AN EMPIRICIAL INVESTIGATION OF CREDIT CARD DEFAULT

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I.   Introduction

This paper uses empirical observations on household credit-card use from a new monthly survey[1] to investigate the determinants of default on credit card debt. It focuses on the relationship between default and the outcomes of financial choices consumers make within the constraints of the contract terms set by credit card issuers. Our new data set contains the most detailed information yet available on a regular basis on the behavioral aspects of credit card use. We find that once variables constructed from these more detailed data are considered, the debt-to-income ratio, which has been the focus of most previous research on determinants of default, loses its significance as an explanatory variable.

The three new financial variables which we find to have the most significant impact on default are (1) the ratio of total minimum required payment from all credit cards to household income; (2) the percentage of total credit line which has been used by the consumer; (3) the number of credit cards on which the consumer has reached the borrowing limit. All three of these quantities result from consumers' charging behavior under the unique arrangements of credit card loans whereby a line of credit is issued which consumers may *choose to use to a greater or lesser extent*.

Variables number 1 and 2 above capture specific institutional arrangements of the credit card contract. The debt-to-income ratio used in many previous studies acts as a rough proxy for the more detailed behavior that is embodied in these two variables. Since credit cards have expanded the set of decisions that a consumer must make in the use of a debt instrument, they have therefore expanded the possibilities for the employment of strategy by consumers. These important aspects of credit card use are not adequately reflected in the debt-to-income ratio. The

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[1] The Buckeye State Poll (BSP) is a monthly survey conducted by the Survey Research Center of Ohio State

third new financial variable introduced in this study – the number of cards on which a consumer has reached the borrowing limit (i.e., maxed-out on) – while related to the percentage of credit line used, go beyond this latter variable to capture further characteristics of credit card users. It is found to have significant predictive power in explaining the tendency for default beyond the first two variables discussed above.

In the next section, we outline briefly certain special features of the credit card market and review previous research in the consumer debt area. Section IV discusses the new data set used in this study and presents descriptive statistics on our variables. In Section V, we introduce an empirical probit model to explain default which incorporates the new credit card variables. Several distinct features emerge in our results which suggest a type of pyramid behavior in the use of credit cards that has been previously suspected but not documented. This and other empirical findings are discussed in Section V.

II.   Special Features and Previous Work on Credit Markets

Much of the early work on consumer debt focused on traditional loans which are unlike credit card loans in several key respects. Whereas traditional loans involve predetermined loan amounts and fixed payment schedules, with credit card loans, the actual borrowing decision is at the consumer's discretion after receiving a fixed line of credit. Debt repayment on credit cards is flexible, with the minimum monthly repayment being a fixed percentage of the total balance. Finally, unlike many traditional loans, credit card borrowing does not require consumers to post collateral which may place a greater risk on the lender. Jaffee and Russell (1976) and Stiglitz and Weiss (1981), as well as others, studied the tradition loan market theoretically using the tools of asymmetric information and adverse selection.

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However, with the growth of credit card debt in the U.S. economy in the last decade, researchers have increasingly turned their attention to various aspects of this unique credit instrument. Ausubel (1991), who was one of the first to carry out an empirical study of this market, found that abnormally high profits and high and sticky interest rates exist in the industry in spite of its seemingly competitive structure with over 6,000 card issuers.[2] He speculated that search/switching costs and a type of irrational consumer behavior might be involved in these paradoxical market outcomes. Responding to Ausubel's argument, Brito and Hartley (1995) introduced the aspect of the liquidity service of credit cards which saves consumers the opportunity cost of holding money for payment. Therefore they argue that it is rational for consumers to hold positive credit card balances even in the face of the high interest rates. Mester (1994) also pointed that high and sticky interest rates could exist without irrationality on the part of consumers because of information problems for the credit card banks. Park (1997) explains the situation by referring to the open-ended nature of the credit card loan and the high risk involved with this for banks; while Stavins (1996) found that defaulters had higher interest elasticities, and this could induce banks to keep their interest rates high.

After a lull in credit card defaults in the early 1990's, default and personal bankruptcy began to increase sharply after 1995; and this phenomenon has become a serious issue for banks and policy makers (Domowitz and Eovaldi (1993)). Work by Ausubel (1997) and Domowitz and Sartain (1999) both find a strong positive correlation between credit card debt and personal bankruptcy filings. The potentially serious impact of credit card default on the general state of the economy has prompted a number of researchers to explore the default issue. Calem and Mester (1995) test the argument of Ausubel's 1991 paper that irrational consumer behavior and

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[2] U.S. General Accounting Office (1994). For a discussion of the growth of credit card debt, see Yoo (1998).

adverse selection problems account for the failure of competition in the credit card market. They also examine default in this market and find that cardholders with higher balances have a higher probability of default. Laderman (1996) concludes that although cyclical factors in the economy affect charge-offs by banks, the aggressive marketing of card issuers since the mid-1980's has deteriorated the quality of the cardholders' pool and contributed to the high rate of charge-offs seen in the 1990's. Morgan and Toll (1997), using a permanent income/life-cycle approach, and Black and Morgan (1998) also attribute rising default to socioeconomic and demographic characteristics of cardholders.

While the research to date on credit card default has provided valuable information about trends in this market, lack of detailed data has limited the understanding of consumer behavior and motivation in the use of cards and subsequently in a more complete understanding of default. The Survey of Consumer Finances (SCF) has provided previous researchers the most comprehensive view of consumer debt (Jappelli, 1990; Callem and Mester, 1995;Yoo, 1997,1998; Black and Morgan, 1998). However, some critical features of the consumer situation are not available in the SCF. The survey utilized here was specifically designed to capture certain complex characteristics which are unique to this market and will be explained in the next section.

III.   New Aspects of Credit Card Behavior

With the availability of these data in the survey used here, a new and more complex picture of cardholders' behavior has emerged. First, the total minimum required payment to income ratio performs better as a predictor of default than the more traditional debt to income ratio. The debt to income ratio has greater long-run significance as an indicator or a consumer's

overall debt condition. The total minimum required payment to income ratio, on the other hand, is more relevant to a consumer's immediate month-to-month ability to avoid default. Credit counselors report that many consumers are more likely to make debt decisions based on the resulting minimum required payment than on the overall cost of the item purchased on credit. The widespread availability of revolving credit has changed the nature of budget constraint for consumers. Many consumers using revolving credit are maximizing utility subject to the minimum required monthly payment constraint rather than an overall income constraint. Therefore it is not surprising that the minimum required payment to income variable was more powerful in predicting default behavior than the debt to income variable.

A second variable which is found to influence default behavior is the percentage of the total credit line which the consumer has used. In our work this variable is computed from the responses to two separate survey questions: the total credit card balances carried forward and total credit line. The ratio of these two quantities forms the critical variable for our empirical model. We should point out that in most previous work, the data used for credit card balances includes both convenience-use balances which will be paid off as well as carried balances which actually form true revolving credit (Stavins, 1996; Ausubel, 1999). Our data for balances comes from a survey question which determines balances after most recent monthly payoff, and hence they more accurately reflect actual debt. A high debt balance to credit line ratio should increase the probability of default for a card user. A strategic factor exists for consumers in this variable. A consumer facing default may try to obtain more credit line in order to avoid this situation. Which consumers can actually obtain additional credit is, however, also dependent on bank's assessment of their riskiness. Hence the balance to credit line ratio works to lower the probability of default in two ways. First it provides the consumer an additional opportunity to

move their *current* repayment obligation to a *future* period. Secondly, the balance to credit line variable reflects information that banks have about the credit-worthiness of the consumer and this works to lower the denominator (i.e., raise the value of the ratio) for consumers who are known to be high risk.

Although decreases in the balance to credit line ratio lessens the probability of default, this should be a short-run phenomenon. The consumer behavior discussed above has the nature of a *Ponzi* scheme. As with all such pyramid schemes, there will undoubtedly be a limit to the ability of consumers to pay off old debt with new debt. So this behavior should be a "second order effect" on default probability. The first variable discussed above – the minimum required payment to income ratio – should be the ultimate factor determining a consumer's ability to avoid default.

Finally, a unique aspect of credit card behavior is captured by the number of cards on which a consumer has charged to the credit limit. In our study, we refer to this variable as "maxcards". It reflects the way in which consumers manage their credit card purchases. It is an indication of the consumer's willingness to take on debt beyond the bank's assessment of their ability to handle that level of debt. Previous researchers have pointed out that independent behavior among many banks (Bizer and DeMarzo, 1992) makes this situation possible. If there were only one card-issuing bank in the economy and it was maximizing profits, then presumably the credit line issued to any consumer should accurately reflect that consumer's ability to manage that level of credit (given the consumer's income, obligations, education and earning ability which should all be known to the bank).[3] However, "sequential banking" (Bizer and DeMarzo,

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[3] In fact, as has been pointed out (Broecker, 1990), credit-worthiness tests may not be perfect indicators of the ability to manage credit.

1992) has made it possible for consumers to max-out on more than one card, and this influences their default probability.

IV.   The New Data Set

The data on credit card usage come from a monthly random household telephone survey conducted by the Center for Survey Research Center at the Ohio State University in each of the 12 months per year. All data used in the present study are taken for the household level. The data used here come from the period February, 1998 through May, 1999. The sample each month consists of at least 500 households throughout the state of Ohio and has ranged as high as 1,200 in some months. Ohio is close to national averages in terms of socioeconomic and demographic variables and provides a representative setting for tracking consumer debt condition.

Default and Other Variables

The survey asks respondents how many times in the last six months they have missed making a minimum required payment on a credit card. The response to this question forms the basis of our dependent "default" variable in the ordered probit model below.[4]

Table 1: Proportion of Defaulters in Sample

Variable	N	Percent of Sample
TOTAL SAMPLE OF CARDHOLDERS	5,384	100 %
NON-DEFAULT GROUP	4,766	88.5
DEFAULT GROUP	618	11.5

In addition to the three important explanatory financial variables which have been discussed earlier, we will use a number of other independent variables to capture other effects and to control for socioeconomic and demographic differences in the sample. Table 2 below lists

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[4] By the terms of the credit card contract, a card user is technically in default if a minimum required payment is missed. Banks are officially allowed to write off a balance after a sixty day period.

the variables used in this study as they are taken directly from the survey or as they are computed from these direct variables.

Table 2: Definition of Variables

Variable	*Definition*
NOPAYMIN	Number of Times of Missing Pay-Off At Least the Minimum Amount Due on Any of Credit Cards In the Past Six Months
INCOME	Annual Household Before-Tax Income from All Sources
BALCARRY	Total Amount Owed on All Credit Cards after the Most Recent Payments (i.e., carried over)
MINPAY	Total Minimum Required Payments
MPIncRATIO	MINPAY/(INCOME/12)
CDIncRATIO	BALCARRY / INCOME
CDLinRATIO	BALCARRY / Total Credit Line from All Credit Cards
MAXCARDS	Number of Credit Cards Reached Credit-Limits
HOMEOWNER	Homeownership: 1 if homeowner, 0 otherwise
AGE	Respondent's Age
EDUCAT	Years of Schooling
MARRIED	Marital Status: 1 if married, 0 otherwise
CHILDNUM	Number of Children
UNEMHUS	Unemployment Status of Husband Among Married Households: 1 if unemployed, 0 otherwise
UNEMWIFE	Unemployment Status of Wife Among Married Households: 1 if unemployed, 0 otherwise
UNEMSING	Unemployment Status of Single Among Single Households: 1 if unemployed, 0 otherwise

Means and standard deviations for the financial and socioeconomic variables used in this research for the total sample as well as for the default and non-default groups are presented in Table 3 below. A t-test on the differences between the means of the two groups has been performed, and the results of this are also presented in the table.   With the simple comparison of those variables it is easily seen that the two groups are different in many aspects. As one might expect, the non-default group appears to be more solid financially. They have higher incomes and greater credit lines, but they carry lower balances on their credit cards. The credit card debt-to-income ratio is roughly twice as high for the default group as for the non-default group. The defaulters are on average younger, less likely to be married or homeowners, but more likely to

have more children in their households. However, there are no significant differences in the educational levels of the two groups or in the unemployment situations of their households.[5]

Table 3: Descriptive Statistics for Credit Card Users

Variable	ALL SAMPLE		NON-DEFAULT		DEFAULT	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
INCOME	$54,140	67564.11	$54,919	70844.75	$49,828	38247.66
CREDLINE*	$19,696	30366.46	$20,276	31442.05	$15,817	21108.35
BALCARRY	$2,110	4156.56	$1,967	3879.03	$3,093	5372.34
MAXCARDS*	0.23	0.79	0.16	0.62	0.72	1.44
MINPAY*	$109	258.49	$101	245.54	$155	319.34
CDLinRATIO*	19.2%	0.27	17.1%	0.25	32.9%	0.33
MPIncRATIO*	3.4%	0.08	3.0%	0.07	5.5%	0.09
CDIncRATIO*	5.3%	0.12	4.7%	0.10	9.5%	0.20
HOMEOWN*	81.6%	*n.a.*	83.0%	*n.a.*	72.6%	*n.a.*
EDUCAT	14 yrs	1.91	14 yrs	1.93	13 yrs	0.20
MARRIED*	61.8%	*n.a.*	62.6%	*n.a.*	54.9%	*n.a.*
AGE*	46 yrs	15.15	47 yrs	15.32	41 yrs	12.63
CHILDNUM*	0.82	1.19	0.79	1.19	1.03	1.18
UNEMHUS	0.4%	*n.a.*	0.5%	*n.a.*	0.2%	*n.a.*
UNEMWIFE	0.1%	*n.a.*	0.1%	*n.a.*	0.2%	*n.a.*
UNEMSING	0.5%	*n.a.*	0.5%	*n.a.*	0.8%	*n.a.*

* T-test of difference between default and non-default groups significant at 1% level

V.   THE EMPIRICAL MODEL

In this section we present an ordered probit model for analyzing default risk. utilizing the financial variables which have recently become available through the survey described above. Here default risk is represented as the number of times in the last 6 months that the respondent has missed making a minimum payment on a credit card. This variable, referred to as NOPAYMIN, takes values from zero to 6 in our data, with zero representing the "no default" group. The financial explanatory variables include: (a) total minimum required payment-to-income ratio; (b) carried balance-to-income ratio; (c) percentage of total credit line used; and (d)

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[5] Age and education refer to the status of the household survey respondent only.

the number of credit cards on which the consumer has reached the borrowing limit. The socioeconomic and demographic variables presented in Table 3 are also included in this model. We also include the log of income as a control. For this probit regression in the pooled data of 16 survey months is used. We have also included a dummy variable for each survey month to control for these time differences. The results of the regression are given in Table 4. Table 5, which follows immediately, presents the marginal probabilities associated with the significant independent variables.

Table 4: ORDERED PROBIT REGRESSION RESULTS

Variable	Parameter Estimate	Standard Error
INTERCP1***	-2.1261	0.2814
INTERCP2***	-2.0239	0.2804
INTERCP3***	-1.8741	0.2792
INTERCP4***	-1.6164	0.2779
INTERCP5***	-1.2652	0.277
INTERCP6***	-0.9451	0.2765
CDLinRATIO***	0.4798	0.1045
MPIncRATIO***	1.0156	0.3855
CDIncRATIO	-0.3354	0.2268
MAXCARDS***	0.2214	0.0301
LOG(INCOME)	-0.0505	0.0476
CHILDNUM**	0.0411	0.0205
MARRIED*	-0.1113	0.0613
HOMEOWN	-0.001	0.0711
AGE***	-0.00618	0.00211
EDUCAT	0.0097	0.0153
UNEMHUS	-0.2873	0.4568
UNEMWIFE	-4.6654	2713.4
UNEMSING	0.2679	0.3138
n: 3,794 Score: 300.980 with 28 DF (p=0.0001)		

* significant at 10% level.
** significant at 5% level.
*** significant at 1% level.

Table 5: Marginal Effects on Predicted Probability

N of Default	CDLinRATIO	MPIncRATIO	MAXCARDS	CHILDNUM	AGE	MARRIED		
						=0	=1	Net Change
y=0	-0.0302	-0.0640	-0.0139	-0.0026	0.0004	0.0466	0.0583	0.0117
y=1	-0.0064	-0.0135	-0.0029	-0.0005	0.0001	0.0107	0.0126	0.0019
y=2	-0.0109	-0.0231	-0.0050	-0.0009	0.0001	0.0188	0.0217	0.0029
y=3	-0.0232	-0.0490	-0.0107	-0.0020	0.0003	0.0416	0.0466	0.0050
y=4	-0.0384	-0.0813	-0.0177	-0.0033	0.0005	0.0739	0.0787	0.0048
y=5	-0.0364	-0.0771	-0.0168	-0.0031	0.0005	0.0766	0.0765	-0.0002
y=6	0.1455	0.3081	0.0672	0.0125	-0.0019	0.7318	0.7057	-0.0261
(1) Maximum Number of Default is 6.								
(2) MAXCARDS, CHILDNUM, and AGE are treated as continuous variables.								

As expected, the three key financial variables all have positive signs, and all three are significant at the one percent level. An examination of Table 5 reveals that all signs for the marginal effects are as expected. For example, a marginal increase in the CDLinRatio will *decrease* the probability of *not* missing a minimum payment by three percent. The largest impact on default probability comes from the minimum required payment-to-income ratio (MPIncRATIO). From Table 5 we see that the marginal impact of this variable on default probability is roughly twice as large as that of the CDLinRatio variable. By contrast, the most commonly used measure of household financial status – the debt-to-income ratio –- is *not* significant at the 10 percent level when the other financial variables are included in the model. As expected, the probability of missing a minimum payment increases significantly as the number of cards on which a consumer has maxed-out rises. Thus the cardholder behavior that we postulated in section III is supported by our empirical results.

Default risk is found to be inversely related to the age of the cardholder. Default is somewhat less likely for married cardholders, but its likelihood increases with number of children. The lack of significance of education, income, or home-ownership in directly influencing default is noteworthy since banks traditionally have relied heavily on these three characteristics in assessing the credit-worthiness of loan applicants. It also suggests that the

behavior of consumers in using credit cards which is captured in our financial variables is not affected by these socioeconomic characteristics, although they may influence the individual components of our financial variables (e.g., total credit line, etc.).[6]

Finally, it is interesting to see how well our empirical model would predict defaulters versus non-defaulters. Based on a binomial probit analysis dividing the sample into those who have not missed a minimum payment and those who have missed one or more times, we find that the model would predict the actual division of the sample correctly 87 percent of the time.

VI.   SUMMARY AND CONCLUSIONS

This paper has empirically investigated consumer credit card usage and default with a new monthly set of survey data taken from February 1998 through May 1999. This data set contains variables on credit card behavior that have not previously been available. Credit cardholder default is examined in an ordered probit analysis where the number of *missed* minimum payments in the last six months (taken as an indicator of default) is fitted to key financial aspects of credit card use and a variety of socioeconomic variables. The three explanatory financial variables which, to our knowledge, are used for the first time in the current study are (a) the total minimum required payment to income ratio; (b) the percentage of total credit line which the consumer has used; and (c) the number of credit cards on which the consumer has charged to the credit limit. These variables are found to have a significant positive effect on the probability of credit card default, whereas the variable most commonly used to predict default – the total credit card debt to income ratio – is not statistically significant.

The minimum required payment to income ratio is more relevant for the consumer's ability to avoid default in the short-term than is the debt to income ratio, which is more

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[6] None of the variables education, income, or homeownership was correlated with default at a level greater than 0.2.

appropriate for considering the long-term financial condition of the consumer. The percentage of total credit line which has been used reflects a consumer's ability to avoid default by relying on additional credit to pay off old debt in a manner which is similar to classic pyramid-scheme behavior. Finally, the number of credit cards on which a consumer has "maxed out" is an indication of the consumer's willingness to take on debt beyond the bank's assessment of their ability to handle that level of debt, and this is found to expose the consumer to a greater risk of default.

High default has been a major problem in the credit card market and has been growing in recent years despite the strength of the U.S. economy. Clearly credit card default is a complex phenomenon involving many factors beyond the scope of the present research. The variables which we have examined here capture some key behaviors which have not been studied previously and hopefully shed new light on this default problem.

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