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, and many do so despite having sufficient liquid assets to have paid it off. We propose an explanation for this puzzle based on self-control. In our model, the "accountant self" of the household can control the expenditures of the "shopper self" 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 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 card but more likely to revolve debt once they have it, and to revolve less debt relative to their liquid assets. While this pattern is difficult to explain with reference to a need to borrow or to screening by banks, it is consistent with a significant role for self-control motives. Such motives 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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JEL classification codes: G110, E210, D910.

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. Reported card debt is sizeable: among households revolving debt on bank-type credit cards, the average outstanding balance in 1998 was $4,041 and the median was $1,800. More than half of households that revolve credit card debt report liquid savings in their checking, saving, and money market deposit accounts that are more than sufficient to have paid off the bill in full. The median interest rate on the card most frequently used by these households was 15 percent, far exceeding returns on their liquid assets. The puzzling behavior of revolvers of such high-interest credit card debt is the object of this paper.

Although there has been limited research to date on borrowing behavior of households through the use of credit cards, it has already identified three puzzles. One has to do with the use of high- rather than lower-interest credit cards for borrowing purposes (Ausubel, 1991). Ausubel attributes this 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, especially when they can avoid some of the costs associated with holding precautionary money balances.

A second puzzle arises from the co-existence in household portfolios of credit card debt and accumulations of illiquid assets for retirement, reaching quite high median levels in the 50 to 59 age category. Laibson, Repetto, and Tobacman (2000)

1

termed this 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, the 'Debt Puzzle'. They showed that consumer preferences that exhibit hyperbolic discounting are consistent with such behavior.

The third puzzle, which we term the 'Puzzle of Debt Revolvers' arises from the co-existence of high-interest credit card debt and low-interest liquid assets that could be used to repay at least part of it. This tendency has been documented in data by Morrison (1998), Gross and Souleles (2000, 2001), and Bertaut and Starr-McCluer (2000). 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 irrationality, especially since we show that it characterizes a large segment of the population. It is also difficult to invoke informational considerations: interest rates on credit cards and on liquid accounts are printed on the monthly statements. 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.[2] Finally, hyperbolic discounting generates problems of controlling future selves and this is accomplished by holdings of illiquid rather than liquid assets.

A more promising explanation and –to the best of our knowledge- the only one proposed to date, has been put forth by Lehnert and Maki (2001). They point to chapter 7 bankruptcy laws in most US states that allow households to discharge a large part of their unsecured debt although households then forfeit assets not explicitly exempted. They argue that it can be consistent for a household to run up unsecured

debt and liquid assets, if it is contemplating bankruptcy. Once the household decides to declare bankruptcy, it can be optimal to convert the liquid assets to a bankruptcy-exempt asset category (like housing). The authors consider that households "borrow to save" if they have both liquid assets and unsecured debt (including credit card debt) in excess of $3,000 (in 1998 dollars).[3] They find that households living in a state with a high bankruptcy exemption level are about 1 percentage point more likely to be "borrowing to save".

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). 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. Indeed among the most puzzling households, namely those with liquid assets in excess of credit card debt, only 22 percent satisfy the requirements for "borrowing to save", leaving 78 percent to be explained.[4]

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 the saving and the 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.[5]

We then examine econometrically whether pooled data from the 1995 and 1998 waves of the SCF are consistent with such a self-control explanation of credit card behavior. First, we examine the factors determining who has a bank-type credit card. Second, we look at factors determining who revolves credit card debt. The two decisions are modeled as a bivariate probit, with the second choice adopted only by those who choose the first: it is impossible to revolve credit card debt without choosing to hold one. The third and final stage is a regression of the (log) ratio of revolving balance to liquid assets, allowing for the fact that the sample contains only households that chose to have a credit card and revolve credit card debt.

In Section 2, we document the characteristics of those who revolve credit card debt, using data from the 1998 SCF. In Section 3, we sketch a model of credit card behavior in the absence of default motives, first without self-control considerations and then under the assumption that saving decisions are separated from consumption decisions. We show that co-existence of revolving credit card debt and liquid-asset holding is puzzling in the former case but consistent with a self-control model. In Section 4, we discuss how the self-control model can be differentiated from alternative interpretations and describe the estimation procedure. In Section 5 we present estimation results in three stages using pooled cross-sectional data. We find that estimates tend to be consistent with a self-control interpretation. Section 6 offers concluding remarks.

2. Revolvers of Credit Card Debt in the Data

In this section, we report 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. 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.

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 one-third of credit card holders report that they carry credit card debt at relatively high interest rates, although they have more than sufficient liquid assets to pay off their balances (column 3). This behavior is exhibited by all age groups, all education groups, and all income groups. However, it is 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.

Among households with balances on bank-type credit cards, the average outstanding balance in 1998 was $4,041, while the median was $1,800 (Table 2, column 1). Households that carry credit card debt although they have readily available financial resources to pay off such debt tend to have somewhat lower levels of credit card debt, but these amounts remain sizable. Columns 2 and 3 of Table 2 show median levels of bank-type card debt and median levels of liquid financial assets for these households. For households that carried an outstanding balance although they had sufficient liquid financial resources to pay it off, the median outstanding balance in 1998 was $850, while median liquid financial assets for this group were several times this amount at $5,000.[6] Table 2 also shows the median levels of credit card debt by age, education, and income. Credit card debt tends to increase with age (except for households aged over 65), and with income and education. So do financial assets, so that the ratio of liquid financial assets to card debt for households that could pay off this debt varies little by age, education, and income (column 4).

Using a credit card as a source of revolving credit may be a reasonable strategy 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 does not appear to be an important explanation for why so many U.S. households carry both credit card debt and liquid financial assets. Although a small fraction of these households do pay low interest rates on the card most frequently used, the median interest rate for these households was 16 percent (column 5).

This puzzling behavior may also arise if households only temporarily carry a balance because of special circumstances, while their normal practice is to pay off the balance in full. Because the SCF is a cross section data set, we are not able to

determine whether current holders of credit card debt are habitual holders. However, 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.[7]

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[8], 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:

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

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

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

$$R_t^c : \begin{cases} R_t^c > R_t > 1 & if \; P_t < B_t \\ \\ R_t^c = 1 < R_t & if \; P_t \ge B \end{cases} \qquad (4)$$

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

$$B_t \le \overline{B}, \quad 0 \le t \le T-1 \qquad (6)$$

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

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.[9]

Equation (3) describes the evolution of the outstanding credit card balance, B. The household starts period t with an accumulated credit card balance $B_t \ge 0$. It repays an amount $P_t \ge 0$, 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.[10]

Item (5) lists the usual nonnegativity constraint for consumption, and the borrowing constraint that prevents households from borrowing at the low interest rate.[11] 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.[12] At $P_t = B_t$, R_t^c jumps to unity and resources are

9

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.[13] Thus, the shopper determines the policy function $C_t = C_t(B_t - P_t)$, where the constant credit limit $\bar{B}$ 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.[14] The accountant's problem can be expressed in the following way:

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

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

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

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:

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

This condition can be interpreted as follows. The derivative $\dfrac{\partial C_t}{\partial u_t}$ 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 $U'(C_t)\dfrac{\partial C_t}{\partial u_t}$, 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 $\dfrac{\partial C_t}{\partial u_t}$, and this in turn reduces

tomorrow's balance directly by $R_t^c \dfrac{\partial C_t}{\partial u_t}$. 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 A Case of Rule-of-thumb Shoppers

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 shopper behavior based on an empirically motivated rule of thumb.

We assume that shoppers adopt the rule of thumb of always purchasing as

much as they can without exceeding a target utilization rate for the credit card limit.[15]

This is consistent with the empirical findings of Gross and Souleles (2000, 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,[16] 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

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

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

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

This simplifies to

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

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:

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

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

$$B_{t+1} \equiv \lambda \overline{B}\ \forall t,\ 0 < \lambda \leq 1 \tag{3''}$$

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

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

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.[17]

4. Testable Implications and Estimation Approach

4.1 Testable Implications

Before a household is observed to revolve credit card debt while also holding liquid assets, it needs to pass two "hurdles": first, it needs to have a credit card, and second to decide to revolve the balance on this credit card. Since the estimation procedure must allow for the two hurdles, it yields estimates of the effects of various factors on overcoming each hurdle and on the ratio of credit card balance to liquid assets. We employ the pattern of estimated effects across these three stages in order to differentiate self-control from other alternatives regarding credit card behavior.

The self-control model outlined above implies a particular pattern of effects. Factors that make households less confident about their ability to control credit card

spending should make them *less* likely to have a credit card, *more* likely to revolve card debt once they acquire a card, and likely to have a *smaller* credit card balance relative to their available liquid assets. If self-control considerations are pervasive, we should observe this particular pattern of sign reversals for a number of factors significant for credit card behavior.

Other conceivable explanations of credit card behavior would not imply the same pattern of effects. For example, if need to borrow is crucial, then factors that encourage households to acquire credit cards should also make them more likely to use the cards as borrowing instruments, and to have larger balances relative to liquid assets. Similarly, it is unlikely that supply-side factors such as screening of applications could induce this particular pattern of sign reversals. For this to happen, banks should display a tendency to give cards to those who are less likely to revolve card debt and more likely to have a large balance relative to their liquid financial assets. However, it is not an objective of banks to discourage revolving of debt once they have determined the credit limit, nor to encourage large debts relative to assets. 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).

4.2 Estimation Approach

Estimation of a regression model for the ratio of credit card debt to liquid financial assets needs to allow for sample selection. This is because households for which we have observations on card debt are not randomly selected from the population, but instead are observed only for those households that have found it desirable to hold card debt. Modeling the decision to carry a credit card balance itself is a complicated one. 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, all of 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 also influence whether or not the household would wish to use the card as source of revolving credit, and if they do choose to borrow with the credit card, how much debt to hold.

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 a second dummy variable $z_2 = 0,1$ for whether the household had an outstanding balance on the card after the last monthly payment. For households that carry credit card debt ($z_2 = 1$), we also observe the ratio of their credit card debt to their liquid financial assets, which we express as the log of this value.[18] We write the estimation model for each household i as

$$y_i = \beta' x_i + \varepsilon_i$$
$$z_{i1} = \alpha_1' v_{i1} + u_{i1}$$
$$z_{i2} = \alpha_2' v_{i2} + u_{i2}$$
$$\varepsilon, u_{i1}, u_{i2} \sim \text{trivariate normal with variances } \sigma^2, 1, 1 \text{ and correlations } \gamma_1, \gamma_2, \text{ and } \rho_{1,2}$$

y_i is observed only when $z_{i2} = 1$ and z_{i2} is observed only when $z_{i1} = 1$.

We estimate this model through a two-stage regression with sample selection. First, we estimate the decision to hold a credit card balance for those households that have a bank-type credit card. As both of these variables are observed as 0,1 dummy variables, we estimate this first step as a bivariate probit with sample selection, allowing for correlation between the error terms u_1 and u_2. In the second stage, we allow for correlation between unobserved determinants of the acquisition of a credit card and of the decision to hold a card balance with the amount of debt held, by

estimating a Heckman sample selection regression model for the log ratio of credit card debt to liquid assets, for those households with a card balance.[19]

5. Estimation Results

We derive three sets of estimates, for the effects of various factors on holding a credit card, on revolving a balance, and on the size of the balance relative to liquid assets. Our data set is the pooled samples of the 1995 and 1998 U.S. Surveys of Consumer Finances. These two most recent waves of the SCF provide us with a large and rich data set on household assets, liabilities, demographic characteristics, and a number of variables that also capture household attitudes.[20] Together, we have 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. Variables are defined in the Data Appendix.

5.1 Who Has Credit Cards?

We first estimate a model of who has a bank-type credit card. Since this is reduced-form estimation, results reflect the interplay between demand and supply factors (see Table 3, left column). Controlling for other factors, education correlates positively with holding of bank-type credit cards. High-school dropouts are significantly less likely to hold a card than their counterparts who graduated from high school, and these are in turn less likely to have a card than households headed by someone with at least a college degree. This may reflect both a bank tendency to prefer such customers and an increased facility of more educated households in using credit cards. It is perhaps interesting that the positive role of education in credit card holding parallels its positive role in stockholding (Haliassos and Bertaut, 1995). In that case, unlike for credit cards, there is no need for households to obtain permission to hold the financial

instrument. Taken together, the two findings suggest that use of modern financial instruments is significantly facilitated by education enabling households to handle the informational requirements they impose.

Income is also highly significant for whether a household has a bank-type credit card. Although this may seem a natural consequence of stating income on credit card applications, providers of consumer credit reveal that income in not used as a criterion for approval. Income may instead be serving as a proxy for the volume of household transactions. By contrast assets, both financial and non-financial, tend to be used as loan criteria, and they appear here with the correct (positive) sign.

Old age matters for whether households have a bank-type credit card. Households headed by someone more than 65 years old are significantly less likely than their middle-aged counterparts to have a credit card. This may be partly due to more limited transactions needs in these older ages or may be capturing elements of a cohort effect, given that the use of credit cards was not widespread through much of their working lifetime. Being young (below 40) appears to reduce the probability of having a credit card relative to being middle-aged, but the effect is only significant at the 10% level. Note that --all other factors equal-- being young *and* college educated increases the probability of holding a card, compared with being middle-aged *and* a high-school graduate. This is consistent with currently observed marketing of cards to recent college graduates. A time dummy shows that, controlling for all the listed factors, households were less likely to have a bank-type credit card in 1998 than in 1995.

Being married plays a significant role for credit card holding. Controlling for age, income, wealth, and education, married households are significantly more likely to have a card than those headed by single males.[21] By contrast, having more children tends to discourage credit card holding. Unlike marital status, employment status does

not seem to matter for credit card holding. Self-employed households are not more likely to have a bank-type credit card than their counterparts working for others, and the same is true for those who are either unemployed or not in the labor force.

Households that report being liquidity constrained (in the sense of having been denied credit or been given less credit than requested or even been discouraged from applying) are significantly less likely to have a card. Responses refer to any type of loan.[22] Inclusion of this term contributes to ensuring that effects of remaining variables are not attributable to a general incidence of borrowing constraints in the demographic category considered.

A case where this may be important is that of minorities. Once we include the liquidity constraints term, race and ethnic origin matter for whether a household has a credit card only at the 10% level of significance. Since we control for perceived borrowing constraints, the finding that non-white or Hispanic households are marginally less likely to possess a credit card is less likely to arise from a general inability of minority households to obtain credit. In fact, statistically significant effects have been consistently found for stockholding where no application is involved. 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 risk or consumption loans may be more promising explanations.

Mainly for identification purposes, we also included variables that proxy for regional factors likely to influence access to credit cards. These include the percentage of households in the census region[23] 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. Of those, relative

income is strongly statistically significant, enhancing the probability of holding a credit card.

Our results so far suggest that willingness to use credit cards, financial sophistication, and responsibility significantly enhance the probability that a household has a bank-type credit card. This is consistent with an important role for self-control considerations stressed in this paper. Factors that make households more confident about their ability to control credit card spending should contribute to a tendency to apply for credit cards. Indeed, the most extreme way to impose self-control is not to apply for a credit card at all.

However, it is still difficult to distinguish the self-control interpretation from a more traditional one involving need to borrow. Under the latter, households that need to borrow are more likely to apply for a credit card, but bank screening selects those more likely to repay their debts. This also results in credit card holding being more prevalent among financially responsible, informed and well-to-do households. The next section provides a way to differentiate between these two possibilities.

5.2 Which Credit Card Holders Revolve Credit Card Debt?

In this section, we report estimation results on the factors that tend to encourage a household to revolve high-interest credit card debt, allowing for the fact that such behavior is only observed among holders of cards. Combined with results from the previous section, this can shed more light on the plausibility of the self-control explanation. If self-control is important for both decisions, then factors that make households more confident about their ability to control credit card spending should make them *more* likely to have a credit card and *less* likely to revolve card debt once they acquire a card.

Supply-side factors, such as screening of applications, should not reverse these tendencies as long as they correlate with other signs of financial responsibility. Could screening of applications *induce* such a reversal of signs, causing us to attribute it spuriously to self-control considerations? This would happen if banks tended to give cards to those who are less likely to revolve card debt. Then, the criteria for granting credit cards would also make revolving of debt less likely. However, it is not an objective of banks to discourage revolving of 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).

By contrast, if need to borrow is crucial then factors that encourage households to acquire credit cards should also make them *more* likely to use the cards as borrowing instruments. Comparison of the roles played by each factor in the first and second stages should allow us to differentiate between the two stories. With one exception, the signs of effects on holding are opposite to those on revolving for factors significant for both decisions, as implied by self-control (Table 3, right col.).

Married households provide some key insights into the self-control story. We find that being married does not have a significant effect for whether households revolve credit card balances. Rather than marital status being irrelevant, 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 more coordination problems, because two people are involved. Based on our findings, these two considerations cancel each other.

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. This would not be

observed if children simply contributed to the need to borrow. The phenomenon is, however, consistent with an increase in the number of children making it more likely that a household will not be able to exercise full control of its credit card spending.

While college education makes a household more likely to have a credit card, it reduces the probability that it will be revolving credit card debt. This is consistent with a significant effect of a college degree on the ability of households to control their credit card spending. The propensity to revolve debt does not seem to be affected by the precise level of education of households without a college degree.

Although wealthier households (in terms of income, financial or nonfinancial wealth) are more likely to have credit cards, they are less likely to be revolving credit card debt, controlling for other factors. It seems that such households are attracted to credit cards mainly by the convenience of using credit cards for transactions, and they are either more confident about their ability to control credit card spending or less concerned about the consequences of failing to do so.

The exception to the reversal of signs between the two estimation stages regards households with heads 65 years or older. These are less likely to hold a card and less likely than their younger counterparts to revolve credit card debt. The effects of old age do not seem attributable to concerns about maintaining self-control. Combined with findings in the consumption literature that older households tend to experience a downward shift in consumption, they suggest that old age contributes to a smaller propensity to undertake credit card transactions.

The last and perhaps more problematic among factors included in both stages of estimation are race and ethnic origin. These are only marginally significant for whether the household has a bank-type credit card, but strongly significant for whether it revolves credit card debt. Households headed by a non-white or Hispanic person are more likely to revolve credit card debt. One possible explanation for this

22

finding is that non-white or Hispanic households tend to be more concerned about losing control of credit card spending, and they tend not to apply or to keep allowable spending low if they do have a card. This explanation is consistent with self-control and could be corroborated by the observed tendency of such households to abstain from risky financial instruments such as stocks.

However, it does not seem possible to rule out an alternative interpretation. Despite our attempt to control for general inability to obtain loans by including the variable on liquidity constraints in the regression of who has a credit card, it is possible that it does not fully capture the particular difficulties of minority households to secure loans relative to the rest. For example, it may not capture difficulties that arise from more limited access of minorities to marketing information provided by the financial services sector. If so, the race and ethnic origin dummy may be capturing (marginal) 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.

Turning to factors not present in the first estimation, we find that those who are more financially alert, in the sense that they tend to shop around a lot for the best interest rates, are less likely to be revolving credit card debt. Given that revolving credit card debt is costly, one would expect such 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.

An unusually low level of income in the previous year (perhaps because of a change in employment status) makes the household more likely to revolve credit card

debt. This is consistent with a more intensive effort to control credit card spending by households that experienced bad luck. However, it is also possible that much of the observed effect is due to a tendency to borrow temporarily on the credit card, before the need disappears or lower-cost loans are approved.

Attitudes to risk do not appear relevant for whether the household will run a balance on the credit card, except among those who refuse to undertake any financial risk whatsoever. The same is true of the probability of staying in the same address, i.e. not moving, of health conditions, and of whether the household has home equity qualifying it for a home-equity loan.[24]

Our estimate of Rho, the correlation between the error terms in the bivariate probit with selection, is significant and negative. This supports our general 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 which make a household more likely to hold a card, also make it less likely to hold a balance on the card. This is consistent with a self-control explanation of debt revolvers.

Finally, controlling for all these characteristics of credit card holders, there is increased tendency of households to revolve high-interest credit card debt in 1998 than in 1995, and therefore more of a reason to explain this tendency.

5.3 What Determines the Ratio of Revolving Debt to Liquid Assets?

The previous section focused on factors that induce households to revolve credit card debt in any amount small or large, relative to the amount of liquid assets held. In this section, we investigate what determines the reported size of revolving debt relative to liquid assets held simultaneously. Liquid assets are defined as the sum of assets in checking, saving, and money market accounts. Results in this section are subject to

limitations imposed by underreporting of credit card debt amounts in the SCF, usually attributed to a stigma associated with credit card borrowing (see Laibson, Repetto, and Tobacman, 2000). However, they are less likely to be severe in our case, since we study credit card balances relative to liquid assets that exclude cash holdings.[25]

Our estimation of factors influencing the (logarithm of the) ratio of outstanding debt to liquid assets uses only households with positive balance, but allows for selectivity bias resulting from the double hurdle of having a credit card and revolving debt on it. The smaller the amount of revolving debt relative to available liquid assets, the more difficult it becomes to explain why the balance (or part of it) is not repaid using those assets. Results are shown in Table 4.

Those with at least a college degree tend to have larger revolving debt relative to liquid assets than their counterparts with lower education. This confirms that higher education of the financial officer in the household makes it less likely that households will be exhibiting puzzling behavior. Controlling for education of the financial officer, the educational level of the spouse does not have a statistically significant effect on the size of revolving debt relative to liquid assets that could be used to repay it. There is also no statistically significant effect of whether the spouse of the financial officer has a paying job or not.

Although those who shop around for interest rates do not tend to run a balance on their credit cards, those who do revolve debt do not appear to decide the ratio of credit card debt to liquid assets with reference to the interest rate on the credit card. Lack of interest in arbitrage possibilities among revolvers is in accordance with our theoretical model.[26] Similarly, there is no significant effect of attitudes to risk that are known to influence other portfolio items, such as shares of risky financial assets in total financial assets.

By contrast, the level of the total limit on credit cards has a strong positive effect on the size of credit card debt relative to liquid assets. This is consistent with the empirical findings of Gross and Souleles (2001), who used a unique proprietary data set to show that households tend to fill a proportion of their available credit limit.

Those younger than 40 are more likely than older households to be exhibiting puzzling behavior in the form of lower outstanding debt relative to liquid assets, controlling for the total limit on their credit cards and for their various assets. They were also found to be (marginally) less likely to hold a credit card than their middle-aged counterparts (at the 10% level), but equally likely to have a positive balance (Table 3). All in all, credit card behavior of this age group is hard to reconcile with a 'need to borrow' combined with general inability to borrow at lower interest rates.

An increase in the (log) level of financial assets lowers the ratio of revolving debt to liquid assets. If this increase in financial assets results from an increase in liquid assets, then this implies that card debt increases by about 0.7% for any 1% increase in liquid assets. However, households with more non-financial assets or higher incomes tend to have larger balances on their credit cards relative to their available liquid assets. Thus, although wealthy households are less likely to revolve credit card debt, if they do revolve debt they tend to have a larger balance in absolute terms than their less wealthy counterparts.

Non-white or Hispanic households are not only more likely to revolve credit card debt but also more likely to be revolving smaller amounts relative to their liquid assets. We are inclined to attribute this behavior to social and cultural factors that tend to emphasize self-control mechanisms in credit card spending. Fewer borrowing opportunities for non-white or Hispanic households compared to whites would not justify such an effect. Minority households could simply repay (part of) the high-interest debt and obtain a cash advance if and when needed. Finally, the amounts of

credit card debt that households revolve tend to be smaller relative to their liquid assets in 1998 data than in 1995 data.

5.4 Debt Revolvers by Accident?

Although we have documented the widespread nature of the phenomenon of debt revolvers, it is still conceivable that such behavior is accidental for most households and reflects no consistent behavioral pattern. In this section, we perform two adjustments. First, we remove from the definition of card balance holders households that declare that they "always or almost always" pay off their balance in full. Second, we do not consider as debt revolvers households that revolve only a small sum (less than fifty dollars). Repeating the estimation subject to these two adjustments and comparing results (in Tables 5 and 6) with those in Tables 3 and 4 helps us assess which of the observed effects are an artifact of the presence of accidental debt revolvers rather than reflecting an underlying behavioral pattern.

An overwhelming majority of households that revolve credit card debt revolve more than fifty dollars and declare that they do not usually pay off their balance in full.[27] Estimation results for the bivariate probit when the relevant choice is defined as revolving debt above fifty dollars and not usually paying off the balance (Table 5) are very similar to the original ones in Table 3 where the two qualifiers were not included. After adjusting for the size and frequency of debt revolving, the role of marital status in credit card ownership is further enhanced, since there is now a statistically significant difference between single males and single females in credit card ownership in addition to that between married and single households. The role of race and ethnic origin for revolving debt is attenuated, suggesting that accidental revolving tends to be somewhat more prevalent in this population category. Finally, those without a job are more likely to be usually revolving credit card debt above the

cutoff level. Overall, the presence of accidental debt revolvers does not appear to have material influence on our conclusions regarding who has a credit card and who revolves credit card debt.

Comparison of Table 6 with Table 5 shows that accidental debt revolvers have a slightly bigger influence on the results for the ratio of credit card balance to liquid assets. Once we adjust the sample to exclude such households, young age, income, and financial wealth cease to be statistically significant. This suggests that young and low-income households tend to revolve infrequently very small amounts of card debt relative to their liquid assets, but once this is accounted for, young age and the level of income no longer influence the relationship between card debt and liquid assets. The finding that financial wealth is irrelevant for the debt-to-asset ratio of systematic debt revolvers implies that a 1% increase in financial wealth, when it involves financial assets, tends to lead to a 1% increase in the credit card balance. If anything, this strengthens the argument that debt revolvers are not motivated by a pronounced need to borrow. Finally, the lack of significance of the year dummy for systematic debt revolvers suggests that there may have been an increase in the amounts of debt accidentally revolved relative to liquid assets between 1995 and 1998.

6. 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 a sizable fraction of U.S. households do so despite having more than sufficient readily available financial assets to have paid off the balance in full. 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", and we present an alternative interpretation that does not rely on bankruptcy motives or financial distress.

In our model, 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.

Ratio of bank-type credit card debt to liquid financial assets, for households holding such debt: bank-type credit card debt is the sum of all outstanding balances after making the last payment on all of the household's bank-type credit cards. Liquid assets are the sum of amounts held in checking, saving, and money market accounts, and call accounts at brokerages. For the 69 households in the pooled 1995 and 1998 Surveys with bank-type card debt and no liquid assets, this ratio is defined as the amount of card debt. For 1995 Survey respondents, dollar amounts converted to 1998 dollar equivalents using the annual consumer price index.

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.

Financial assets: sum of total financial assets, including liquid assets, 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.

31

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.

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.

Willingness to take financial risk: household response to question on willingness to take financial risk for commensurate return. Coded as willing to take substantial risk for substantial return or above average risk for above average return, willing to take average risk for average return (omitted dummy), not willing to take financial risk.

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

Spouse education: education of spouse or partner, 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.

Spouse job: spouse or partner is employed or self-employed.

Interest rate on credit card: annual interest rate on bank-type card with the highest balance.

Credit limit: total amount household could borrow on bank-type credit cards, in thousands of 1998 dollars.

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

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.

	Percent with a bank-type credit card	Percent of bank-type card holders with outstanding balance on Card	Percent of card holders with outstanding balance < liquid financial assets	Percent of card holders with outstanding balance > liquid financial assets
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				
All Households	67.2	54.9	32.1	22.8
By Age:				
Less than 35	57.9	71.5	39.2	32.3
35 < 55	72.6	61.3	35.4	25.9
55 < 65	75.4	49.6	30.5	19.1
65 or greater	61.6	26.6	18.3	8.3
By education:				
Less than high school	34.7	59.4	28.8	30.5
High school diploma	62.8	57.2	32.0	25.2
Some college	73.3	63.6	37.4	26.2
College degree	88.2	48.2	30.5	17.7
By income:				
Less than $10,000	24.5	62.4	23.3	39.2
$10,000 < $25,000	50.8	55.9	29.7	26.2
$25,000 < $50,000	72.8	58.0	31.5	26.5
$50,000 < $100,000	89.5	56.5	36.9	19.7
$100,000 or greater	97.6	37.0	27.6	9.4
By sex and marital status:				
Single male	59.9	51.1	27.5	23.5
Single female	52.3	56.0	31.9	24.1
Married	76.1	55.2	33.0	22.2
By race/ethnic origin:				
White non-Hispanic	81	37.8	22.8	14.9
Other	49.6	64.1	36.9	27.2

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 with outstanding balance < liquid financial assets			
		Median debt on bank-type credit cards	Median liquid financial assets	Median ratio of liquid financial assets to card debt	Median interest rate on card with highest balance
All Households	1800	850	5000	4.6	16
By Age:					
Less than 35	1500	650	2870	3.6	16
35 < 55	2000	1000	6700	4.8	16
55 < 65	2300	1000	6100	5.2	16.5
65 or greater	900	500	3700	11	15
By education:					
Less than high school	1300	550	4000	5.7	18.7
High school diploma	1400	630	3190	4.8	15.7
Some college	2000	1000	5150	3.3	17
College degree	2000	1000	7200	5.2	14
By income:					
Less than $10,000	800	250	1500	5	15
$10,000 < $25,000	1200	500	2400	4	18
$25,000 < $50,000	1700	700	3710	4.4	15.8
$50,000 < $100,000	2400	1000	7500	4.8	15
$100,000 or greater	3200	2000	14350	5.8	16

Table 3. Results from the Bivariate Probit of Bank-Type Credit Card Ownership and 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: Has an Outstanding Balance on a Bank-Type Credit Card	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-2.911	0.2185**	2.832	0.1435**
Married	0.373	0.0580**	0.001	0.0544
Single female	0.115	0.0602+	0.087	0.0596
Number of children	-0.069	0.0201**	0.076	0.0146**
Nonwhite/Hispanic	-0.092	0.0482+	0.147	0.0427**
Age Less than 40	-0.083	0.0477+	0.060	0.0392
Age greater than 65	-0.291	0.0564**	-0.608	0.0606**
Less than HS education	-0.403	0.0527**	0.004	0.0615
College degree	0.455	0.0495**	-0.274	0.0359**
Log Income	0.106	0.0124**	-0.067	0.0108**
Log Financial wealth	0.135	0.0069**	-0.135	0.0064**
Log Non financial wealth	0.078	0.0062**	-0.053	0.0076**
Self employed	0.027	0.0594	-0.137	0.0415**
Not Working/Unempl.	-0.091	0.0851	-0.111	0.0806
Liquidity constrained	-0.255	0.0446**		
FIRE occupation	1.372	1.5220		
Relative median net worth	-0.064	0.0852		
Relative median income	0.650	0.2188**		
Income low			0.139	0.0437**
Shop Investment			-0.096	0.0328**
Health fair/poor			-0.041	0.0400
Prob. Stay at address			0.000	0.0005
Above average financial risk			0.027	0.0391
No financial risk			-0.076	0.0380*
Has home equity			0.040	0.0454
D1998	-0.135	0.0407**	0.107	0.0318**
Rho	-0.844		0.0790**	

Log likelihood = -6287.26

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 has an outstanding balance on their bank-type credit card.

** Significant at 1 percent
* Significant at 5 percent
+ Significant at 10 percent

Table 4. Results from Regression of Log Ratio of Credit Card Balance to Liquid Financial Assets, for Households with Outstanding Balances on Bank-Type Credit Cards 1995 and 1998 U.S. Surveys of Consumer Finances		
	Coefficient	Standard Error
Constant	0.663	1.4452
Married	0.303	0.1849
Single female	0.006	0.1600
Number of children	-0.025	0.0593
Nonwhite/Hispanic	-0.467	0.1332**
Age Less than 40	-0.229	0.1037*
Age greater than 65	0.168	0.4616
Less than HS education	-0.142	0.2047
College degree	0.686	0.2086**
Log Income	0.150	0.0624*
Log Financial wealth	-0.325	0.0863**
Log Non financial wealth	0.089	0.0432*
Self employed	0.067	0.1305
Not working/unemployed	0.270	0.2161
Spouse less than HS education	-0.228	0.1425
Spouse college education	-0.138	0.1205
Spouse has job	0.141	0.1093
Above average financial risk	0.001	0.1024
No financial risk	0.007	0.1102
Interest rate on credit card	0.003	0.0089
Credit limit	0.019	0.0019**
Has home equity	-0.035	0.1159
D1998	-0.260	0.1066*
Lambda (A)	-2.318	0.8299**
Lambda (B)	2.188	0.6205**

Note:
Lambda (A) is an estimate of Φ_γ, the error term in the log regression, times the correlation between the error terms in the log regression and the bivariate probit equation for "Has a balance on a bank-type credit card."
Lambda (B) is an estimate of Φ_γ, the error term in the log regression, times the correlation between the error terms in the log regression and the bivariate probit equation for "Has a bank-type credit card."

Log likelihood = -5720.11
Selected sample = 2,664 observations

** Significant at 1 percent
* Significant at 5 percent
+ Significant at 10 percent

Table 5. Results from the Bivariate Probit of Bank-Type Credit Card Ownership and Outstanding Balance Greater than $50 on Bank-Type Credit Cards; Household Does Not Usually Pay Off Balance in Full U.S. Surveys of Consumer Finances, 1995 & 1998

	Dependent Variable: Has a Bank-Type Credit Card		Dependent Variable: Has an Outstanding Balance on a Bank-Type Credit Card	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-2.816	0.2159**	2.512	0.1721**
Married	0.391	0.0586**	-0.042	0.0564
Single female	0.132	0.0607*	0.084	0.0601
Number of children	-0.071	0.0198**	0.088	0.0149**
Nonwhite/Hispanic	-0.106	0.0480*	0.082	0.0424+
Age Less than 40	-0.088	0.0475+	0.044	0.0394
Age greater than 65	-0.286	0.0564**	-0.534	0.0721**
Less than HS education	-0.402	0.0528**	0.048	0.0652
College degree	0.456	0.0495**	-0.249	0.0371**
Log Income	0.105	0.0125**	-0.057	0.0126**
Log Financial wealth	0.135	0.0070**	-0.138	0.0067**
Log Non financial wealth	0.078	0.0063**	-0.050	0.0079**
Self employed	0.023	0.0594	-0.152	0.0437**
Not Working/Unempl.	-0.091	0.0851	-0.141	0.0806+
Liquidity constrained	-0.195	0.0434**		
FIRE occupation	1.031	1.5185		
Relative median net worth	-0.079	0.0846		
Relative median income	0.580	0.2157**		
Income low			0.124	0.0432**
Shop Investment			-0.126	0.0334**
Health fair/poor			-0.026	0.0409
Prob. Stay at address			0.000	0.0005
Above average financial risk			0.007	0.0396
No financial risk			-0.095	0.0380*
Has home equity			0.001	0.0454
D1998	-0.140	0.0408**	0.100	0.0327**
Rho	-0.827		0.0831**	
Log likelihood = -6014.63				
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 has an outstanding balance greater than $50 on their bank-type credit card, and does not usually pay the balance in full.				
** Significant at 1 percent * Significant at 5 percent + Significant at 10 percent				

Table 6. Results from Regression of Log Ratio of Credit Card Balance to Liquid Financial Assets, for Households with Outstanding Balances on Bank-Type Credit Cards Who Do Not Usually Pay Off Balance in Full 1995 and 1998 U.S. Surveys of Consumer Finances		
	Coefficient	Standard Error
Constant	1.072	1.4292
Married	0.317	0.1980
Single female	0.073	0.1575
Number of children	-0.058	0.0644
Nonwhite/Hispanic	-0.421	0.1173**
Age Less than 40	-0.057	0.0982
Age greater than 65	0.592	0.4081
Less than HS education	-0.033	0.2163
College degree	0.490	0.2024*
Log Income	-0.008	0.0609
Log Financial wealth	-0.141	0.0888
Log Non financial wealth	0.092	0.0436*
Self employed	0.044	0.1354
Not working/unemployed	0.291	0.2201
Spouse less than HS education	-0.159	0.1388
Spouse college education	-0.089	0.1197
Spouse has job	0.063	0.1100
Above average financial risk	0.017	0.1003
No financial risk	0.181	0.1113
Interest rate on credit card	0.016	0.0089+
Credit limit	0.017	0.0020**
Has home equity	-0.086	0.1107
D1998	-0.100	0.1051
Lambda (A)	-2.099	0.7638**
Lambda (B)	1.397	0.6331*

Notes: See notes to Table 4

Log likelihood = -3996.03
Selected sample = 2,013 observations

** 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] 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.

[3] About 12 percent of homeowners and 5% of renters fall into this category.

[4] 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.

[5] This should be contrasted with 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.

[6] 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 nearly $9,000, ten times their credit card debt.

[7] 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.

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

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

[10] 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.

[11] 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.

[12] 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.

[13] 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.

[14] 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.

[15] Such behavior can arise optimally in the context of a homothetic, single-self, buffer-stock model (see Ludvigson, 1999). 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).

[16] Gross and Souleles (2001) find that almost 14% of their sample have credit card utilization rates, defined as the ratio of card balance to credit limit, above 90%. The proportion of households displaying utilization rates above 90% 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).

[17] 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.

[18] We choose this specification because the presence of the high-income over sample in the Survey generates observations with unusually high values of both credit card debt (maximum = \$108,000) and liquid assets (maximum = \$74,751,950).

[19] For technical details and procedures used, see Greene (1998).

[20] 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.

[21] Differences between single males and single females are only marginally significant.

[22] Ideally, we would like households to respond to this question excluding their experience with applications for bank-type credit cards, but this is not available. Although it is conceivable that some households respond that they are liquidity constrained only because of their experience with bank-type credit cards and despite their positive experience (or lack of experience) with other types of loans, we doubt that these represent a significant fraction of liquidity constrained households.

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

[24] The absence of a role for the home equity dummy may be due to the inclusion of the amount of non-financial wealth as a separate regressor.

[25] The extent to which liquid assets are understated because of the omission of cash holdings cannot be readily assessed, because Flow of Funds accounts do not report cash holdings of the household sector separately.

[26] The lack of statistical significance does not seem to be attributable to lack of variation in reported credit card rates. Among those with a credit card, the mean reported rate on the highest-cost card is 13.18 with standard deviation 5.93, and among revolvers it is 14.36 with standard deviation 4.75.

[27] Of 2,664 households that revolve credit card debt in our original pooled sample from the 1995 and 1998 Surveys, 2013 households revolve more than fifty dollars and declare that they do not usually pay off their credit card balance in full.