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Debt Revolvers for Self Control*

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Abstract

By 1998, about two-thirds of U.S. households held a bank-type credit card. Despite high interest rates, most revolve credit card debt. The majority of debt revolvers have substantial liquid assets, apparently violating arbitrage. We propose an "accountant-shopper" model that could provide an explanation for this puzzle. In our model, the "accountant self" (or spouse) of the household can control the expenditures of the "shopper self" (or spouse) by limiting the purchases the shopper can make before encountering the credit limit. Since the card balance is used for control purposes, the accountant self may also find it optimal to save in lower-return riskless assets. Using attitudinal responses and demographic data from the pooled 1995 and 1998 Surveys of Consumer Finances, we estimate a bivariate probit model of the decisions to have a credit card and to revolve debt on it, allowing for sample selection. The pattern of estimated coefficients is consistent with debt revolvers being motivated primarily by self-control considerations rather than intertemporal consumption smoothing.

Keywords: credit cards, consumer debt, portfolio puzzles, household portfolios

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1. Introduction

Credit card holding has increased steadily over the past 20 years. According to the most recent Survey of Consumer Finances (SCF), in 1998 more than two-thirds of U.S. households had a bank-type credit card,[1] compared to only 43 percent in the 1983 *Survey*. The majority of households with a bank-type credit card had not paid off their last credit card bill in full, and thus carried an outstanding balance--not including new charges--on that card at the time of the Survey interview. Slightly less than half of card holders declare that they do not usually pay off their credit card balance in full each month. Reported card debt is sizeable: among households revolving debt on bank-type credit cards, the median outstanding balance in 1998 was $1,800. The majority of households that revolve credit card debt report substantial liquid savings in checking, saving, and money market deposit accounts, with a median of $4,850.[2] The median interest rate paid by such households on the card with the highest balance was 15 percent, far exceeding returns on their liquid assets. The puzzling portfolio behavior of revolvers of high-interest credit card debt who also save in low-interest liquid assets is the object of this paper.

The limited research to date on borrowing behavior through credit cards has already identified three puzzles. An early puzzle is the use of high- rather than lower-interest credit cards for borrowing (Ausubel, 1991), which he attributed mainly to failure of consumers to anticipate the likelihood that they will have to pay interest on outstanding credit card balances. Brito and Hartley (1995) argue that relatively small costs of arranging for other types of loans can induce rational individuals to borrow on high-interest credit cards.

Gross and Souleles (2001) use a proprietary administrative data set of individual credit card accounts from different card issuers to estimate consumption responses to exogenous increases in credit lines and to changes in interest rates.

Households differ in the extent to which they utilize the credit limit allowed by the card issuer. Grouping households according to utilization rates, Gross and Souleles remarkably find that households' consumption response to an exogenous increase in the line is such as to return utilization near to its initial level in the space of five months or so. They also use the 1995 Survey of Consumer Finances to document two credit card portfolio puzzles: the co-existence of credit card debt (i) with substantial holdings of illiquid assets for retirement, and (ii) with low-interest liquid assets.

Laibson, Repetto, and Tobacman (2000) deal with the former, which they termed the 'Debt Puzzle'. They show that consumer preferences with hyperbolic discounting are consistent with the tendency of consumers to act impatiently when it comes to credit card borrowing but patiently when it comes to accumulation of illiquid assets for retirement.

This paper deals with puzzle (ii), namely the co-existence of high-interest credit card debt and low-interest liquid assets, which is also documented in Bertaut and Starr McCluer (2001). We term this the 'Puzzle of Debt Revolvers'. It constitutes an exceptionally difficult portfolio puzzle, as it seems to run contrary to one of the most fundamental notions in Economics and Finance, namely that of arbitrage.

It would be problematic to attribute this tendency to lack of information or irrationality, since interest rates on credit cards and on liquid accounts are printed on the monthly statements and we show that this tendency characterizes a large segment of the population. Indeed, a recent Federal Reserve study finds that U.S. credit card holders are generally aware of the terms of borrowing on their credit cards (Durkin, 2000). It may be argued that debt revolvers find it difficult to borrow in other ways and need liquid assets to cover contingencies for which credit cards are not accepted. Yet, it is always possible to obtain cash advances.[3] Revolving of debt is also not attributable to the use of automatic payment facilities: 98 percent of debt revolvers are presented monthly with the option to pay off their credit card debt and apparently make a conscious decision not to do so. Finally, hyperbolic discounting entails control of future selves, and this is accomplished by holding illiquid rather than liquid assets.

Lehnert and Maki (2001) argue that a household that contemplates bankruptcy may run up unsecured debt and liquid assets, so that it can discharge a large part of unsecured debt (based on chapter 7 bankruptcy laws) but convert liquid assets to a bankruptcy-exempt asset category (like housing) once it declares bankruptcy. Using data from the Consumer Expenditure Survey, they find that households living in states with high bankruptcy exemption levels are 1 to 4.5 percentage points more likely to have both liquid assets and total unsecured debt in excess of a threshold ranging between \$2,000 and \$5,000 (in 1996 dollars).[4]

While strategic bankruptcy considerations may motivate the behavior of some debt revolvers, they alone seem unlikely to account for the widespread nature of this phenomenon, especially among households whose portfolios show no signs of financial distress. The data presented in this paper show that debt revolvers are widespread, especially in the middle class (i.e. households with incomes between \$25,000 and \$100,000). Indeed, among households with liquid assets in excess of credit card debt, only 14 percent meet the Lehnert-Maki amount requirements at the \$3,000 threshold. [5] Even if all of these were considered strategic defaulters, this would still leave 86 percent to be explained.

We sketch a model of credit card behavior that abstracts from default motives and yet can generate co-existence of revolving card debt with holdings of liquid assets in the absence of financial distress. The model stresses that saving and consumption decisions, normally modeled as being simultaneous, cease to be so in the presence of credit cards. The decision of how much to save (or dissave) is assigned to the "accountant" or financial officer in the household, or more generally to the "accountant self" that pays bills and is in charge of finances. The shopper self uses the purchasing power offered by the available limit on the card to shop and determines the consumption level of the household, in a way not necessarily consistent with the preferences of the accountant or the financial constraints faced by the household. The accountant self, however, decides how much of the credit line to make available to the shopper self by making a payment into the credit card account. Manipulation of the size of this payment offers a way to the accountant self to exercise (shopper) self-control and to limit credit card purchases. Since the revolving balance is now mainly an instrument of self-control rather than a means to borrow, it is no longer inconsistent with positive holdings of liquid assets.[6] We then examine econometrically whether available attitudinal responses and demographic data from the pooled 1995 and 1998 waves of the SCF provide empirical support to a self-control explanation of credit card behavior.

New information on attitudes of credit card holders in the 2001 *Survey of Consumers* shows that about forty percent of card holders perceive self-control problems emanating from the availability of credit cards and the possibility of overspending, though considerably fewer are willing to admit that this is a problem for themselves and not just for others (Durkin, 2002). Existing research in marketing and in consumer psychology stresses that self-control problems occur when the benefits of consumption arise earlier than the costs (Hoch and Loewenstein, 1991). This literature also points to evidence that liquidity enhances both the probability of making a purchase and the willingness to pay for a given item (see Shefrin and Thaler, 1988; Prelec and Simester, 2001; Wertenbroch, 2002). Moreover, Soman and Cheema (2002) present experimental and survey evidence suggesting that consumers interpret their available credit lines as indications of future earnings potential and adjust their spending accordingly. Policy makers are also discovering the relevance of self-control considerations for savings decisions.[7]

Revolving credit card debt entails interest costs that we estimate below. Based on our findings, the costs paid by debt revolvers are neither negligible nor prohibitive as a means of imposing self-control in consumer spending. Costly self-rationing as a means of self-control may be a fairly novel concept in research on financial portfolios, but it has been stressed in Marketing and in economic research on mental accounting.[8] A telling example refers to deadlines that various people, including academics, impose on themselves to avoid procrastination even when missing them entails substantial costs (Thaler, 1980; Ariely and Wertenbroch, 2002).

Section 2 documents the characteristics of those who revolve credit card debt using the 1998 SCF. In Section 3, we present a model of credit card behavior in the absence of default motives, first without and then with self-control considerations. In Section 4, we investigate whether available survey data yield empirical support to a self-control explanation. Section 4.1 discusses what data are available and how bivariate probit estimation with sample selection can help differentiate self-control from intertemporal consumption smoothing interpretations of debt revolvers. Section 4.2 presents estimation results, while section 4.3 checks robustness by focusing exclusively on debt revolvers who hold substantial liquid assets. Section 5 concludes.

2. Revolvers of Credit Card Debt in the Data

In this section, we document the puzzle using data on bank-type credit cards and household liquid assets from the 1998 SCF, the most recent and most comprehensive survey of household portfolios in the United States. We also review some potential explanations for the puzzling behavior of debt revolvers that are not borne out by the data (in the SCF or in other sources).

In 1998, more than two-thirds of US households had a bank-type credit card. As indicated in the first column of Table 1, bank-type credit cards are more likely to be held by households with higher education, with higher income, by married couples, and by households who report their race and ethnic origin as white, non-Hispanic. Bank-type credit cards are held by a notably smaller fraction of households where the household head is either less than 35 years old or more than 65 years old. As indicated in column 2 of Table 1, the majority of households that had a bank-type credit card had not paid off their last credit card bill in full.

Although households that are younger, have lower education, or lower income are less likely to have credit cards, a higher percentage of those that do have cards use them as a source of revolving credit. Some households may temporarily carry a balance because of special circumstances, while their normal practice is to pay off the balance in full. The Survey does ask households about their normal card payment practices. Of households with a reported balance, only a little over 20 percent stated that they "almost always" pay off the balance in full, while almost half reported that they "hardly ever" do so.[9] As column 3 indicates, most households with a bank-type credit card typically do not pay off their card balances, and this is again more prevalent for households that are younger, have lower education, or lower income.

Recent attention has been paid to the fraction of households with relatively high levels of credit card debt and the potential for such households to default on that debt by declaring personal bankruptcy (see Lehnert and Maki, 2001). Data from the SCF confirms that some households do indeed have very high levels of credit card debt. However, there is a different, more prevalent, and puzzling feature of credit card borrowing: nearly half of all credit card holders report that they do not typically pay off their credit card balances each month, while at the same time they hold ample amounts of liquid financial assets—assets held in banking, checking, and money market accounts that amount to more than half their average monthly income and are at least $500 (column 4). This behavior is exhibited by all age groups, all education groups, and all income groups. However, it is somewhat more common among younger households, among those with only a high school degree, or some college (but no college degree), and among households with incomes between $25,000 and $100,000 than for either low-income or high-income households. Thus, it tends to be a "middle-class" puzzle.

One might suspect that this behavior, though puzzling, is mainly attributable to automatic payment facilities that allow households to make minimum payments on their credit card accounts without reviewing their balances every month. This suspicion is not confirmed by the data. Of the 2,664 households in the combined 95/98 Surveys who had a balance on a credit card, only 51 used automatic payment facilities for any type of "irregular" payment, which includes credit card payments. Among those who usually have a balance, only 44 used such facilities. In both cases, 98 percent of those who carry a balance on their credit card are presented monthly with the option to pay off their credit card debt and apparently make a conscious decision not to do so.

Households appear to perceive self-control problems associated with holding a credit card. Although the majority of cardholders interviewed in the 2001 *Survey of Consumers* found that their credit cards made managing their personal finances easier by allowing flexibility in smoothing expenditure and repayment, 10 percent admitted that it was more difficult to manage their own finances. The possibility of overspending and overextending financial resources was the most common reason noted. Cardholders were much more willing to admit that "others" faced such problems. When asked about whether credit cards make managing finances easier or more difficult "for others", 40 percent responded that it made managing finances more difficult (Durkin, 2002). Two factors may be creating these disparate views regarding personal financial management and financial management of others. First, these questions were asked only of card holders. A higher percentage for those having difficulty would be expected in the broader population of "others", because this includes households who choose not to hold cards because of self-control problems. Additionally, households may be reluctant to admit their own self-control problems with regard to credit cards but more willing to identify the problem more generally.[10]

Skeptics may argue that households concerned about overspending could ask institutions to reduce their credit line instead of revolving costly debt. However, this seems to happen very rarely, if at all, in the data, and it is by no means clear that it would be an efficient way to handle self-control problems. Gross and Souleles (2001) track credit card accounts over time and report that only 10 percent of line changes are requested by the household, while in 90 percent of the cases it is the institution that initiates the line change. Moreover, households rarely ask for reductions, if at all, and institutions have been reluctant to reduce lines. As a result, line changes are generally nonnegative. Households with self-control problems do have the option not to hold any credit cards. Those who decide to hold credit cards probably do so not only for ease of transactions (which could alternatively be provided by a debit card or checks), but also because they value the ability to borrow for unforeseen contingencies without filing time-consuming and costly applications. Reducing the credit line and guaranteeing to pay off in full whatever the shopper charges on the credit card could severely limit the available buffer for unforeseen contingencies. Thus, limiting the credit line is not a costless way of enforcing self-control.

How costly is the alternative of revolving credit card debt while holding liquid assets? This depends on the size of balances, liquid assets, and interest rates faced by debt revolvers (Table 2). Among households with balances on bank-type credit cards, the median outstanding balance in 1998 was $1,800 (col. 1). Households that typically carry credit card debt although they have ample amounts of readily available financial resources have similar or even slightly higher levels of credit card debt. Columns 2 and 3 of Table 2 show that the median level of bank-type card debt for these households was $1,900, while median liquid financial assets for this group were about twice this amount at $4,850.[11] Table 2 also shows the median levels of credit card debt by age, education, and income. Both credit card debt and financial assets tend to increase with age (except for those aged over 65), and with income and education.

Revolving credit card debt may entail negligible cost if interest rates charged on such debt are low, especially if the debt is financed at typical introductory "teaser" rates of 1 to 5 percent. However, this is not the case for most households. Although a small fraction of debt revolvers with liquid assets do pay low interest rates on the card most frequently used, the median interest rate for these households was 15 percent (column 5).

The next two columns provide an estimate of the interest cost to each household that habitually revolves credit card debt from not using available liquid assets to pay off the card balance. The first computes the minimum of two amounts, the card balance and the amount of liquid assets, and reports its median for each category. The second multiplies the minimum for each household by the interest rate the household faces on the card with the highest balance.[12] The median interest cost for the entire population is about two hundred dollars per annum, and it varies somewhat across demographic groups. On the whole, it is of the order of the cost of a DVD player per year. This is neither so low that households should not bother to eliminate it nor so high as to render it a prohibitively costly way of imposing self-control.

3. The Model

3.1 A Model of Credit Card Use

Consider a household that maximizes expected discounted lifetime utility of consumption, possibly subject to nondiversifiable earnings risk. The household has access to two financial instruments: a riskless liquid asset that offers gross return R_t, and a credit card that allows the household to revolve credit up to a maximum level $\overline{B}$ at a gross real rate R_t^c. The rate R_t^c depends on whether the household has paid off its credit card balance in the previous month. If it has, then new purchases are given an interest-free grace period equal to one model time period ($R_t^c = 1$). If it has not, then the previous balance and new purchases are subject to the credit card rate, which is higher than that on the riskless liquid asset ($R_t^c > R_t$). For simplicity, we will abstract from investment in illiquid assets and also assume that the household cannot borrow at all at the low riskless rate[13], i.e. that $A_t \geq 0 \; \forall t$.

There is one consumption good, and it can be bought using a credit card. The household decides how much to consume in each period, $C_t \geq 0$, and how much of the outstanding credit card balance, B_t, to repay in period t by making a payment $P_t \geq 0$. All variables are expressed in real terms. Given these assumptions, the household's optimization problem can be written as follows:

$$\underset{\{C_t, P_t\}_{t=0}^{T-1}}{Max} \; E_0 \sum_{t=0}^{T-1} \beta^t \, U(C_t), \qquad 0 < \beta < 1 \tag{1}$$

$$s.t. \; A_{t+1} = \left(A_t + Y_t - P_t\right) R_t \tag{2}$$

$$B_{t+1} = \left(B_t - P_t + C_t\right) R_t^c \tag{3}$$

$$R_t^c : \begin{cases} R_t^c > R_t > 1 \quad if \;\; P_t < B_t \\ \\ R_t^c = 1 < R_t \quad if \;\; P_t \geq B \end{cases} \tag{4}$$

$$C_t \geq 0,\ \ A_t \geq 0\ \ \forall t \tag{5}$$

$$B_t \leq \overline{B}, \quad 0 \leq t \leq T-1 \tag{6}$$

$$A_0 = 0;\ B_0 = 0;\ B_T = 0 \tag{7}$$

Equation (1) states that the objective of the household is to maximize expected lifetime utility over its lifetime of T periods without a bequest motive. Next period's felicity is discounted relative to current period's felicity, so that β is less than unity. Equation (2) describes the evolution of the real stock of the liquid riskless asset. At the beginning of each period t, the household observes the stock of the liquid asset accumulated to date, receives labor income equal to Y_t, and decides what part of the outstanding credit card balance to pay off using available cash on hand, $A_t + Y_t$. Any remaining cash on hand is held in the liquid asset.[14]

Equation (3) describes the evolution of the outstanding credit card balance, B. The household starts period t with an accumulated credit card balance $B_t \geq 0$. It repays an amount $P_t \geq 0$, and it revolves the remaining balance, $B_t - P_t$, augmented by new purchases, C_t, at a gross real rate R_t^c.

Expression (4) determines the relevant value of R_t^c. If the payment does not cover the outstanding credit card balance $(P_t < B_t)$, the gross interest rate on credit card debt applies both to the inherited balance and to new purchases. If the household repays the outstanding balance so as not to revolve card debt $(P_t = B_t)$, then new purchases, C_t, are given a grace period when no interest is charged and the gross interest rate is unity. If the household wants to use the credit card for purchases that exceed the entire credit limit, it can make a payment in excess of the outstanding balance $(P_t > B_t)$ and take advantage of the grace period on new purchases. Because of the grace period, the household has no reason to pay for the consumption good directly out of liquid assets.[15]

Item (5) lists the usual nonnegativity constraint for consumption, and the borrowing constraint that prevents households from borrowing at the low interest rate.[16] Relations (6) and (7) state that the credit limit on the card is $\overline{B}$ and that the credit card will be taken away prior to the end of life.

The maximum amount that can be spent on current consumption consists not only of 'cash on hand' (the sum of assets minus outstanding liabilities plus labor income) but also of the unused part of the credit line:

$$X_t \equiv A_t + Y_t + (\overline{B} - B_t) \tag{8}$$

In view of (2) and (3), the transition equation for consumable resources is

$$X_{t+1} = (A_t + Y_t - P_t)R_t - (B_t - P_t + C_t)R_t^c + Y_{t+1} + \overline{B} \tag{9}$$

All terms are either given or exogenous to the household at time *t*, except for P_t, R_t^c, C_t. Let us fix the consumption decision. Then, higher payments simply transfer mass from the first to the second parenthesis in (9). Now, given B_t, the choice of P_t determines R_t^c through (4). As long as the payment into the credit card account does not cover the full outstanding balance, $R_t^c > R_t$ and the household increases future consumable resources by transferring funds from the liquid asset to the card account. Moreover, since both interest rates are riskless, this transfer constitutes a genuine arbitrage opportunity.[17] At $P_t = B_t$, R_t^c jumps to unity and resources are further enhanced. Beyond this amount, arbitrage opportunities cease to exist: payments into the card account reduce consumable resources because $R_t^c < R_t$, and will be made only if optimal consumption exceeds the credit limit, $\overline{B}$.

This simple result is the essence of the credit card puzzle and is not dependent on preference parameters or the earnings process. In view of arbitrage opportunities shown in (9), revolving credit card debt should not coexist with positive holdings of cash on hand, let alone with substantial holdings of liquid assets relative to its size, as documented in the Survey of Consumer Finances.

3.2 A Model of Credit Card Use in an Accountant-Shopper Household

Now suppose that the household consists of two units, an "accountant" and a "shopper". The "accountant" is the member of the household who manages finances. The "shopper" visits the stores with credit card in hand. Note that the "accountant" is not necessarily the breadwinner in the family, nor even necessarily a different person from the shopper. Even a single person can behave differently when paying bills and when shopping at the store, and it is more general to think of the accountant and the shopper as two selves performing different tasks (hence the term "self-control"). The accountant self recognizes that the shopper self does not necessarily exhibit the same preferences or does not take into account the same constraints as the accountant self.

The accountant self decides the size of payment to the credit card account, P_t. Given current cash on hand and the outstanding credit card balance, this determines both the amount to be kept in the form of liquid assets, $A_t + Y_t - P_t$, and the maximum amount that can currently be charged to the credit card for consumption purchases, $\overline{B} - B_t - P_t$.

Although the accountant self ultimately derives utility from household consumption, it is the shopper self who visits the stores and undertakes consumption expenditures. The shopper self is told the available credit on the card account and decides how much to spend on consumption as a function of available credit.[18] Thus, the shopper determines the policy function $C_t = C_t(B_t - P_t)$, where the constant credit limit $\overline{B}$ has been suppressed.

The accountant self can exercise shopper-self control by manipulating P_t and through it the amount of unused credit made available to the shopper.[19] The accountant's problem can be expressed in the following way:

$$\underset{\{P_t\}_{t=0}^{T-1}}{Max}\, E_0 \sum_{t=0}^{T-1} \beta^t\, U(C_t[B_t - P_t]), \qquad 0<\beta<1 \tag{1'}$$

$$s.t.\ A_{t+1} = \left(A_t + Y_t - P_t\right) R_t \tag{2}$$

$$B_{t+1} = \left(B_t - P_t + C_t[B_t - P_t]\right) R_t^c \tag{3'}$$

where $C_t[B_t - P_t]$ is the policy function for consumption chosen by the shopper, (2) is repeated for convenience, (3') replaces (3), and (4)-(7) continue to hold as before. Denoting the accountant's control variable, $B_t - P_t$, by u_t, we can write the first order condition for the accountant's choice as:

$$U'(C_t)\frac{\partial C_t}{\partial u_t} + \beta\, E_t\left[U'(C_{t+1})\frac{\partial C_{t+1}}{\partial u_{t+1}}\left(R_t^c - R_t + R_t^c\,\frac{\partial C_t}{\partial u_t}\right)\right] = 0 \tag{10}$$

This condition can be interpreted as follows. The derivative $\frac{\partial C_t}{\partial u_t}$ represents the amount by which the shopper changes the current choice of consumption level when the accountant changes (infinitesimally) the unpaid credit-card balance. The resulting change in utility of the accountant is $U'(C_t)\frac{\partial C_t}{\partial u_t}$, and it should match in equilibrium the effects on next period's discounted expected utility.

Revolving a larger amount of debt into the next period imposes an interest cost equal to the differential $R_t^c - R_t$. On the other hand, use of the credit card balance as a control mechanism reduces current consumption by $\frac{\partial C_t}{\partial u_t}$, and this in turn reduces tomorrow's balance directly by $R_t^c\,\frac{\partial C_t}{\partial u_t}$. This additional effect provides a way in which using the available credit as a self-control device can offset the arbitrage opportunities posed by the interest differential between liquid assets and credit cards.

3.3 An Empirically Motivated Case of Shopper Behavior

Once saving and consumption decisions have thus been separated, one can explore various cases of accountant-shopper combinations and interactions. In this section, we illustrate the potential of such setups to generate co-existence of revolving credit card debt and liquid assets through a simple example of infinite-horizon households and an empirically motivated assumption about shopper behavior.

We assume that shoppers always purchase as much as they can without exceeding a target utilization rate for the credit card limit. Such behavior can be thought of as a rule of thumb, but can also arise optimally in the context of a homothetic, single-self, buffer-stock model (see Ludvigson, 1999).[20] This assumption is consistent with the empirical findings of Gross and Souleles (2001) based on a large proprietary data set of credit card holders, but somewhat exaggerates the speed with which households attain their target utilization rate. Although utilization rates differ across households in the Gross-Souleles data,[21] in each group defined with reference to utilization rates utilization returns back near its initial level in the "long run". The time span involved is of the order of five months.

If we denote the household-specific utilization rate by λ, then the shopper self purchases as much as is consistent with maintaining a revolving credit card balance

$$B_t = \lambda \overline{B} \quad \forall t,\ 0 < \lambda \leq 1. \tag{11}$$

Given the transition equation (3) for the revolving credit card balance, the implied consumption rule is

$$C_t = \lambda \overline{B}\left(\frac{1}{R_t^c} - 1\right) + P_t \tag{12}$$

Because the shopper self is consistent in following the simple rule of thumb, the accountant self can perfectly control the level of current consumption through the choice of the payment P_t into the credit card account. Note that P_t affects consumption not only directly but also by determining R_t^c, in a way given by (4). As long as the accountant chooses to revolve credit card debt ($P_t < B_t$), the marginal propensity of the shopper to spend on consumption out of every extra dollar the accountant pays into the credit card account is equal to unity.

Using (12) to substitute marginal propensities to consume into the first order condition (10), we get

$$-U'(C_t) + \beta E_t[U'(C_{t+1})(-1)(R_t^c - R_t - R_t^c)] = 0. \qquad (13)$$

This simplifies to

$$-U'(C_t) + \beta E_t[U'(C_{t+1})R_t] = 0 \qquad (14)$$

This first order condition is identical to that governing accumulation of the liquid asset in the standard saving model without credit cards. The reason why can be understood by observing the nature of the accountant's problem when the shopper follows this rule of thumb. The accountant's problem now becomes:

$$\underset{\{P_t\}_{t=0}^{\infty}}{Max}\; E_0 \sum_{t=0}^{\infty} \beta^t\, U(C_t[P_t]), \qquad 0<\beta<1 \qquad (1')$$

$$s.t.\; A_{t+1} = (A_t + Y_t - P_t)\, R_t \qquad (2)$$

$$B_{t+1} \equiv \lambda \overline{B} \;\; \forall t,\;\; 0 < \lambda \le 1 \qquad (3'')$$

$$C_t \ge 0,\;\; A_t \ge 0 \;\; \forall t \qquad (5)$$

$$A_0 = 0;\; B_0 = 0 \qquad (7)$$

where the function $C_t(P_t)$ is given by (12) and the shopper's rule of thumb has resulted in replacement of the transition equation (3') with identity (3''). The accountant's choice of the payment amount P_t no longer influences the evolution of credit card debt but only consumption and accumulation of liquid assets, as in the standard saving model without credit cards.

Intuitively, sacrificing one dollar of liquid assets to pay off a dollar of the credit card balance increases consumption by one dollar as in the standard saving model, but it does not result in lower credit card debt. In terms of equation (13), the interest savings from paying off one extra dollar of the outstanding balance are exactly offset by the interest charges on the extra dollar of consumption this induces. The only remaining effect is to forego the interest on liquid assets, R_t as would happen in a standard model of (liquid) asset accumulation. Since arbitrage cannot be effected, there is no reason why revolving credit card debt should be inconsistent with positive holdings of liquid assets.[22]

4. Is There Empirical Support for the Self-control Hypothesis?

4.1 Making Use of Available Data

Although the potential of self-control considerations for explaining credit card puzzles can be shown in the context of a theoretical model, probing household-level data for direct empirical support is subject to some limitations. An important obstacle is that self-control problems are largely unobservable, at least in the context of existing household surveys that also contain pertinent information on portfolios. For instance, while the Survey of Consumer Finances is the most comprehensive source on household portfolios and associated demographic characteristics, it contains little information on attitudes and habits that suggest directly either self-control problems or lack of concern for such issues. The limited number of pertinent variables of this sort can then be augmented with more standard demographic variables that contain a self-control aspect possibly in addition to other types of effects.

We focus on three direct attitudinal questions in the SCF that seem pertinent to the issue at hand. Two of them ask, respectively, whether the household member in charge of finances (the "accountant" in our terminology) thinks it is acceptable to borrow in order to purchase fur and jewelry, and whether it is acceptable to borrow in order to cover living expenses. Controlling for other factors, positive answers to these questions suggest that the "accountant" perceives less of a need to exercise self-control in credit card behavior. Additionally, the Survey identifies smokers, a habit that is known to be harmful but difficult to control for some individuals. To the extent that smoking is a signal of more general self-control problems, the smoker variable points to households that could benefit from costly self-control mechanisms such as revolving high-interest debt.

In addition to the relatively scarce attitudinal questions, household surveys contain a wealth of demographic variables that can be shown to influence credit card behavior. Although we are not aware of existing psychological or economic literature that has established clear relationships between particular demographic characteristics and self-control problems, it is worth asking whether there are aspects of such demographic variables that are relevant for self-control and whether their overall effects on credit card behavior are consistent with those aspects. For example, attaining a college degree is often used as a signal of self-discipline as well as of increased understanding of financial matters. Being young implies that the household faces both bigger uncertainty regarding the future and a multitude of as yet unaccomplished objectives: self-control is important for the young on both counts. Although college education and young age can influence credit card behavior through various channels, it is interesting to see if their overall effect is consistent with what is implied by a model focusing on their self-control aspect rather than on a hypothesized need of credit card holders to borrow at high interest rates.

Modeling econometrically the decision to revolve debt on the credit card is somewhat involved. Households may be observed to have no credit card balance because they choose not to carry a balance on their card, or because they do not have access to a credit card in the first place. Furthermore, these decisions are likely to be correlated. Unobservable household-specific factors that determine the desirability of having a credit card (and the likelihood of receiving a card upon application) are likely to influence also whether or not the household would wish to use the card as source of revolving credit.

Specifically, we observe the dummy variable $z_1 = 0,1$ for whether or not the household has at least one bank-type credit card. For households that have credit cards, we observe (in our benchmark model) a second dummy variable $z_2 = 0,1$ for whether the household had an outstanding balance on the card after the last monthly payment. We write the estimation model for each household *i* as

$$z_{i1} = \alpha_1' v_{i1} + u_{i1}$$
$$z_{i2} = \alpha_2' v_{i2} + u_{i2}$$
$$u_{i1}, u_{i2} \sim \text{bivariate normal with variances } 1,1 \text{ and correlation } \rho_{1,2}$$
$$z_{i2} \text{ is observed only when } z_{i1} = 1$$

We estimate the decision to hold a credit card balance for households that have a bank-type credit card. As both of these variables are observed as 0,1 dummy variables, we estimate this as a bivariate probit with sample selection, allowing for correlation between the error terms u_1 and u_2. Estimation yields two sets of estimates: first, of factors influencing whether the household has a credit card, and second, of those determining whether it revolves credit card debt. The pattern of estimated coefficients across these two stages can help distinguish between two alternative hypotheses on why households end up revolving high-interest credit card debt.

One hypothesis is that households revolve credit card debt as part of their effort to smooth consumption intertemporally. Under this hypothesis, households revolve such high-interest debt because it is difficult or costly for them to secure loans at more attractive interest rates. If this is the case, factors that encourage households to acquire credit cards should also make them more likely to use the cards for borrowing. Supply-side factors such as screening of applications would, if anything, reinforce such tendencies. It is not an objective of banks to discourage revolving of credit card debt once they have determined the credit limit. As Brito and Hartley (1995) put it, '[t]he most desirable customers are those who borrow a substantial amount on their cards and yet remain well within their credit limits and therefore are unlikely to default' (p. 409).[23]

By contrast, the accountant-shopper self-control model implies that high-interest credit card debt is revolved mainly as a self-control device rather than for consumption smoothing purposes. Under this hypothesis, we should observe a pattern of sign reversals across the two estimation stages: factors that make households less confident about their ability to control credit card spending should make them *less* likely to have a credit card, and *more* likely to revolve card debt once they acquire a card. These reversals should be observed even after controlling for difficulties that households encounter in securing other types of loans. As an additional check, factors that explicitly signal lack of self-control problems or of concern for such issues should not generate sign reversals.

4.2 Estimation Results

Our data set is the pooled samples of the 1995 and 1998 U.S. Surveys of Consumer Finances, the two most recent waves of the SCF. The pooled sample has 8,406 observations, 6,906 of which have at least one bank-type credit card, and 2,664 of which carried an outstanding balance on their bank-type credit cards. In order to focus on households that usually rather than accidentally revolve credit card debt, we eliminate households responding that they always or almost always pay off their credit card bill. This leaves us with 2,013 households that usually revolve credit card debt. Variables are defined in the Data Appendix.[24]

The first node of the bivariate probit deals with whether the household has a bank-type credit card or not. The second, observed only for credit card holders, deals with the choice of whether to (usually) revolve credit card debt or not. Our estimates are reported in Table 3. Let us first examine the sign pattern of estimated coefficients across the two nodes for the three attitudinal variables mentioned in the previous subsection. The first two such variables are directly linked to borrowing for consumption. Controlling for various demographic characteristics that include age, education, income and non-liquid wealth, households that find it acceptable to borrow for fur and jewelry purchases are more likely to have a card and to usually revolve debt on it. The same holds for those that find it acceptable to borrow for living expenses. Households giving these responses are likely to be less concerned about exercising self-control in credit card behavior, and this is consistent with the observed absence of sign reversal implied by self-control considerations. On the other hand, being a smoker also has statistically significant effects for both nodes: it contributes negatively to having a credit card and positively to revolving credit card debt if the household has a card. This is what one would expect to find if smoking signals self-control problems in other areas, such as credit card behavior, and the household uses the revolving balance to control credit card purchases.

Let us now turn to demographic variables in Table 3. We first look at variables that make a household less likely to be holding a bank-type credit card but more likely to be revolving debt if it has one. Controlling for other factors, household heads under forty years are less likely to have credit cards and more likely to revolve credit card debt if they have a card. This is observed despite controlling for difficulties in securing other types of loans or credit lines through the liquidity constraints variable.[25] Young households have a number of future objectives related to homeownership and acquisition of assets and durable goods, and they face uncertainty about their long stream of future earnings. They thus have good reasons to be cautious in controlling their impulse spending, including credit card spending. Our finding is consistent with such considerations being important.

Similarly, controlling for available resources and for difficulties in obtaining other types of loans, having more children makes a household less likely to have a credit card and more likely to revolve high-interest card debt if it does get a card. It seems plausible that an increase in the number of children makes it more difficult for a household to exercise full control of its credit card spending and our estimates are consistent with such factors being important.

Households headed by a non-white or Hispanic person are less likely to have a bank-type credit card and more likely to revolve credit card debt, controlling for perceived borrowing constraints on other types of loans. If the financial services industry has made less of an effort to market itself to minority households, more limited familiarity with financial instruments or even some cultural predisposition against taking financial risks or losing control of credit card spending may be plausible explanations for this finding. In fact, this finding parallels findings in the stockholding literature that such groups have a more limited tendency to hold stocks, where no application or bank screening are involved (see, for example, Bertaut and Starr McCluer, 2001).[26]

Our estimate of Rho, the correlation between the error terms in the bivariate probit with selection, is significant and negative. This supports our findings of sign reversal between the influence of the same factor in the card holding and revolving decisions. It implies that unobserved household-specific characteristics that make a household less likely to hold a card also make it more likely to revolve debt on the card, thus reinforcing the role of observed characteristics consistent with a self-control explanation of debt revolvers.

At the other end of the spectrum are factors that make household heads more confident or less concerned about their ability to control spending. Such factors should contribute to a tendency to apply for credit cards for the convenience they afford in making transactions, and discourage households from revolving debt as a disciplining device. Indeed, the most extreme way to impose self-control is not to apply for a credit card at all. College education and higher incomes, non-liquid financial wealth, and non-financial wealth fall in this category. The more educated are not only more knowledgeable about financial instruments but they also have demonstrated considerable self-discipline in meeting the challenges of college degree programs. For both reasons, they can be more confident about their ability to exercise self-control in their finances. This is demonstrated in credit card behavior here, but it is also corroborated by their greater tendency to absorb financial risk through stockholding (Haliassos and Bertaut, 1995). Education is not the only possible source of confidence. Those with higher incomes or assets can be more confident because they are financially successful, but also less concerned about going on a spending spree using a credit card. We find that all these factors make households more likely to have a credit card and less likely to be running a balance on it.[27] The SCF also identifies households whose average monthly expenses were below their incomes over the previous year and thus could afford to save (hence the label "saver" in Table 3). The estimated sign pattern is the same for this variable that clearly signals reduced need to borrow as for education, income, and assets.

Marital status presents an interesting pattern of estimates. Being married makes it more likely that the household has a credit card, but it does not have a significant effect for whether the household revolves credit card balances. Married households see an advantage to having a credit card for transactions purposes, but do not regard marital status as a decisive factor for whether they will revolve debt. Rather than marital status being irrelevant for the decision to revolve debt, we consider it as giving rise to two conflicting (and apparently mutually offsetting) factors. The presence of a spouse may help control credit card spending, if spending by one spouse must be justified to the other or be consistent with some overall plan. On the other hand, having a spouse may create coordination problems between the two spouses. Based on our findings, these two considerations cancel each other out.

Households headed by someone more than 65 years old are significantly less likely than their middle-aged counterparts to have a credit card and less likely to revolve debt. Findings in the consumption literature that older households tend to experience a downward shift in consumption suggest that old age contributes to a smaller propensity to undertake credit card transactions. This is probably reinforced by a cohort effect, given that the use of credit cards was not widespread through much of their working lifetime.

Mainly for identification purposes, we also included in the first regression (left panel of Table 3) variables that proxy for regional factors likely to influence access to credit cards but are separate from individual characteristics that we do control for. These include the percentage of households in the census region[28] employed in finance, insurance, or real estate; the median net worth in the region, relative to the national median net worth; and median income, relative to national median income. The motivation for using such regional variables for identification is that there may be some tendency of banks to offer cards in regions that are more affluent or have a higher concentration of finance-related professionals. Of those variables, relative income of the region is strongly statistically significant, enhancing the probability of holding a credit card.

An important factor not present in the first estimation but only in the estimation regarding debt revolving is an SCF variable identifying households that are more financially alert, in the sense that they tend to shop around a lot for the best interest rates. As seen in the right panel of Table 3, such households are less likely to be revolving credit card debt. Given that revolving credit card debt is costly, one would indeed expect those households to be more sensitive to the high interest rate charged to debt revolvers and to be less willing to use this mechanism in order to achieve other objectives, such as self-discipline in credit card spending. Incidentally, the finding that financially alert households are less likely to carry a balance tends to argue against the idea that revolving balances are mainly motivated by strategic bankruptcy motives.

4.3 Focusing on Coexistence of Credit Card Debt with Substantial Liquid Assets

As a robustness check, this section re-estimates the bivariate probit focusing on households that not only revolve credit card debt but also hold substantial liquid assets that could be used to repay (at least part of) the debt. Specifically, we continue to require that credit card holders "usually" revolve credit card debt (in the sense defined above) but now we also require that they hold liquid assets at least equal to half their average monthly income and at least equal to $500. Although there is no generally agreed upon threshold for transactions balances, this amount combined with cash holdings that are not recorded in the SCF, should be sufficient to cover normal transactions needs. Households that satisfy these requirements represent about one half of households with an outstanding credit card balance and about sixty percent of those who do not usually pay off their credit card balance (see Table 4).

Our discussion in the previous subsection is not materially altered when we confine attention to households that combine credit card debt with significant holdings of liquid assets. One difference is that households that find it acceptable to borrow in order to buy furs or jewelry or in order to cover living expenses are significantly more likely to be revolving credit card debt but not significantly more likely to be holding substantial liquid assets alongside credit card debt. If anything, this difference corroborates the self-control story, since such households do not perceive a need to exercise self-control by restricting the available credit card limit.

Among demographic variables, young age (below 40 years) is replaced by low education (high school dropout) in the list of factors significantly discouraging households from having a credit card and encouraging them to revolve debt. Both young age and low education are factors *a priori* likely to be associated with self-control problems, but low education is found to be more powerful when explaining the coexistence of credit card debt with substantial liquid assets controlling for the propensity to shop around for attractive interest rates. All in all, our conclusions carry through regardless of whether we investigate all those who revolve credit card debt or we confine attention to those who also hold substantial liquid assets.

5. Concluding Remarks

Credit card usage by U.S. households has increased steadily over the past 20 years, and by 1998, about two-thirds of U.S. households held a general-purpose bank-type credit card. Most card holders carry an unpaid balance on their cards, and the majority of those hold substantial liquid assets at the same time. Because revolving credit card debt typically involves borrowing at an interest rate well above that earned by households on their riskless liquid assets, this portfolio puzzle is particularly intriguing, as it suggests violation of standard financial arbitrage. While strategic bankruptcy considerations may explain the behavior of some households, we find that this puzzling behavior is quite widespread, especially among the "middle class". We present an alternative interpretation that does not rely on bankruptcy motives or financial distress.

In our "accountant-shopper" model of household behavior, the presence of the credit card allows saving and consumption decisions to be separated. The financial accountant self of the household can impose control on the consumption decisions of the shopper self by revolving a balance on the card, limiting the amount of new purchases the shopper can make before encountering the card's credit limit. Since the balance is used for control purposes in this framework, the accountant self may also find it optimal to save in a lower-return riskless asset to finance future consumption.

Using data from the pooled 1995 and 1998 Surveys of Consumer Finances, we find that a number of factors make households less likely to hold a credit card but more likely to revolve debt once they have a card, and more likely to revolve small amounts relative to their liquid financial assets. This combination of findings is hard to explain by either a pressing need of households to borrow at high interest rates or by deliberate bank policy to reject such applicants. It is, however, consistent with a significant role for self-control considerations that tend to discourage households from applying for credit cards, and to encourage those who do get them to leave little room to their (other) selves to overspend.

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Data Appendix

Variable definitions from the 1995 and 1998 Surveys of Consumer Finances

Has a bank-type credit card: household has at least one general-purpose credit card (Visa/Mastercard/Discover/Optima) with a revolving credit feature.

Has an outstanding balance on bank-type credit card debt: household had an outstanding balance after making the last payment (and not including any new charges) on a bank-type credit card.

Does not usually pay off bank-type credit card balance in full each month: respondent stated that household paid off balances on bank-type credit cards in full only "sometimes" or "hardly ever."

Married: includes both married couples and couples living together with shared finances.

Kids: number of children living at home, including step-children, adopted children, and foster children.

Age variables: of household head. Coded as less than 40, 40 to 64 (omitted dummy), and 65 or more.

Education variables: of household head. Coded as less than High School (no degree or equivalent), High School degree or equivalent but no college degree (omitted dummy), college degree or greater.

Nonwhite or Hispanic: respondent identification of race and ethnic origin.

Income: income in previous year, from all sources, before taxes and other deductions. Dollar amounts converted to 1998 dollar equivalents using the annual consumer price index.

Non-liquid financial assets: sum of total financial assets other than liquid assets including certificates of deposit, savings and other bonds, directly-held equities, mutual funds, retirement accounts, cash value life insurance polices, trusts and other managed accounts, and miscellaneous other financial assets. For the 1995 Survey respondents, dollar amounts converted to 1998 dollar equivalents using the annual consumer price index.

Non-financial assets: current market value of primary residence, investment real estate, net equity in privately-owned businesses, and other non-financial assets including vehicles for personal use, artwork, antiques, jewelry, and valuable collections. For the 1995 Survey respondents, dollar amounts converted to 1998 dollar equivalents using the annual consumer price index.

Self employed: household head's occupation is classified as self employed.

Not Working: Respondent is unemployed or not in labor force (other than retired).

Liquidity constrained: households responding they were turned down for credit, who did not eventually get the amount they requested by reapplying, and those who did not apply for credit because they thought they would be turned down, excluding those households who were turned down for a credit card.

Income low: household response to question whether income was unusually low compared to that expected in a normal year.

Shop investment: households responding 4 or 5 to a question on the amount of shopping around for the best saving and investment terms it does, on a 1 to 5 scale, where 1= "no shopping", 3= "moderate shopping", 5= "a great deal of shopping".

Health fair or poor: respondent or spouse in fair or poor overall health.

Probability stay at current address: household response to question on chance of staying at current address over next two years, on scale of 0 (no chance) to 100 (absolutely certain to stay), with 50 = 50-50 chance.

Has home equity: household has value of residences greater than outstanding amount of mortgage and home equity-line-of credit debt.

D1998: household is from the 1998 wave of the Survey.

OK Credit for Fur/Jewelry: respondent stated that it is "all right for a person like yourself to borrow money to finance the purchase of a fur coat or jewelry."

OK Credit for Living expenses: respondent stated that it is "all right for a person like yourself to borrow money to cover everyday living expenses."

Smoker: household head is a smoker.

Saver: Household's monthly expenses were less than income over the previous year.

F.I.R.E. employment: percent of households in census region employed in finance, insurance, or real estate. The census regions are:
Northeast: New England Division (CT, ME, MA, NH, RI, VT),
Northeast: Middle Atlantic Division (NY, NJ, PA),
South: South Atlantic Division: (DE, DC, FL, GA, MD, NC, SC, VA, WV),
South: East South Central Division: (AL, KY, MS, TN),
South: West South Central Division: (AR, LA, OK TX),
Midwest: East North Central Division (IL, IN, MI OH WI),
West North Central Division (IA, KS, MN, MO,NE, ND, SD),
West: Mountain Division (AZ, CO, ID, MT, NV, UT, WY, NM), and
West: Pacific Division (AK, CA, HI, OR, WA).

Relative median net worth: household median net worth in census region, relative to national median net worth.

Relative median income: household median income in census region, relative to national median income.

Table 1. U.S. Household Ownership of Bank-Type Credit Cards and Outstanding Balances on Bank-Type Credit Cards
1998 U.S. Survey of Consumer Finances

	Percent with a bank-type credit card	**Percent of bank-type card holders**		
		With outstanding balance on card	**Who do not usually pay off credit card balance in full each month**	**Who do not usually pay off credit card balance in full and have liquid financial assets > threshold***
All Households	67.2	54.9	46.5	27.6
By Age:				
Less than 35	57.9	71.5	60.7	31.4
35 < 55	72.6	61.3	53.2	31.2
55 < 65	75.4	49.6	39.6	28.8
65 or greater	61.6	26.6	21.3	14.4
By education:				
Less than high school	34.7	59.4	54.3	23.6
High school diploma	62.8	57.2	50.8	27.6
Some college	73.3	63.6	51.4	32.5
College degree	88.2	48.2	39.6	26.4
By income:				
Less than $10,000	24.5	62.4	52.5	23.8
$10,000 < $25,000	50.8	55.9	47.6	28.8
$25,000 < $50,000	72.8	58.0	51.4	27.8
$50,000 < $100,000	89.5	56.5	46.7	30.6
$100,000 or greater	97.6	37.0	28.5	18.6
By sex and marital status:				
Single male	59.9	51.1	45.3	26.6
Single female	52.3	56.0	49.5	28.6
Married	76.1	55.2	45.7	27.5
By race/ethnic origin:				
White non-Hispanic	81	52.0	44.1	27.0
Other	49.6	70.4	59.7	30.9

*Liquid financial assets of at least $500 and at least one-half total monthly income.

Table 2. Median Levels of Bank-Type Credit Card Debt and Liquid Financial Assets of U.S. Households Holding Outstanding Balances on Bank-Type Credit Cards
1998 U.S. Survey of Consumer Finances

	Median debt on bank-type credit cards, for households holding such debt	Card holders who do not usually pay off credit card balance in full and have liquid financial assets > threshold*				
		Median debt on bank-type credit cards	Median liquid financial assets	Median interest rate on card with highest balance	Median value of Min (card balance, liq. Assets)	Median annual implied credit cost**
All Households	1800	1900	4850	15.0	1500	195
By Age:						
Less than 35	1500	1200	3360	16.0	1100	150
35 < 55	2000	2000	6100	14.0	1800	216
55 < 65	2300	3100	4800	15.7	1900	220
65 or greater	900	1000	3400	15.0	730	110
By education:						
Less than high school	1300	900	3770	15.0	730	108
High school diploma	1400	1100	3400	15.0	1050	120
Some college	2000	2000	4000	15.0	1500	215
College degree	2000	2400	6200	14.9	2000	258
By income:						
Less than $10,000	800	800	1200	15.0	650	83
$10,000< 25,000	1200	1100	2000	17.0	1000	130
$25,000<$50,000	1700	1500	3770	15.0	1300	160
$50,000<$100,000	2400	2500	6650	13.9	2500	270
$100,000 or greater	3200	4500	11000	15.7	4500	509

* Liquid financial assets of at least $500 and at least one-half total monthly income
** Min(card balance, liquid financial assets) x (interest rate on card with highest balance)

Table 3. Results from the Bivariate Probit of Bank-Type Credit Card Ownership and Whether Household Usually Has Outstanding Balance on Bank-Type Credit Cards U.S. Surveys of Consumer Finances, 1995 & 1998				
	Dependent Variable: Has a Bank-Type Credit Card		**Dependent Variable: Does Not Usually Pay Off Balance on Bank-Type Credit Card**	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-2.462	0.2225**	1.814	0.1913**
Married	0.392	0.0584**	-0.016	0.0590
Single female	0.121	0.0604*	0.071	0.0621
Number of children	-0.078	0.0199**	0.091	0.0153**
Nonwhite/Hispanic	-0.176	0.0489**	0.111	0.0441*
Age Less than 40	-0.157	0.0477**	0.131	0.0400**
Age greater than 65	-0.258	0.0573**	-0.644	0.0728**
Less than HS education	-0.456	0.0525**	0.046	0.0705
College degree	0.459	0.0498**	-0.258	0.0384**
Log Income	0.123	0.0119**	-0.071	0.0126**
Log Non-liquid fin. wealth	0.058	0.0045**	-0.045	0.0046**
Log Non financial wealth	0.093	0.0062**	-0.055	0.0086**
Self employed	0.022	0.0602	-0.190	0.0447**
Not Working/Unempl.	-0.105	0.0849	-0.177	0.0855*
OK credit fur/jewelry	0.255	0.0915**	0.246	0.0594**
OK credit for living expenses	0.126	0.0410**	0.068	0.0348+
Smoker	-0.267	0.0448**	0.217	0.0406**
Saver	0.132	0.0416**	-0.386	0.0369**
Liquidity constrained	-0.343	0.0481**		
FIRE occupation	1.161	1.5552		
Relative median net worth	-0.046	0.0870		
Relative median income	0.620	0.2213**		
Income low			0.079	0.0448+
Shop Investment			-0.121	0.0347**
Health fair/poor			-0.039	0.0431
Has home equity			-0.003	0.0478
Prob. Stay at address			0.000	0.0005
D1998	-0.108	0.0411	0.074	0.0334*
Rho	-0.702		0.1078**	
Log likelihood = -6033.97				
8,604 observations from the pooled 1995 & 1998 Surveys of Consumer Finances for estimation of bank-type credit card ownership. 6,906 observations selected for estimation of who does not usually pay off outstanding balance on their bank-type credit card in full each month.				
** Significant at 1 percent * Significant at 5 percent + Significant at 10 percent				

Table 4. Results from the Bivariate Probit of Bank-Type Credit Card and Whether Household Usually Has Outstanding Balance on Bank-Type Credit Cards and Has Liquid Assets Over Threshold, U.S. Surveys of Consumer Finances, 1995 & 1998				
	Dependent Variable: Has a Bank-Type Credit Card		**Dependent Variable: Does Not Usually Pay Off Balance on Bank-Type Credit Card**	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-2.462	0.2148**	1.503	0.1861**
Married	0.377	0.0576**	-0.128	0.0590*
Single female	0.108	0.0597+	0.052	0.0629
Number of children	-0.085	0.0195**	0.080	0.0162**
Nonwhite/Hispanic	-0.162	0.0484**	0.100	0.0461*
Age Less than 40	-0.140	0.0473**	0.035	0.0415
Age greater than 65	-0.240	0.0568**	-0.387	0.0690**
Less than HS education	-0.454	0.0522**	0.119	0.0702+
College degree	0.461	0.0491**	-0.189	0.0400**
Log Income	0.121	0.0112**	-0.103	0.0121**
Log Non-liquid fin. Wealth	0.058	0.0045**	-0.029	0.0051**
Log Non financial wealth	0.092	0.0061**	-0.053	0.0091**
Self employed	0.040	0.0594	-0.073	0.0457
Not Working/Unempl.	-0.105	0.0851	-0.121	0.0902
OK credit fur/jewelry	0.262	0.0875**	0.100	0.0618
OK credit for living expenses	0.114	0.0406**	-0.047	0.0353
Smoker	-0.279	0.0444**	0.126	0.0429**
Saver	0.126	0.0412**	-0.161	0.0371**
Liquidity constrained	-0.336	0.0462**		
FIRE occupation	1.721	1.4462		
Relative median net worth	-0.060	0.0821		
Relative median income	0.621	0.2090**		
Income low			0.082	0.0443+
Shop Investment			-0.047	0.0340
Health fair/poor			-0.054	0.0427
Has home equity			0.032	0.0472
Prob. Stay at address			0.000	0.0005
D1998	-0.112	0.0405**	0.144	0.0345**
Rho	-0.840		0.0615**	
Log likelihood = -5413.76				
8,604 observations from the pooled 1995 & 1998 Surveys of Consumer Finances for estimation of bank-type credit card ownership. 6,906 observations selected for estimation of who does not usually pay off outstanding balance on their bank-type credit card in full each month and has liquid assets over threshold amount.				
** Significant at 1 percent * Significant at 5 percent + Significant at 10 percent				

Endnotes

[1] A bank-type credit card is a credit card that is not restricted to use at a particular store chain and that can be used readily as a source of revolving credit.

[2] Specifically, 27.6 percent of bank-type card holders do not usually pay off their credit card balance in full and have liquid financial assets at least equal to one-half of their total monthly income and of an amount no less than $500.

[3] Indeed, the model of Brito and Hartley (1995) contains costs of obtaining other loans but stresses the role of credit card balances in *economizing* on holdings of liquid assets for precautionary purposes.

[4] Depending on the threshold, between 8 and 21 percent of homeowners and between 3 and 9 percent of renters fall into this category.

[5] In our calculations, we have included households revolving debt on bank-type credit cards in excess of $2,500 and liquid assets in excess of $3,000. These restrictions yield similar demographics as requiring $3000 of *total* unsecured debt and liquid assets in excess of $3,000. Reducing the threshold to $2,000 raises the fraction of SCF households that "borrow to save" to about 24 percent, while raising it to $5,000 reduces the fraction to 5 percent.

[6] This should be differentiated from a self-control model based on hyperbolic discounting, as in Laibson et al. (2000). Under hyperbolic discounting, different selves are temporally separated rather than contemporaneous; (credit card) borrowing is undertaken for intertemporal consumption smoothing rather than for control; and the control function is assigned to assets that need to be sufficiently illiquid in order to be available to influence behavior of future selves. Laibson et al. explicitly state that their model is not designed to handle the puzzle of liquid asset holdings. Gross and Souleles (2001) share this view and independently mention in passing that the current puzzle could perhaps be solved by models in which agents undertake costly actions (such as revolving debt) to limit their impulse spending.

[7] "Clearly, neoclassical economics, with its strong assumptions about rational decision-making, provides a helpful theoretical framework, but we will also need to rely on other models and frameworks to help us better understand how people process information and make decisions. The work of economists such as Richard Thaler on the benefits of "low-willpower" techniques to increase savings is an example in this regard." Remarks by Vice Chairman of the Board of Governors of the Federal Reserve Roger W. Ferguson, Jr. before the National Council on Economic Education, Washington, D.C., May 13, 2002.

[8] Anecdotal evidence on precommitment and self-rationing is abundant (see, for example, Hoch and Loewenstein, 1991; Schelling, 1992; Thaler and Shefrin, 1981, and Wertenbroch, 2002). Serious self-control problems are difficult to observe under controlled conditions, and therefore controlled empirical evidence on self-rationing is only now beginning to emerge (see, Wertenbroch, 1998; Soman and Cheema, 2002). For example, consumers have been observed to purchase small and more expensive packs of cigarettes rather than cartons, so as to discourage themselves from smoking too much.

[9] Using data from special waves of the Surveys of Consumers for 1999 and 2000, Durkin (2000) finds a slightly higher percentage of credit card holders report "hardly ever" paying off their balance than in the 1998 SCF.

[10] Lack of willingness to admit problems with handling credit cards has already been noted in the literature in a different context. Using data sources other than the SCF, Gross and Souleles (2001) and Laibson et al. (2000) have noted an apparent understatement of credit card balances in household responses in the SCF, probably reflecting reluctance on the part of card holders to admit the extent of card indebtedness.

[11] When the definition of assets is expanded to include a broader definition of safe investment assets (also including bank certificates of deposit, cash value life insurance policies, and riskless assets held in retirement accounts), the puzzle is even more apparent. The median amount of safe financial assets for these households was over $8,000, more than five times their credit card debt.

[12] The interest cost to maintaining both credit card debt and liquid financial assets should reflect the interest rate spread between interest charged on the card debt and interest earned on assets. However, for the majority of these households, these assets are held primarily in non-interest-earning checking accounts.

[13] This is the practice followed in many dynamic models of consumption behavior with liquidity constraints. A more complicated alternative is to allow for forms of borrowing in addition to the credit card that entail higher transactions costs.

[14] The assumption that liquid assets will not be used directly for purchases of the consumption good is not restrictive, as will be seen shortly.

[15] The household has an incentive to pay into the credit card account as much as it takes to pay off the outstanding balance, since this ensures that new credit card purchases are subject to the grace period. If its optimal payment either falls short of or exceeds the outstanding balance, then the household is indifferent between using the credit card or liquid assets to purchase the consumption good, because the interest cost of new purchases is the same between these two options.

[16] Although this borrowing constraint is extensively used in the saving literature, it is not essential to the argument in this paper, since we are mainly interested in households with positive liquid assets.

[17] Traditionally, arbitrage refers to interest gains from borrowing at a low riskless rate to invest at a higher rate without risk. In our case, it refers to interest savings: the agent considers lowering investment in the low-rate asset in order to lower borrowing at the high rate that has been undertaken for other reasons.

[18] As in the previous model, this can exceed the size of the credit line, $\overline{B}$, if the accountant has decided to make a payment in excess of the accumulated balance.

[19] Notice that if the policy rule followed by the shopper is known to the accountant or can be inferred from the shopper's actions, then the accountant can achieve perfect control of the current household consumption level, conditional on the state in period *t*. Even in this case, however, the accountant does not control the entire consumption path. This is because $P_t \geq 0$, and the accountant can at best restrict consumption in the first period C_0 to be no more than the credit card limit.

[20] In such a model, the optimal buffer of unused credit is a constant fraction of the available credit limit. For a comparison of rules of thumb and optimal behavior in buffer-stock models, see Allen and Carroll (2000).

[21] Gross and Souleles (2001) find that almost 14 percent of their sample have credit card utilization rates, defined as the ratio of card balance to credit limit, above 90 percent. The proportion of households displaying utilization rates above 90 percent is higher among younger rather than older households, among those with low rather than high income, and those with small rather than large credit limits. Demographic groups are obtained by splitting the sample at (about) the median level of the relevant characteristic (i.e., age, income, credit limit respectively).

[22] Note that the model does *not* imply that the household will necessarily choose to revolve credit card debt. For example, if the accountant is happy to consume $\lambda\overline{B}$, then the balance will be paid off resulting in consumption of $\lambda\overline{B}$ according to (12). More generally, in periods in which the accountant's desired consumption level is no less than that of the shopper, there is no need to control the shopper by not paying off the entire balance.

[23] If fear of default is indeed a major motivating factor for banks in screening applicants, then supply-side factors may contribute to making credit card holding less pronounced among demographic groups likely to borrow large amounts. The role of such factors, however, seems to have been weakened in the 1990s with the advent of better credit scoring methods, enabling card issuers to offer cards at varying interest rates depending on assessment of credit risk. In fact, households that previously may have been considered more likely to default account for the largest percentage increase in card ownership in the 1990s. From 1977 to 1989, bank-type card ownership among U.S. households increased by 18 percentage points, from 38 percent to 56 percent, with the largest percentage increases occurring in the middle and top two income quintiles. From 1989 to 1998, however, card ownership for all households increased another 12 percentage points to 68 percent. The increase was most dramatic for households in the second lowest income quintile (22 percentage points, from 36 percent ownership to 58 percent ownership). For further details, see Durkin (2000).

[24] One variable we do not have access to in the public use Surveys of Consumer Finances is information on the state of residence of the household.

[25] The liquidity constraints dummy excludes households who said they had been turned down or not received credit desired for a credit card.

[26] If the variable on liquidity constraints as perceived by the households fails to capture the particular difficulties of minority households to secure loans (e.g., because they were not targeted by the financial services industry), then the race and ethnic origin dummy may be capturing difficulties as reflected in credit card applications in the first stage, and then a stronger tendency of minorities to borrow on the credit card because they are unable to secure low-interest loans.

[27] It is conceivable that targeting of educated and well-to-do households by credit card companies may contribute to the finding that such households are more likely to hold a card. However, it should be noted that some providers of consumer credit reveal that the level of income itself in not used as a criterion for approval. Moreover, it is unlikely that companies target educated or well-to-do households *because* they are less likely to borrow. The latter is probably a consequence of their reduced need to rely on revolving credit card debt as a method of self-control, combined with their ability to use cheaper forms of credit.

[28] Census regions are defined in the Data Appendix.

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