of a callback when the respondent has all the information together to answer the questions. To ensure the highest data quality, a number of steps are undertaken. There is third party monitoring of the interview process. There are extensive checks for internal consistency in the responses, including the use of filtering algorithms.

The debt index has been tested for possible bias from item non-response using Rubin's (1978, 1987) multiple imputation approach. The index as currently calculated has been compared to the index using imputed data, and the correlation is 0.98. Thus, missing data, due to item non-response, does not appear to add a significant bias to the overall index.

Table C1 below demonstrates that the sample characteristics for the Ohio sample are very close to characteristics of the national sample used for the *Survey of*

Consumer Finances. The main difference occurs with gender. The disproportionate number of males in the *SCF* arises from its personal interviewing of household heads in a sample that over-represents the wealthy. The Ohio sample's gender breakdown is closer to the actual national proportions, which results from its random sampling.

Table C1: Descriptive Statistics for the CDI Sample and 1998 SCF Sample

Variable	Definition	CDI Sample Mean	1998 SCF Mean[*]
Log of Income	Log of household income	10.5	11.10
Interest rate	Interest rate charged on one most commonly used credit card	14.37	14.52
White	Dummy variable =1 if the race of the respondent is white; =0 otherwise	0.86	0.86
Own	Dummy variable =1 if the respondent owns house; =0 otherwise	0.77	0.78
Education	Highest grade completed	13.19	14.32
Age	Age of the respondent	47.15	50.02
Gender	Dummy variable = 1 if respondent is male; = 0 otherwise	0.41	0.76
Employed	Dummy variable=1 if the respondent is employed; =0 otherwise	0.61	0.76

[*] These statistics for the SCF are taken from Min and Kim (2003), table 2.

APPENDIX D

Wording of the Survey Questions

The exact wording of the survey questions used in the construction of the two indices is presented below.

Consumer Debt Index

"The following set of questions asks about you (and your spouse's/partner's) use of credit cards. When we say credit cards in these questions, we do not include any debit cards that you may have which merely subtract funds from a bank account."

1. Last month, did you make any charges or take any cash advances on one or more of your credit cards?

2. On how many different credit card accounts did you charge or take a cash advance on last month?

3. According to your most recent statements, approximately what did the total charges and/or cash advances amount to for the last month for all your credit cards together?

4. Have you or will you pay off all of the last month's charges and/or cash advances on your most recent statements or did you or will you carry some of them over?

5. Approximately how much of the total amount of your last month's charges and/or cash advances on your most recent statements have you or will you pay off?

6. Right now, approximately what is the total amount you owe on all your credit cards after your most recent payments?

7. Considering all the credit card accounts that you have, approximately what is your total line of credit or credit limit?

8. In the past six months, how many times did you not pay off at least the minimum amount due on any of your credit cards?

25

9. Approximately what was the total amount you were required to pay in minimum monthly payments last month on all your credit cards taken together?

Debt Stress Index Sub-component

"Now, I'd like you to think about your *overall* debt, including any that is on credit cards, store credit, a mortgage or home equity loan, a car loan, or any other outstanding loan you may have."

10. Overall, how often do you worry about the total amount you owe in overall debt? Would you say you worry (a) all of the time; (b) most of the time; (c) some of the time; (d) hardly ever; or (e) not at all?

11. How much stress does the total debt you are carrying cause to you? It is (a) a great deal of stress; (b) quite a bit; (c) some stress; (d) not very much; or (e) no stress at all?

12. Now, thinking ahead over the next five years, how much of a problem, if any, will the total debt you have taken on be for you? Will it be (a) an extreme problem; (b) a large one; (c) medium; (d) small; or (e) no problem at all?

13. How concerned are you that you *never* will be able to pay off these debts? Are you (a) very concerned; (b) quite concerned; (c) somewhat concerned; (d) not very concerned; or (e) not at all concerned?

REFERENCES

Ausubel, Lawrence M., "The Failure of Competition in the Credit Card Market," *The American Economic Review,* vol 81, no. 1 (March, 1991), pp.50-81.

Brito, Dagobert I. and Peter R. Hartley, "Consumer Rationality and Credit Cards," *Journal of Political Economy,* vol. 103, no. 4, (1995), pp. 400-433.

Calem, Paul S., and Loretta J. Mester, " Consumer Behavior and Stickiness of Credit Card Interest Rates," *American Economic Review*, 85(5), December 1995, 1327-1336.

Carroll, Christopher D., Jeffrey C. Fuhrer, David W. Wilcox, "Does Consumer Sentiment Forecast Household Spending? If So, Why?" *American Economic Review,* Vol. 84, No.5 (Dec. 1994), 1397-1408.

Carroll, Christopher D. and Wendy E. Dunn. "Unemployment Expectations, Jumping (S,s) Triggers, and Household Balance Sheets," NBER Macroeconomics Annual 1997.

Domowitz, Ian, and Thomas L. Eovaldi, "The Impact of the Bankruptcy Reform Act of 1978 on consumer Bankruptcy," *Journal of Law and Economics,* October, 1993, v. 36, pp.803-835.

Domowitz, Ian and Robert L Sartain. "Determinants of the Consumer Bankruptcy Decision," *The Journal of Finance*, February, 1999, v.54, pp. 403-420.

Dunkelberg. William C. "Analyzing Consumer Spending and Debt," *Business Economics*, July 1989, v. 24, pp. 17-22.

Dunn, Lucia F. and TaeHyung Kim. "An Empirical Investigation of Credit Card Default," Working Paper # 99-15, Ohio State University. October 1999.

Dynan, Karen, Kathleen Johnson, and Karen Pence. "Recent Changes to a Measure of U.S. Household Debt Service", *Federal Reserve Bulletin*, October 2003, 417-26.

Fisher, Irving. *The Making of Index Numbers: A Study of Their Varieties, Tests, and Reliability*, Houghton Mifflin Company, New York, 1927.

Garner, C. Alan. "Can Measures of the Consumer Debt Burden Reliably Predict An Economic Slowdown?" Federal Reserve Bank of Kansas City, *Economic Review*, 1996, v. 81, no. 4, pp. 63-76.

Gross, David B. and Nicholas S. Souleles. "An Empirical Analysis of Personal

> Bankruptcy and Delinquency," *Review of Financial Studies*, Spring 2002,

> v. 15, no. 1, pp. 319-347.

*Handbook of Cyclical Indicators: A Supplement to the Business Conditions

> Digest,* U.S. Department of Commerce, 1984.

Jappelli, Tullio, "Who is Credit Constrained in the U.S. Economy?" *The Quarterly

> Journal of Economics,* vol. 105, No. 1 (February, 1990), pp. 219-234.

Kennickell, Arthur B., and Martha Starr-McCluer, "Changes in Family Finances

> From 1989 to 1992," *Federal Reserve Bulletin,* (October, 1994), v. 80, pp. 861-

> 882.

Lea, Stephen E. G., Paul Webley, and R. Mark Levine, "The Economic

> Psychology of Consumer Debt", 1993, *Journal of Economic Psychology*,

> 14, pp. 85-119.

Lea, Stephen E. G., Paul Webley, and Catherine M. Walker, "Psychological

> Factors in Consumer Debt: Money Management, Economic Socialization,

> and Credit Use", 1995, *Journal of Economic Psychology*, 16, pp. 681-701.

Ludvigson, Sydney. "Consumption and Credit: A Model of Time-Varying Liquidity

> Constraints," *The Review of Economics and Statistics,* August 1999, 81

> (3): 434-447.

Lunt, Peter K. and Sonia M. Livingstone, "Predicting Personal Debt and Debt

> Repayment: Psychological, Social, and Economic Determinants", *Journal

> Of Economic Psychology*, 1992, 13, pp. 111-134.

Maki, Dean M. "The Growth of Consumer Credit and the Household Debt Service

> Burden," *Board of Governors of the Federal Reserve System, Finance and

> Economics Discussion Paper.* 2000/12.

McCarthy, Jonathan. "Debt, Delinquencies, and Consumer Spending", CIEF,

Federal Reserve Bank of New York, February 1997, Volume 3, Number 3.

Min, Insik, and Jong-Ho Kim, "Modeling Credit Card Borrowing: A Comparison of

Type 1 and Type 2 Tobit Approaches", *Southern Economic Journal*, July

2003, v. 70, issue 1, 128-43.

Morgan, Donald P. and Toll, Ian. "Bad Debt Rising", CIEF, Federal Reserve

Bank of New York, March 1997, Volume 3, Number 4.

Murphy, Robert G. "Household Debt and Consumer Spending", *Business

Economics,* Jul 98, Vol. 33 Issue 3, p38.

_____. Does Household Debt Help Forecast Consumer Sprending?"

Working Paper, Boston College, December 2000.

Rubin, Donald B., "Multiple Imputation in Sample Surveys—a Phenomenological

Bayesian Approach to Non-Response," in *Proceedings of the Survey Research

Methods Section, American Statistical Association*, 1978, pp. 20-34.

Rubin, Donald B., *Multiple Imputation for Nonresponse in Surveys*, John Wiley & Sons,

New York, 1987.

Sullivan, Teresa A., Elizabeth Warren, Jay Lawrence Westbrook: *As We Forgive

Our Debtors: Bankruptcy and Consumer Credit in America*, New York:

Oxford University Press, 1989.

Wilke, John R., "FDIC Says Bank Credit-Card Losses Soared to a 14-Year High

in Quarter," *The Wall Street Journal,* September 12, 1997, p. A2.

Yoo, Peter S., "Charging up a Mountain of Debt: Accounting for the Growth of

Credit Card Debt," *Review, Federal Reserve Bank of St. Louis,*

(March/April, 1997), pp. 3-13.