Debit or Credit?

Jonathan Zinman*
Dartmouth College
October 19 2005

* jzinman@dartmouth.edu. JEL: D14, D91, E41, G29. An earlier version of this paper, "Why Use Debit Instead of Credit?: Consumer Choice in a Trillion Dollar Market", is available as Federal Reserve Bank of New York Staff Report no. 191. I thank four anonymous referees and Beth Kiser for comments that led me to change the focus and approach in this version. Thanks also to Jeff Arnold, Dan Bennett, and Lindsay Dratch for excellent research assistance; Gautam Gowrisankaran, Charlie Kahn, and Jamie McAndrews for conversations that sparked this paper; Aprajit Mahajan for help implementing his measurement error correction; Paul Calem and Kevin B. Moore for advice on and access to the SCF credit score variables; and Bob Avery, Bob Chakravorti, Tom Davidoff, Geoff Gerdes, Kathleen Johnson, Dean Karlan, Beth Klee, Dave Skeie, Jon Skinner, Victor Stango and lunch/seminar participants from the Federal Reserve Bank of New York (FRBNY), Federal Reserve Bank of Chicago, the Economics of Payments Conference at the Federal Reserve Bank of Atlanta, and the Applied Micro Conference at the Federal Reserve Bank of San Francisco for helpful comments. Most of this paper was completed while I was on staff at FRBNY, which provided excellent research support. The views expressed are those of the author and are not necessarily shared by the FRBNY or the Federal Reserve System.

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ABSTRACT

This paper tests whether a neoclassical consumer choice model performs well in a case where behavioral considerations have strong intuitive appeal due to self-control issues, complex intertemporal tradeoffs, and low pecuniary stakes. The decision in question is a ubiquitous one: "debit or credit?". This choice has received relatively little academic scrutiny, despite the fact that debit is overtaking credit as the most prevalent form of electronic payment at the POS. Market research and conventional wisdom suggest that debit cards, which draw immediately on checking account balances, offer no benefits to the neoclassical consumer. Rather, the popular view seems to be that debit use is driven by a behavioral channel that somehow prevents "overborrowing" on credit cards.

But there are actually standard economic motives for using debit. Principally, credit card *borrowers* (as opposed to *convenience users*) pay interest to charge purchases on the margin (i.e., they don't get the float), and hence might rationally choose to use debit rather than credit in order to minimize transaction costs. Debit use might also be rational for consumers lacking access to a credit card or facing credit limit constraints. Empirical tests produce evidence that is consistent with important roles for each of these three neoclassical motives, and robust to a rich set of controls for underlying transaction demand and other potential confounds.

On the other hand, specific behavioral alternatives to the neoclassical model find little support in nationally representative data. Consumers are *not* indifferent between debit and credit, which rules out bounded rationality and/or rational indifference over small stakes. Several other results cast doubt on the notion that debit helps control spending.

All in all the results suggest that the neoclassical model adequately explains consumer choice even on a margin where behavioral alternatives have strong intuitive appeal.

I. Introduction

What is in it for the user? They are losing the "float".
- Warren G. Heller, Director of Research, Veribanc, Inc.
(Quoted in American Banker, June 29, 2000)

Debit cards... offer no fundamental advantage over credit cards except that they eliminate the feeling of being even briefly in debt.
- Prelec and Loewenstein (1998), p. 19.

This shift to debit cards could mark an important turning point as far as personal finances.... Because the cards act like cash, there is no chance of running up a large debt. "It forces discipline..."
- Christian Science Monitor, December 1, 1997
(Quote from Lawrence Chimerine, Chief Economist, Economic Strategy Institute)

Why should one care about how consumers choose to pay for goods and services at the point-of-sale (POS)? The pecuniary stakes of this decision are relatively small— less than $20 per month for most consumers.[1] But the stakes of *modeling* this type of high-frequency consumer choice are large, because they speak to the fundamental debate on the descriptive power of neoclassical vs. behavioral economics. This paper tests whether a neoclassical consumer choice model performs well in a case where behavioral considerations have strong intuitive appeal.[2]

The decision in question is a ubiquitous one: "debit or credit?". The economic and/or psychological determinants of this choice have received relatively little academic scrutiny, despite the fact that debit is overtaking credit as the most prevalent form of electronic payment at the POS.[3] Market research and conventional wisdom suggest that debit cards, which draw directly on checking account balances, offer no benefits to the neoclassical consumer. The popular view that debit use presents a puzzle for neoclassical economics is reflected in the quotes above.

[1] Although the stakes of any individual's choice may be small, Section II shows that its ubiquity aggregates to a large market.
[2] Miravete (2003) is similar in spirit and finds support for a neoclassical model of calling plan choice in the face of small stakes.
[3] Hancock and Humphrey (1997) note a lack of studies on the determinants of payment choice generally. Since then there have been several related studies. Rysman (2004) uses transaction-level data to estimate network effects in payment card networks. Hayashi and Klee (2003) examine complementarities between electronic payment use and other types of technology adoption. Kennickell and Kwast (1997), Carow and Staten (1999), Mantel (2000), and Stavins (2001) find effects of consumer demographic characteristics on payment choice. Boeschoten (1998) examines demographic and transaction size effects on payment choice in the Netherlands. Frame and White (2004) discuss the difficulty of identifying demographic effects on debit use, and find a relative dearth of empirical work on financial innovation generally. Humphrey, Kim, and Vale (2001) find that retail payment choice is responsive to price in aggregate data from Norway.

Behavioral explanations have intuitive appeal here because the debit or credit choice is characterized by small pecuniary stakes, evident self-control issues, and complex intertemporal tradeoffs.[4] One particularly important notion is that debit serves as a form of virtual commitment device against the type of "overspending" with credit cards posited by Ausubel (1991), Prelec and Simester (2001), and Bertaut and Haliassos (2002).[5] How debit might serve this function is rarely formalized, but mental accounting is a leading candidate (Zinman 2004). In fact, payment choice does tend to follow patterns consistent with the mental accounting model in Prelec and Loewenstein (1998), where debit is preferred for smaller transactions involving instantaneous consumption, and credit for larger, more durable items (Reda 2003). If debit actually does improve self-control, its small pecuniary cost implies that it does so cheaply relative to the substantial cost of overspending.[6] Besides self-control issues, the complexity of the POS payments choice in the face of small stakes lends credence to other behavioral explanations. Section III illustrates that the neoclassical optimization problem requires calibrating several cost margins and nontrivial cash flow uncertainty. Consequently behavioral rules-of-thumb and/or rational indifference may prevail.

But the introductory quotes belie that fact that there *are* potentially important, neoclassical reasons for using debit. Principally, the majority of credit card users who "revolve" balances incur interest costs to charge purchases on the margin; i.e., they don't get the "float", or interest-free loan. (Revolvers are credit card *borrowers* who do not pay off their balance in full by their payment due date, as opposed to *convenience users*.) Hence these revolvers might rationally choose to use debit rather than credit (or rather than making more frequent credit card bill payments), in order to minimize interest (or

[4] A growing number of papers on household borrowing and saving decisions have found substantial deviations from neoclassical predictions over *large* stakes (but low frequencies compared to the debit v. credit choice). See, e.g., Ameriks, Caplin, and Leahy (2003), Ashraf, Karlan, and Yin (forthcoming), Barber and Odean (2001), Bertrand, Karlan, Mullainathan, Shafir, and Zinman (2005), Chan and Stevens (2004), Choi, Laibson, and Madrian (2005), Guiso and Jappelli (2005), Iyengar and Jiang (2003), Odean (1998), and Thaler and Benartzi (2004).

[5] See also, e.g., Mann (2002). The time-inconsistency implied by concerns about "overspending" or "undersaving" has been formalized via quasi-hyperbolic preferences; see, e.g., Laibson (1997).

[6] Section III shows the many consumers pay $3 a month or less (in foregone float) to use debit instead of credit. This is much less, in present value terms, than the estimated $2,000 that consumers with sophisticated quasi-hyperbolic preferences would pay to commit themselves not to borrow on credit cards (Laibson, Repetto and Tobacman 2004).

time) costs.[7] These motives hold, on the margin, even for the small (Laibson, Repetto and Tobacman 2003b) fraction of consumers who simultaneously hold nontrivial stocks of low-yielding liquid assets and expensive credit card debt. Debit use might also be rational for consumers lacking access to a credit card or facing a binding credit constraint.

This paper puts a neoclassical model to the test. It starts by developing a standard model of consumer payment choice at the POS that focuses on sensitivity to the (implicit) relative price of electronic payments, and then tests the model's key predictions in nationally representative data.[8] Each of the key predictions is borne out: regular debit use is discretely more prevalent among revolvers, consumers facing binding credit limit constraints, and consumers lacking a credit card. The correlations between debit use and these implicit cost variables are economically large, statistically significant, and robust to controls for potential confounds stemming from compositional differences, transaction demand, and/or indifference to payment choice. Figures 1 and 2 depict the key results graphically.

The results are thus *consistent* with a large neoclassical motive for debit use. But can the data can be used to formulate tests that *rule out* alternative, behavioral models? I show that my results do in fact cast serious doubt on the premise that bounded rationality drives debit use. In the case of spending control motives, richer data are needed to formulate conclusive tests. However, the available circumstantial evidence provides little support for any behavioral model of debit use; e.g., new nationally representative evidence from the May 2004 Survey of Consumers shows that only 5.8% of debit users report being motivated by self-control issues in response to an open-ended question, while 5.5% of *non-users* report *avoiding* debit use for self-control reasons (Borzekowski, Kiser and Ahmed 2005).

[7] Some might question whether revolving credit card balances at "high" rates can be squared with traditional rationality in the first place. Indeed, computational consumption function models underpredict credit card borrowing, whether they posit exponential (Carroll 2001) or quasi-hyperbolic time discounting (Angeletos, Laibson, Repetto, Tobacman and Weinberg 2001). But the models do predict *some* credit card borrowing (e.g., by 30% of households at a real rate of 15% in Carroll's model). Gross and Souleles (2002) show that credit card borrowing does respond strongly to price.

[8] The lack of publicly available consumer-level data on explicit transaction fees is not much of a constraint, as I show that the first-order theoretical determinant of relative payments price is often whether the consumer has been revolving balances on her credit card-- and hence must "borrow-to-charge". One thus can use household data from the Survey of Consumer Finances to test whether consumer behavior is consistent with joint optimization over payment options.

In all the paper finds little to shake neoclassical priors, and much to validate them. The results suggest that the neoclassical model adequately explains consumer choice even on a margin where behavioral alternatives have strong intuitive appeal.

II. Market Background

Although this paper's primary purpose is to test whether a neoclassical consumer choice model explains debit use, recent developments in the market for consumer POS payments provide two additional sources of motivation. First is the growth of debit use and the sheer size of the POS payments market. Debit has surpassed credit to become the most common form of Visa point-of-sale ("POS") transaction in the United States (Visa 2002). Overall, debit was used for over 15.5 billion POS transactions totaling $700 billion in the year 2002 (CPSS 2003).[9] This represented about 35% of electronic payment transaction volume and 12% of POS noncash payments (Gerdes and Walton 2002).[10] Debit's ascension has been sudden, with 47% of households using it by 2001, up from 18% in 1995 (Table 1). Industry observers predict continued strong growth for debit, while forecasting relatively weak growth in credit card charge volume.[11] Although the stakes of any individual's consumer choice may be small, the ubiquity of the choice aggregates to a very large market.

Another motivating factor is that the debit vs. credit choice has implications for modeling and regulating the industrial organization of payments networks. A growing theoretical literature finds that the relative efficiency of alternative pricing practices, merchant acceptance rules, and governance arrangements depends critically on the elasticity of consumer demand for payments services (Chakravorti 2003).[12] Such issues bear directly on antitrust actions taken recently in the United States, United Kingdom, and Australia.

[9] Virtually all debit volume is attributable to consumers— businesses rarely use debit at the point-of-sale.
[10] Credit card transaction volume totaled $1.6 trillion in 2002 (CPSS 2003).
[11] See, e.g., McDonald and Wasserstrom (2003), Lyons (2004).
[12] See Rochet and Tirole (2002) for a specific and seminal example of such a model.

III. Consumer Choice at the Point-of-Sale: A Simple Neoclassical Model

A. Overview

This section details the consumer's payment choice problem at the POS, and models it using a neoclassical framework where traditional margins of cost minimization drive the decision. I describe how debit and credit offer essentially identical advantages relative to alternative payments media and how they enjoy virtually identical acceptance. Therefore it proves straightforward to boil down the POS payment choice to one between debit and credit.[13] Turning to this choice, it is shown that while credit offers float to convenience users, and superior fraud protection and reward incentives during the sample period, debit is a relatively cheap alternative for certain consumers. Specifically, a neoclassical model generates clear predictions on which consumers should be more likely to use debit— those who revolve credit card balances, those who face binding credit card credit limits, and those who lack a credit card.

B. Attributes of Payments Media

Traditionally, the literature on media of exchange have focused on acceptance, security, portability, time costs, and pecuniary costs as the key elements of payment choice (Jevons 1918). I begin by briefly comparing debit, credit, and alternative payments media (principally cash and check) along each of these first four dimensions, and then develop a simple model of consumer choice between debit and credit based on pecuniary costs.

Acceptance: Debit and credit enjoy similarly widespread acceptance as payments devices; indeed, Shy and Tarkka (2002) treat them as equivalent. Rough equivalence has come about due to the rise of "offline" debit, whereby an ATM card with a Visa or Mastercard mark can be used, as a debit card, anywhere the credit card brand is accepted.[14] In essence then, one can use debit wherever one can use credit (with a few exceptions, including some online purchases, car rentals, etc.) Consequently debit and credit are essentially equivalent along this margin when compared to cash or check.

[13] Throughout the paper I focus on "bank"-type credit cards (Visa, Mastercard, Discover, and Optima), which are also commonly referred to as "general purpose". These stand in contrast to "store" or "proprietary" cards.

Security: Debit and credit now offer essentially identical fraud protection, and hence offer similar protection against theft compared to cash or check.

Portability: Debit and credit are plastic card-based media, offering identical advantages over bulkier cash and checkbooks.

Time costs: From the consumer's vantage point at the POS, debit and credit transactions are typically processed exactly the same way, using either a POS terminal or signature-based transactions. These methods may be more or less time-consuming than cash or check, depending on the situation (Klee 2005). Both debit and credit may be used to economize on (virtual) trips to the bank or ATM.[15] Debit and credit may pose different non-POS time costs (re: paying bills), these are considered below.

Debit and credit thus offer very similar attributes along the acceptance, security, portability, and time cost margins. To the extent that they differ on these margins (or that owning multiple cards increases fraud risk), data limitations work *against* finding support for the neoclassical model's hypotheses. Why exactly this holds will be detailed below.

C. Model

The similarities between debit and credit as payment devices suggests that an optimizing consumer could optimally choose her POS payment method in two steps by:

1. Deciding whether to use "paper" (cash, check) or "plastic" (debit, credit), based on the four margins discussed above.
2. Minimizing pecuniary costs, conditional on the choice in step 1.[16]

[14] Hayashi, et al. (2003) describes the debit card industry's institutions and operations.
[15] About 17% of debit transactions involve "cash back" (Breitkopf 2003), and about 29% of debit users ever got cash back during the sample period under consideration in this paper (December 1996 Survey of Consumer Attitudes and Behavior). Cash back is only available in the 25% of merchant locations where there are the POS terminals required for "online" (PIN-based) debit (Breitkopf 2003)
[16] See, e.g., Whitesell (1989), Whitesell (1992), and Santomero and Seater (1996) for more comprehensive models of consumer payment choice.

Then in the case where the consumer is using plastic, she faces the following problem:

(1) Min $[C_d(p), C_c(H, f, r(R, r_{purch}, B, L))]$

C_d and C_c and represent the marginal (implicit) pecuniary cost of using debit and credit, respectively. The direct cost of C_d debit depends on p, the amount of the transaction fee that is sometimes levied. During the sample period under consideration in this paper only about 15% of debit cardholders faced transaction fees (Marlin 2003), and the modal nonzero fee was 25 cents (Dove 2001). Most fees are charged on online debit transactions only; charges per offline or credit card transaction have been very rare in the United States. For the purposes of discussion I assume that debit transactions clear with an effective interest rate of zero, ignoring settlement lags (which can provide a day or two of float) and costly checking account overdrafts (Fusaro 2005).

The cost C_c of using credit depends first on H, whether the household has a credit card. Assume for simplicity that households lacking a credit card (H=0) do so only for supply reasons. (This seems plausible in a standard consumer choice framework, since holding a credit card is essentially costless in the pecuniary sense, given the prevalence of no-fee cards and strong fraud protection.) Then C_c is infinite for these households and debit is relatively attractive.

C_c also depends on f, the "rewards" benefits (e.g., airlines miles, rebates) available per unit charged. These incentives typically have been more prevalent and generous for credit than debit, and can be valued at approximately one cent per dollar charged for the 50% or so of cardholders earning rewards.

C_c depends finally on r, the effective interest rate at which the consumer must borrow (or float) to charge a purchase at the point of sale. r in turn is determined by R, a discrete variable capturing whether the consumer revolved a balance at her last credit card payment due date (assume for the moment that the consumer holds only one credit card; I consider the complication of multiple cards in Section IV). In cases where R=1, i.e., where the consumer did not pay her balance in full, then she must borrow-to-

charge— each dollar charged on the margin begins accruing interest immediately at the consumer's "purchases" rate, r_{purch}.[17] Thus when R =1 debit use is relatively attractive.[18] In contrast, when R = 0 the consumer gets to float for 25 days on average (Garcia-Swartz, Hahn and Layne-Farrar 2004), and retains the option to borrow, so $r<0$.[19]

Overall the stakes of making the "correct" payment choice at the POS, conditional on R, will be small in most cases. A typical revolver who should (in a neoclassical sense) use debit but instead borrows-to-charge probably stands to lose no more than $12 per month.[20] A typical debit user who should float using a credit card stands to lose no more than $3 to $23 per month.[21] In the presence of uncertain cash flows, the cost of using debit incorrectly could be significantly higher due to nonlinear overdraft penalties. If overdraft risk is present but unmeasured (as in this model, and its empirical implementation below) this will bias against accepting the neoclassical hypotheses; e.g., overdraft risk could induce a revolver with nonincreasing demand for credit to borrow-to-charge instead of using debit.

r also depends discretely on whether B, the amount outstanding on the credit line L, exceeds L. When B>L typically three adverse things happen to the consumer: i) the rate on the outstanding balance increases substantially, i.e., $r_{over}>>r_{purch}$; ii) an overlimit fee ranging from $20-$30 is incurred, and iii) her credit rating worsens.[22] r may also vary smoothly with B and L, depending on the option value of

[17] The Federal Reserve Board of Governors' biannual publication "Shop: The Card You Pick Can Save You Money" states: "Under nearly all credit card plans, the grace period applies only if you pay your balance in full each month. It does not apply if you carry a balance forward." See, e.g., the January 1998 or August 2001 versions. Nationally representative surveys have found evidence suggesting that most credit card holders are cognizant of the interest rates charged on their plans; e.g., Durkin (2000) reports that at least 85% are aware of their APRs, and Durkin (2002) reports that 54% of holders consider rate information the "most important" disclosure, with 78% of holders responding that the APR is a "very important" credit term (compared to only 25% for rewards).

[18] In principle the *intensive* margin of the cost of revolving, r_{purch} , should provide an independent source of variation in incentives for debit use along with the extensive margin R. But in practice this is unlikely to be the case, due to data limitations, the large average wedge (over 1,500 basis points) between r_{purch} and the cost of floating, and relatively limited steady-state dispersion in r_{purch} .

[19] For analytical simplicity, I incorporate the opportunity cost of transaction balances, incurred by using debit, into the effective interest rates. This simply increases the reward to floating, and reduces the effective r_{purch} by the amount of the opportunity cost.

[20] A revolver with nonzero but nonincreasing demand for credit card debt and no rewards for credit card charges, who used her credit card to borrow-to-charge rather than using debit and made credit card payments only once per month, would spend about $12 more per month to charge an amount equal to one-half of one month's median income ($2,000) at the median rate revolvers face (14.5% APR). Assuming electronic POS payments do (or could) equal to one-half of income is probably too high, given the preponderance of expenditure that can not be paid by credit or POS debit (see Appendix 1).

[21] A nonrevolving consumer who held a credit card but used debit for $2,000 worth of purchases would forgo about $3.33 per month in float given a riskless real return on assets of 2%, and $20 per month worth of rewards where applicable (assuming the industry-standard reward valuation of one cent per dollar charged).

[22] Furletti (2003) is an excellent source of information on credit card pricing and related developments.

borrowing (more on this in Section V). Debit thus becomes relatively, and potentially discretely, attractive as B approaches L.

D. Not Modeled, Not Needed: Transaction Demand and Portfolio Choice

The model thus far has presumed that transaction demand and portfolio choice are exogenous to the decision about whether to use debit. This sub-section considers the implications of these two assumptions.

In principle, assuming exogenous transaction demand is innocuous, since the model's predictions hold for any *single* transaction, given the values of the cost variables. Taking the model to the available data does create one potential identification issue with respect to transaction demand. But the next section shows that endogenous transaction demand will confound interpretation of correlations between debit and credit use as a test of the neoclassical model only under very restrictive conditions.

The model also takes as given the consumer's credit card borrowing and checking account balances. At first glance this assumption seems inimical to studying neoclassical consumer choice; after all, shouldn't a revolving neoclassical consumer use available cash to pay down expensive credit card debt *immediately* (and then charge later purchases on a credit card), rather than waiting to use debit on future transactions? This would *seem* to maximize yield (or, equivalently, minimize transaction costs) if credit card rates exceed asset yields. If this holds then revolvers should be less likely to use debit, if anything, since they face relatively high opportunity costs of holding checking account balances. This view overlooks three important facts. First, the time and hassle costs of making credit card payments more than once a month will exceed the resulting interest savings in many cases.[23] This provides a specific neoclassical motive for revolvers with nonincreasing credit demand to maintain nontrivial checking account balances and use debit, rather than high-frequency credit card payments, to minimize

[23] Credit card companies only require payments and send statements once a month, so higher-frequency payments entail time management as well as pure time and (in some cases) mailing costs. For a worker who is paid twice a month and submits credit card payments upon salary receipt, the interest savings from making the extra payment are capped at one-half the cost of borrowing-to-charge for the month (assuming a payment settles immediately). This is about $6.00 per month for the median worker from the earlier example.

total transaction costs (i.e., interest + time costs). Second, credit cards and money are very imperfect substitutes as payment devices; most expenditure still can not be paid by credit card (e.g., housing, autos, utilities). Third, the nominal yield on checking account balances conceals much larger real yields (due, e.g., to minimum balance checking accounts). These latter two points imply that most consumers who *appear* to be borrowing "high" (on credit cards) and lending "low" (holding demand deposit balances) are *not* in fact violating arbitrage (see Appendix 1 for discussion and evidence). As such it is likely that most revolvers holding checking account balances are doing so optimally in the neoclassical sense.[24]

In any case the model, and its empirical implementation below, examines whether debit use conforms with neoclassical choice *on the margin*. The model's predictions hold, conditional on the consumer's portfolio, *whether the portfolio itself is optimized or not.*[25] Moreover, the prediction that credit card *holders* will be less likely to use debit can be tested independently of the revolving decision (and of seemingly puzzling portfolio choices related to that decision).

In summary, neoclassical consumers face a complex optimization problem over relatively small stakes when choosing a payment method at the POS. They must consider several payment options, several cost margins (only some of them explicit), intertemporal tradeoffs, and uncertain cash flows. The stakes are nontrivial but probably no more than $20 per month for most consumers. The neoclassical model predicts that debit should be relatively attractive to households lacking a credit card, revolving a credit card balance, and/or facing a binding credit card limit constraint.

IV. Data and Identification

This section details the empirical implementation and identification of the neoclassical model developed in the previous section. The predictions generated by that model suggest the estimating equations:

[24] Appendix Table 2 shows that the few revolvers who actually may be violating arbitrage do not drive the results.
[25] Debit and credit might be chosen jointly and *rationally* as well. Neoclassical, forward-looking consumers may take into account the availability of debit in deciding whether to borrow on credit cards, since the availability of debit makes steady-state

(2) $Y_i = f(H_i, R_i, F_i, X_i)$

(3) $Y_i = f(R_i, X_i \mid H_i = 1)$

Where i indexes consumers, Y is a measure of debit use, H is cardholding, R is revolving, F captures whether the household faces a binding credit card limit constraint, and X includes several variables that can be used to help identify the model by capturing other payments costs, payments and credit demand, and tastes. The neoclassical model predicts that $\partial Y/\partial R$ ("β_R") and $\partial Y/\partial F$ ("β_F") will be positive, and that $\partial Y/\partial H$ ("β_H") will be negative. In each case the null hypotheses is that $\beta = 0$. Equation (3) simplifies (2) in order to focus on the model's starkest prediction, that $\beta_R > 0$, by ignoring F and limiting the sample to cardholders (H=1).

This section details the data and identifying assumptions employed to implement equation (3), and thereby test whether consumer payment choice is *consistent* with the neoclassical model. It focuses only on identifying the reduced-form correlations between credit card use and debit card use, and postpones consideration of whether the resulting estimates actually can be used to *distinguish* between neoclassical and behavioral motives until Section VII.

I use data from the 2001 Survey of Consumer Finances (SCF), a nationally representative cross-section of 4,442 U.S. households. The SCF contains some information on debit use and detailed data on credit card use, financial status, and household characteristics.[26] I set Y = 1 if the household reports using a debit card and zero otherwise,[27] and R =1 if the household did not pay its most recent balance in full on *any* bank credit card. (I maintain the linear functional form for notational simplicity, despite the binary dependent variable.) The SCF does not report balances for individual credit cards, but rather total balances outstanding over *all* of the household's bank credit cards. This creates a downward bias on β_R if

revolving slightly cheaper by providing the benefits of electronic POS payments without borrowing-to-charge. This interaction reinforces the model's prediction that revolvers should be more likely to use debit.

[26] For more information on the SCF see, e.g., Aizcorbe, et al. (2003)

[27] See Appendix 2 for the debit use survey question. The SCF yields proportions of debit users comparable to other surveys; e.g., the Standard Register's *National Consumer Survey of Plastic Card Usage*, a random phone survey of 1,202 households, found that 37% were debit users in March 1999. The 1998 SCF (collected January-August) found that 34% of households used debit.

some households use separate credit cards for borrowing and transacting, and motivates close consideration of samples that are restricted to the 25% of households with only a single credit card.

Two other identification issues influence the choice of estimator and control variables (X's) in implementing equation (3). Recall that the goal is to produce a test of whether consumer behavior is consistent with neoclassical consumer choice.

Consequently omitted variables on debit transaction fees, cash back usage, rewards incentives, and merchant acceptance pose a challenge in the SCF. Each of these unobservables biases β_R towards zero by producing revolvers who rationally do not use debit (due, e.g., to rewards incentives or overdraft risk), or nonrevolvers who rationally do use debit (due, e.g., to cash back transactions in lieu of an ATM trip or the hassle costs of making a credit card payment). Control variables for demographics, attitudes, and household financial condition mitigate the downward bias by proxying for the time costs, consumption patterns, and tastes that drive the unobserved behaviors.

A second threat to identification is the possibility that $\beta_R > 0$ simply picks up indifference. This would occur if revolvers are relatively "big spenders" who choose their payment device haphazardly, perhaps because the computational costs of finding the right solution outweigh the benefits. In this case revolvers might be mechanically more likely to use debit regularly because they transact more (although the binary nature of our measure of regular debit use mitigates this concern). I therefore control for underlying transaction demand with data on wealth, income, income shocks, spending relative to income over the past year, the interest rate on revolving balances, the number of credit cards, credit card charges, and the use of other electronic payments. The latter variables also help (over-)control for any "taste for plastic" that may be correlated with revolving behavior but not necessarily indicative of neoclassical cost minimization.

Overall then, estimating (3) using probit will, under the usual distributional assumptions about the error term, identify whether debit card usage is consistent with the neoclassical model ($\beta_R > 0$). The

estimates are subject to various downward biases in favor of the null ($\beta_R = 0$), the magnitudes of which are bounded in Section VI.

I round out the empirical specifications by pooling SCF cross-sections in some cases. The SCF has been conducted every three years since 1989 and asked questions on debit use since 1992 (Table 1 shows the rapid growth of debit use among SCF households from 1992 to 2001). As the survey lacks any panel component in the years under consideration, the pooled specifications simply add year effects T to produce, e.g..:

(4) $Y_i = f(R_i, X_i, T_t \mid H_i = 1)$[28]

V. Core Results

This section presents results obtained from estimating versions of equations (2)-(4). The findings are consistent with each of the neoclassical model's three predictions: revolving and facing binding credit constraints are found to be positively associated with debit use, while holding a credit card is negatively correlated with debit use.

I first estimate β_R, the correlation between revolving credit balances and debit use, by estimating equations (3) and (4) on several samples from the SCF using probit.[29] The marginal effects, presented in Table 2, suggest that revolvers are significantly more likely to use debit, to the tune of perhaps 6 percentage points (which is 17% of the baseline probability). The "base" specification contains several covariates in the X vector that are designed to help identify β_R. These variables include controls for debit card supply (census region,[30] housing type, and ATM cardholding status); and for life-cycle and transient proxies for transaction demand and secular tastes which might affect payment choice (income last year,

[28] One issue not captured in the notation is that the SCF produces 5 implicate observations per household in order to maximize precision in the presence of substantial imputation of certain financial variables; see, e.g., Kennickell (1998) or Little (1992). Although I use the full dataset of 5 observations per household (and correct standard errors accordingly, using the routine provided by the 2001 SCF codebook at http://www.federalreserve.gov/pubs/oss/oss2/2001/codebk2001.txt), reported sample sizes will be based on the number of *households.*

[29] Throughout the paper I report probit marginal effects with SCF sample weights; using linear probability or logit produces virtually identical results. The results are also robust to using unweighted estimation on samples that exclude wealthy households *a la* Hayashi and Klee (2003).

last year's income relative to average, number of household members, homeownership status, marital status, attitudes toward borrowing for luxury items, occupation, age, gender, educational attainment, military experience, race, and 1-digit industry).[31] Table 3 presents some related summary statistics, and detailed variable definitions are available in Appendix 3. Appendix Table 1, column 1 presents results obtained for the control variables when estimating the base specification as in Table 2, Column 1. The (pseudo) R-squareds are high by cross-sectional standards (e.g., 0.23 when using probit on the pooled sample).

Comparing Column 1 to Columns 2-5 indicates that the correlation between revolving and debit use is robust to different controls for "big spenders" and a "taste for plastic". Column 2 takes the base specification and adds a quadratic in net worth and categories for spending relative to income in the past year. Column 3 then adds dummy variables for whether the household uses other electronic payment media or computer banking. Column 4 adds the number of bank credit cards, last month's bank credit card charges, and the interest rate paid on revolving balances. Column 5 add the interaction between the number of cards and revolving status (since SCF revolvers may in fact hold multiple cards for the express purpose of maintaining one for convenience use). In all the results in Columns 1-5 alleviate concerns, discussed in Section IV, that the observed correlation between revolving and debit use is driven by underlying transaction demand coupled with indifference, or by a preference over payment types that is unrelated to neoclassical cost minimization.

Table 2 also exhibits the effects of limiting the sample based on cardholding (Column 6) and charging behavior (Column 7). These cuts are motivated by the measurement issues discussed in Section IV, but in fact leave the results unchanged in most cases. The results are also robust to other alternative measures of revolving behavior (not shown). These include: using total credit card balances or self-reported habitual revolving behavior to define R (instead of the most recent bank credit card revolving balances), and discarding the 14% of revolvers who hold charge cards (and can thereby float) from the

[30] Census region is not available in the 2001 SCF public release; results estimated on the 1995 and 1998 do not change if region is omitted.

sample. Appendix Table 2 shows that the results are not driven by the few households who actually have excess checking account balances available to pay down credit card debt.

Reading across rows in Table 2, the estimation samples include the individual SCF cross-sections from 1995, 1998, and 2001, as well as the three samples pooled together.[32] This strategy is motivated by two trends: 1) the rapid growth in debit usage over time (Table 1), which implies that both the average and marginal debit users might vary across the cross-sections; 2) rapidly changing supply conditions; specifically, the dramatic increase in debit's acceptance and fraud protection over the sample period. Comparing results across the three sample years suggests stability in the relationship between revolving and debit use from 1998 to 2001, but not between 1995 and the other two survey years. Estimates using the base specification on the 1995 cross-section are substantially smaller, and insignificant. Simulations in Section VI show that the 1995 results could indeed be explained by inferior debit supply conditions.

Table 4 presents estimates of the correlation between credit card holding and debit use. Note first that this presents a power problem, particularly in 1995, since there are few households that use debit but lack a credit card (Table 5, column 5).[33] Accordingly I focus the estimation on 1998 and 2001, although even these years have small cell sizes for debit users lacking a credit card (8% and 9% of the sample, respectively). Nevertheless β_H has the negative sign predicted by the neoclassical model in each of the four specifications estimated (Table 4), and in three of the four cases it is large and statistically significant.[34] The base specification here (Table 4, Column 2) takes the full sample of checking account holders with positive income and estimates a probit with both R and H in the equation. The estimated marginal effect on β_H here indicates that holding a credit card is associated with a 7.2 percentage point reduction in the probability of debit use (this is a 16% decrease on the sample average of 0.45). Adding additional controls for credit card supply (Column 3)-- housing tenure, employment tenure, debt burden,

[31] Results do not change if one-digit occupation code is used instead of, or in addition to, industry.
[32] I omit the 1992 data because the question on debit lacks the later emphasis on usage (see Appendix 2). Adding 1992 data to the pooled sample tends to reduce the point estimates slightly. I omit households lacking a checking account (14% of households) or with nonpositive income (0.7% of households). Including these households does not change the results.
[33] The cardholding coefficient may be attenuated as well, since cardholding mechanically effects revolving. This type of econometric problem is discussed in Angrist and Krueger (1999)

and loan delinquencies— increases the point estimate to -0.47 and reduces the p-value to 0.07. Columns 4 and 5 exclude revolvers in order to maximize sample homogeneity. The marginal effects are smaller in absolute value in each case but still significant in the base specification.

Table 6 presents estimates of the correlation between binding credit constraints and debit use. The first panel presents results from a probit where revolvers are divided into three utilization categories based on the ratio of their most recent bank card balances to their credit limit, with convenience users as the omitted category.[35] As predicted by the neoclassical model, the most intense credit card borrowers-- the 7% of the sample with utilization rates of 75% or greater-- appear discretely and significantly more likely to use debit than the least intense revolvers.[36] The result holds in every sample but the 1995 cross-section.

Additional results suggest that future credit constraints may be as important as current ones in driving debit use. If only current credit constraints matter, than we would expect discrete jumps in debit use only at the bottom and top of the utilization distribution. Such jumps would capture the revolving and credit limit effects, respectively. But if the anticipation of future credit constraints matters, we might find that the credit limit begins to bind at utilization levels substantially below 100%, if consumers hold buffer stocks of available credit. The latter case appears to hold. Whether one demarcates line usage as in panel one, or by conditional terciles (producing much lower cutoffs for medium and high intensity, shown in panel two), it appears that debit usage jumps discretely and significantly for medium, but not again for high, intensity users.[37] Panel three explores this further by dividing revolvers based on conditional quartiles of line utilization, and finds again that the second discrete jump in debit use occurs somewhere in the middle of the utilization distribution. Finally, it also appears that households reporting no

[34] These magnitudes are an order of magnitude smaller than the effects of credit card holding on money balances found in Duca and Whitesell (1995) using the 1983 SCF.

[35] I use total bank credit card balances and the credit limit variable (x414) in constructing the utilization measures; using total credit card balances instead has little impact on the results.

[36] Gross and Souleles (2002) use utilization categories of 0-50%, 50-90%, and >90% in their analysis of the impact of credit constraints on interest rate elasticities and propensities to consume out of available credit. This demarcation is impractical in my sample since only 3% of households have utilization >90%. Presumably this low proportion is due to: a) underreporting of credit card borrowing, and b) the fact that the SCF credit line variable may include lines from multiple cards.

emergency access to capital from family or friends are much more likely to use debit at lower utilization levels, although none of the differences by this proxy for buffer liquidity are statistically significant. These findings raise the question of whether credit constraints might actually bind at R=0, and thereby bias β_R and β_F downward, but conditioning on the size of the credit limit itself does not change the results.

Table 7 displays evidence suggesting that the utilization and revolving correlations with debit use operate through reductions in bank credit card charges, as one would expect. Mechanically, that is, one expects to find revolvers charging less on their credit card if they are in fact minimizing the marginal cost of POS payments by not borrowing-to-charge. This appears to be true, resoundingly, regardless of how one measures revolving behavior.[38] The table presents results only from the 2001 and pooled samples for brevity's sake, and in both samples one finds large reductions in the level of credit card charges for revolvers relative to convenience users. The $428 and $344 reductions in the 2001 and pooled samples (column 1), respectively, each amount to 60% of the sample mean; estimating mean charges using tobit instead of OLS, or estimating median charges using least-absolute-deviations, produces equal or greater proportional reductions (not shown). Debit users do not exhibit significantly greater reductions than non-users, however, suggesting that some revolvers may switch to cash or check rather than debit to manage their payments costs. This makes sense if, as hinted earlier, credit may actually dominate debit as a medium of exchange along certain dimensions (e.g., fraud protection, acceptance) during the sample period under consideration, a possibility explored in Section VI.

Summarizing the key results presented in this section, it appears that households do behave in a manner that is *consistent* with a neoclassical model of consumer choice. This is evidenced by the economically and statistically significant correlations between debit use and revolving status, credit card holding, and credit limit constraints. The point estimates suggest that neoclassical motives could account

[37] The finding here seems analogous to the discrete jump in the propensity to consume out of available credit among medium intensity users found in Gross and Souleles (2002)

[38] A data limitation in the SCF motivates experimentation with the alternative measures of R presented in the second and third columns of results in table 7. The problem is that the SCF only captures *the previous month's* charges, and presumably some fraction of households started revolving only *after* choosing not to pay the previous month's balance in full. For this fraction one would not necessarily expect to observe lower charges in the previous month. Accordingly, the specification presented in column

for a perhaps 38% of cross-sectional debit use (if we simply sum the absolute values of β_R and β_H in Table 4, Column 2 and scale by the proportion of debit-using households). The next section finds that this estimate is almost certainly a conservative lower bound.

VI. Data Limitations and Their Effect on the Core Results

This section explores how measurement error and omitted variables might impact the key estimates presented in Section V. In particular, at least seven different measurement issues could bias β_R downward and thereby understate the true correlation between revolving and debit use. The discussion below draws on results presented in Table 8. Appendix 4 contains more detail on related variable construction and estimation procedures.

1. Mismeasurement of R, revolving behavior

Section V considered alternative definitions of R based on different *reported* measures of credit card borrowing. A deeper problem is that the reports themselves may systematically understate revolving prevalence. *Total* credit card borrowing in the SCF falls far short of aggregate figures compiled from issuers, although underreporting on the *extensive* margin appears to be small (Draut and Silva 2003). I address the latter "misclassification" problem in two ways. The first approach exploits SCF interviewer observations on the quality of a household's responses. Limiting the sample to those most likely to respond truthfully (Table 8, column A) and accurately (column B) increases the estimated correlation between revolving and debit use by up to 4 percentage points, but not significantly so. The second method implements the Mahajan (2004) corrections for misclassification error in binary regressors, using the most recent measure of bank credit card revolving as the true R of interest, and the habitual measure of revolving as the instrument. If we assume that misclassification of R is independent of the covariates, then β_R is essentially unchanged at 0.064 in the base specification; more realistically, allowing the misclassification to vary with race, income, education, age, gender, and industry increases β_R very slightly

2 define revolvers as those who are currently revolving a balance and report habitually revolving a balance; column 3's

to 0.066. Overall then it appears that misclassification of R does not significantly attenuate estimates of β_R.

2. Omitted strategic default motives

β_R might also be biased downward if the model fails to capture strategic default. In particular, a revolver who is contemplating bankruptcy, or simply not making interest payments, might rationally elect to continue borrowing-to-charge rather than using debit.[39] Accordingly, I use imputed SCF credit scores (Barakova, Bostic, Calem and Wachter 2004) to re-estimate the base specification on a sample of high-risk borrowers. Column A shows that the point estimate in the high-risk pooled sample increases slightly; this result is driven by stability in the 1995 and 1998 estimates, as the 2001 point estimate (column B) increases sharply. Alternately, conditioning on functions of the credit score in the pooled base sample *reduces* the point estimate by about 2 to 2.5 percentage points but also leaves the qualitative results unchanged. Overall there is little suggestion that omitted strategic default motives dramatically impact the results.

3. Time and hassle cost motives for debit use

Nonrevolvers may economize on time and hassle costs by using debit to eliminate ATM trips and/or credit card bills. Practically, the absence of data on these motives in the SCF will attenuate β_R as a test of the neoclassical model because they imply that some proportion C of convenience users *should* use debit regularly. Calculations in Section VII suggest that time and hassle cost minimization explains perhaps 44% of debit use among convenience users; i.e., C appears to be large. However, the bias on β_R from unobserved C will be mitigated to the extent that other regressors capture the omitted behaviors. I explore the magnitude of the potential bias via simple simulations that randomly assign "time and hassle cost" motives to some non-revolving debit users in the SCF. Table 8, Columns A and B shows that β_R is .107 and .161 when C = 20% and 44%, respectively. Thus unobserved time and hassle cost motives produce substantial downward bias on β_R.

specification takes the more extreme step of excluding current-but-not-habitual revolvers from the sample.

4. Fraud costs/security precaution

Credit cards offered superior fraud protection during the sample period studied in the paper (Thomson 2002). As such, some revolvers might rationally borrow-to-charge rather than using debit, if the expected fraud loss on a marginal transaction exceeds the expected marginal finance charge. But adding the SCF's categorical measures of appetite for financial risk as additional covariates leaves β_R unchanged. This SCF variable is probably an imperfect proxy for expected fraud loss, however, so I tap market research on preferences for online debit to help develop a rough idea of the extent to which unobserved security concerns might influence estimates of β_R. The *STAR 2000 Consumer Awareness, Trial and Usage Study* found that 51% of debit users preferred online debit, among which 54% cited better security (due to the PIN requirement) as the primary reason for their preference. Accordingly, let us assume that (.51*.54) = 27.5% of debit users will use *only* online debit; given the relative scarcity of PIN terminals (compared to offline facilities), this implies that debit is an unobservably poor substitute for credit for these consumers. I simulate the effect this might have on β_R by randomly assigning a "security precaution" motive to a proportion S of revolvers who do not use debit, taking 27.5% as the strong case, and an arbitrary 10% as the weak case.[40] β_R rises to 0.087 in the weak case (column A) and to 0.136 in the strong case (column B). Overall, it seems that unobserved security precautions might lead to some attenuation of β_R. Note again, however, that the simulations overstate the true β_R to the extent the unobserved security precautions were effectively partialled out in the first place, via the X's.

5. Rewards incentives favoring credit use

Credit cards typically offer more generous rewards (e.g., frequent flier points, rebates, etc.) than debit.[41] The marginal benefit of these rewards might exceed the marginal cost of borrowing-to-charge for many consumers, implying that any unobserved net benefit could bias β_R downward. Assume then that

[39] About half of bad credit card debts are written off without the debtor filing for bankruptcy (Dawsey and Ausubel 2002).
[40] Note that this strong case is almost certainly too extreme, since presumably many consumers who refuse to use offline debit still use online debit and the outcome of interest is a binary measure of debit use.
[41] Despite widely publicized new programs on the debit side, the *STAR 2002 Annual Consumer Survey* found that only about 6% of consumers get ATM or debit rewards (c.f. Marlin 2003). In contrast, credit card incentives have been prevalent for years. The December 1996 SOC found that 56% of credit card holders had a card with rewards.

some fraction Z of revolvers prefers to borrow-to-charge, rather than use debit, in order to obtain rewards. I simulate a "strong" version of the rewards motive by setting Z to 60%, in light of recent survey evidence that rewards are "very important" or "somewhat important" to nearly 60% of bank credit card holders (Durkin 2002). The "weak" version is motivated by the roughly 20% of SCF households who report credit card interest rates of less than 10%. The latter case produces a β_R of 0.116, with the former yielding a huge increase to 0.292. In all it seems likely that omitted information on rewards usage leads to substantial downward bias on estimates of the correlation between debit use and revolving.

6. Multiple bank credit cards

As discussed earlier, the SCF captures total bank credit card balances across *all* cards. R therefore must be derived from this aggregate measure, whereas the precise test of interest requires information on whether the consumer has the ability to float on any *single* bank credit card. The most direct test of the degree to which this biases β_R is to limit the sample to households holding a single credit card (Table 2); however, this approach invites sample composition confounds. Alternatively, one could make assumptions on the degree to which those *appearing* to borrow-to-charge in the data are in fact rationally floating. The rewards and security simulations, which also treat revolvers who do not use debit, give a sense as to how large the bias could be.

7. Debit card supply and merchant acceptance

Although debit is available and accepted widely today-- as 80% of ATM cards sport the offline Visa logo alone (Dove 2002), and as PIN terminals steadily increase in prevalence— this was much less true in 1995. Practically, this implies that during the early part of the sample period under consideration in this paper, there were nonusers who would have used debit given the right supply conditions. If some of these consumers instead borrowed-to-charge, β_R would again be biased downwards. This effect probably helps explain why β_R is so much lower in 1995 than in later years.

All in all it seems plausible that data limitations significantly dampen β_R, the estimated correlation between revolving and debit use.[42] Better data on cash back, rewards, and individual card balances would be particularly useful for generating more accurate estimates of the true correlation. I now turn to the issue of interpreting such estimates as tests of competing models of consumer choice.

VII. Behavioral Alternatives: Some Circumstantial Evidence

The results thus far are *consistent* with strong neoclassical motives for using debit instead of credit. This section shows that related findings cast doubt on competing behavioral explanations.

Bounded Rationality

The results thus far suggest very strongly that bounded rationality does not drive debit use. Bounded rationality might take different forms in this context. Consumers might arrive at behavioral rules-of-thumb, e.g.: "I find that I can keep my monthly spending in the desired range if I use debit for X, Y, and Z types of purchases and credit for A, B, and C types of purchases". They might respond to psychological cues (e.g., advertising) that they are exposed to at the POS (Feinberg 1986) or elsewhere (Bertrand, Karlan, Mullainathan, Shafir and Zinman 2005). Or they might exhibit various manifestations of rational indifference in the face of a complex decision under low stakes, e.g.: "the computational cost likely exceeds that amount I'd save by solving the problem correctly, so I'll just a) choose randomly; or b) always use one or the other; c) never use either and just pay cash or check." In any of these cases the empirical implication in the SCF data is the same: it works *against* finding support for the neoclassical predictions. Put simply, bounded rationality produces indifference and weakens cost sensitivity, while the core findings, in contrast, suggest that debit choice does respond to its (implicit) marginal cost.

[42] Note that missing information on the prevalence of debit transaction fees is *not* likely to bias estimates on β_R, since fees are: 1. not very prevalent (see Section III); and 2. typically charged only on *online* debit transactions. As such fees are unlikely to influence the *extensive* margin of debit use, all else constant, since in most cases consumers will have the option of a fee-free offline transaction.

Spending Control

The core results do not rule out spending control motives in and of themselves (see Zinman (2004), for derivations and discussion). A different type of data is needed for more direct tests; however, three sets of findings from currently available data cast doubt on the salience of spending control motives.

Finding #1: Consumers do not report using debit for self-control purposes in response to an open-ended question.

The May 2004 Survey of Consumers (SOC) asked a nationally representative sample of debit users the following open-ended question: "We are interested in understanding the reasons why people use debit cards to make purchases. Why do you use your debit card to make purchases?" *Only 5.8% of debit users cited spending control motives*. Non-users were asked: "We are interested in understanding the reasons why people don't use debit cards to make purchases. Why don't you use your debit card to make purchases?" *5.5% of non-users cited spending control motives*.[43] These results suggest that findings from earlier market research on spending control questions were biased by the survey design (in sampling and/or prompting).

Finding #2: Evidence suggests that many non-revolvers use debit to minimize time costs of payments.

Perhaps 31% of debit users in the 2001 SCF lack any observable pecuniary reason for using a debit card (Table 9); i.e., they are not revolving but do possess a credit card. (This 31% is almost certainly an upper bound, given the likelihood that revolving is underreported in the SCF.) A neoclassical explanation for this "non-pecuniary group" is time costs-- using debit for cash back and/or to eliminate the hassle of paying a credit card bill. This motive does appear to be prevalent.[44]

[43] Responders could list more than one reason. The most common responses were "convenience" (88% of debit users) and "hard to track spending" (40% of debit nonusers). See Borzekowski, Kiser and Ahmed (2005) for more details.
[44] Differential acceptance may be another, albeit small, motive here, since there were a few establishments that accepted debit but not credit during the sample period. This phenomenon is becoming more prevalent in the wake of the Walmart settlement; 4.9% of debit users in the May 2004 SOC mentioned it.

First some descriptive statistics related to time costs. The December 1996 SOC found that 29% of debit users got cash back; it stands to reason that this proportion has increased over time with the spread of POS terminals. The 2001 SCF shows that 14% of non-revolving debit users exhibited behavior that was consistent with the hassle cost explanation; i.e., they had not incurred any bankcard charges in the previous month. Together these two statistics suggest that time costs alone drive 44% of the non-pecuniary group, if we assume that cash back use had increased to 35% by 2001 and was distributed equally among different types of debit users: 0.14 + (1.0-0.14)*0.35 = 0.44 .

Probit results on the usual sample of bank credit card holders appear to confirm the importance of time costs for debit users generally. Appendix Table 1 shows that higher-income consumers (i.e., those with a larger opportunity cost of time spent obtaining cash or paying a credit card bill) use debit more.[45] This result is obtained after conditioning on revolving and a rich set of other characteristics, including wealth.

Finding #3: **Many debit users who lack a credit card do so by constraint, not by choice.**

Debit might be used to control spending if it enables consumers to forego holding a credit card in order to avoid the temptation of borrowing to finance current consumption.[46] The paper thus far has assumed, in contrast, that holding a credit card is essentially costless (due to the prevalence of no-fee cards, and strong fraud protection), and hence that the relatively small number of debit users who lack a credit card do so by constraint, not by choice. The available evidence suggests that this is a fair assumption. 40% of these debit users report being credit constrained. Estimating a model of credit card holding on the sample of checking account holders in the 2001 SCF (Table 10) produces the expected significant results on several standard supply variables (income, education, homeownership, time at current residence, loan delinquency), conditional on underlying demand for consumption smoothing (proxied by age, household structure, employment status and industry, self-employment, and income

[45] The self-employed are much *less* likely to use debit; this is consistent with minimizing costs of safekeeping cash receipts (i.e., using cash for purchases rather than making an extra trip to the bank to deposit the cash and then using debit).

relative to normal last year). These results hold whether the sample is restricted to debit users (columns 3 and 4) or attitudes toward debt are included (columns 2 and 4). The pseudo-R-squareds range from 0.18 to 0.23, which is reasonably high for cross-sectional analyses. If debit does help control spending by working on the extensive margin of credit card use, then it appears to do so for only a fraction of a small base (e.g., the 15% in Table 9, column 3) of debit users.

In all the available data provide little ammunition for behavioral models that would complement or supplant a neoclassical interpretation of the core results. Whether one examines descriptive statistics or econometric results, the results are consistent with dominant neoclassical motives (i.e., minimizing transaction costs) and small, if any, behavioral motives (i.e., spending control or minimizing computational burden).

VII. Conclusion

This paper finds that a neoclassical model of consumer choice seems to explain debit use at the point-of-sale ("POS"). Available data bears out each of the model's testable hypotheses: those revolving debt on credit cards, lacking a credit card, and/or facing a binding credit constraint are much more likely to use debit. These correlations are large, robust and apparently driven by the minimization of pecuniary costs, time costs, and other transactions costs as traditionally defined.

Related results provide little if any support for behavioral alternatives to the neoclassical model. Consumers are not indifferent over POS payments choices, a finding that rules out bounded rationality and/or rational indifference. Debit users rarely report using debit to control spending in response to new, unprompted survey questions, and those who violate the pecuniary predictions of the neoclassical model nevertheless behave in accordance with time cost minimization motives. The relatively few debit users who lack a credit card appear to do so because of supplier-imposed constraints rather than temptation avoidance.

[46] In the 2001 SCF, 73% of households held a bank credit card and 87% had a checking account.

Taken together the findings in this paper are notable because they validate a neoclassical model of consumer choice even in a setting where behavioral considerations have strong intuitive appeal due to self-control issues (overborrowing), a complex intertemporal optimization problem (with several cost margins and uncertainty), and small pecuniary stakes (less than $20 per month for most consumers). The question of *how* consumers arrive at the neoclassical solution (e.g., learning, intuition, computation) is an important one, but difficult to test in the available data.

Data on individual transactions would permit finer tests of the neoclassical model and direct tests of mental accounting, a specific behavioral alternative. But the results at hand support the neoclassical model.

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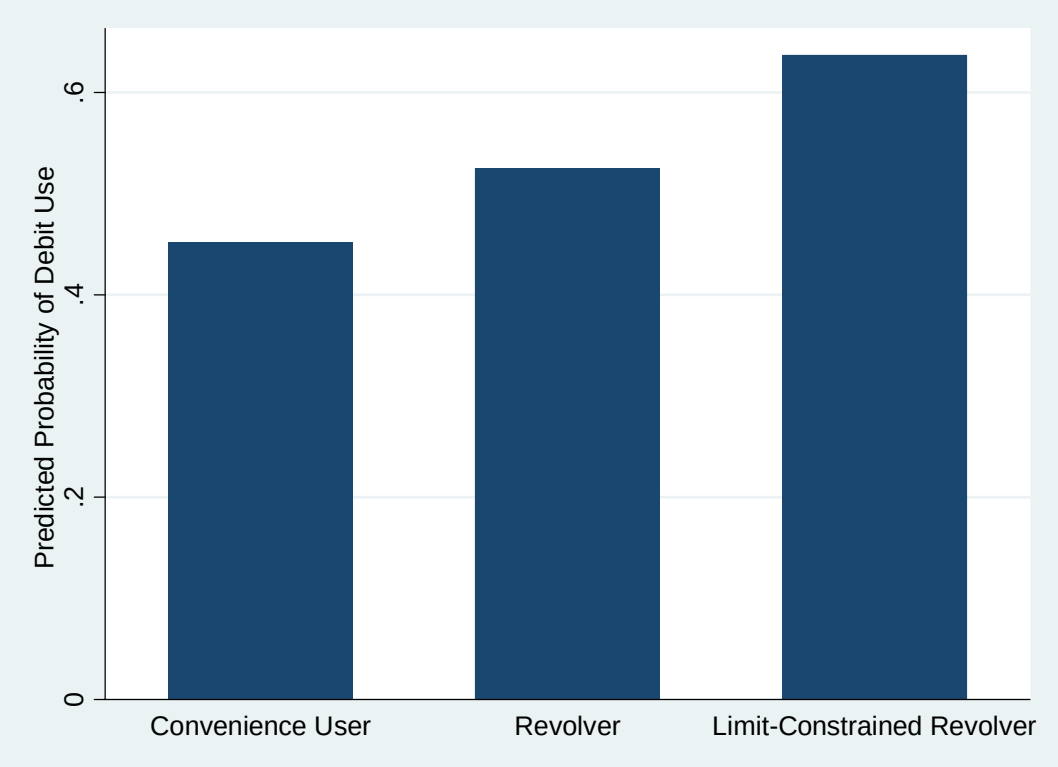
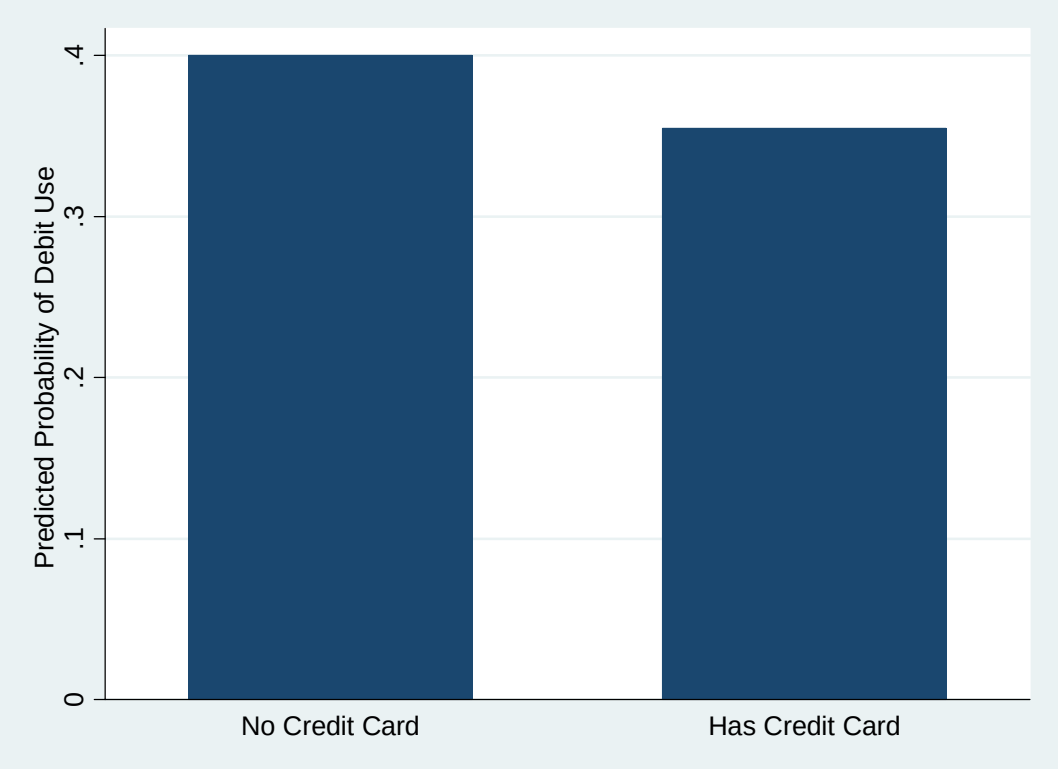
Figure 1. Debit Use Increases with Revolving and High Credit Limit Utilization



Predicted probabilities are calculated from a probit of debit use on utilization categories and the base specification of control variables (see text and Table 6 for details), for credit card holders in the 2001 SCF. Categories are mutually exclusive: "Limit-constrained" revolvers are borrowing at 75% of their credit card limit or greater, "Revolvers" are borrowing at lower utilization rates, and "Convenience Users" have no credit card debt. Control variables are evaluated at their means; accordingly, the figure depicts the marginal effects of revolving status and credit limit utilization that are associated with debit use.

Figure 2. Those Lacking a Credit Card Are More Likely to Use Debit



Predicted probabilities are calculated from a probit of debit use on credit card holding and the base specification of control variables (see text and Table 4 for details), for non-revolvers in the 2001 SCF. Control variables are evaluated at their means; accordingly, the figure depicts the marginal effect of credit card holding that is associated with debit use.

Table 1. Debit Use in the Raw, Over Time

		Has Checking Account and Positive Income (The "Screened Sample")										
Year(s)	*Full Sample*	*Screened Sample*	*No High School*	*College Degree*	*Age 18-34*	*Age 65+*	*No Credit card*	*Has Credit card*	*One Credit card*	*Convenience Users*	*Revolving*	*High Utilization*
1992	0.09 3906	0.11 3429	0.01 226	0.16 1917	0.14 620	0.04 829	0.06 682	0.13 2747	0.10 9645	0.13 1724	0.13 1023	0.14 134
1995	0.18 4299	0.20 3795	0.09 188	0.25 2072	0.30 701	0.10 881	0.14 643	0.23 3152	0.19 914	0.19 1876	0.25 1275	0.20 156
1998	0.34 4305	0.39 3821	0.14 183	0.44 2156	0.57 642	0.17 832	0.33 674	0.40 3147	0.36 952	0.32 1880	0.48 1267	0.54 176
2001	0.47 4442	0.51 3989	0.31 199	0.58 2301	0.72 656	0.22 847	0.43 608	0.53 3380	0.45 996	0.44 2027	0.61 1353	0.72 183
1995-2001	0.34 13046	0.37 11605	0.18 570	0.43 6529	0.53 1999	0.16 2560	0.30 1925	0.40 9679	0.34 2862	0.33 5783	0.45 3895	0.51 515

Each cell presents the proportion of U.S. households in a given SCF (sub-)sample that report using debit, and the number of households in the sample under consideration. Proportions obtained by weighting SCF means by variable x42001. The "screened sample" includes only households with a checking account and positive income. The "convenience users" sample includes only bank credit card holders who are not revolving. High utilization is defined as revolving bank credit card balances greater than 75% of the available credit limit.

Table 2. The Correlation Between Revolving Credit Card Balances and Debit Use

	1	2	3	4	5	6	7
SCF Survey(s)							
1995	.014 (.020) 3152	.010 (.020) 3152	.010 (.020) 3152	.011 (.021) 3152	.042 (.033) 3152	.018 (.031) 914	.011 (.029) 2139
1998	.089*** (.025) 3147	.076*** (.026) 3147	.078*** (.026) 3147	.073*** (.027) 3147	.064 (.043) 3147	.122*** (.041) 952	.098** (.039) 2170
2001	.083*** (.026) 3380	.071*** (.027) 3380	.079*** (.028) 3380	.058** (.028) 3380	.070 (.046) 3380	.053 (.047) 996	.089** (.043) 2319
Pooled	.063*** (.014) 9679	.053*** (.015) 9679	.056*** (.015) 9679	.048*** (.015) 9679	.063** (.025) 9679	.064*** (.024) 2862	.068*** (.022) 6628
Covariates	*Base*	*Add wealth, spending vs. income*	*Add other electronic payments*	*Add charges, # of cards, interest rate*	*Add (cards * R)*	*base*	*Base*
Sample	*Base*	*base*	*base*	*base*	*Base*	*one card only*	*R=1 if no charges last month only*

*** Significant at the 99% level. ** Significant at the 95% level.

Each cell shows the probit marginal effects coefficient and standard error on R (the revolving variable), as well as the sample size, from estimating a version of equation (3) or (4) on SCF data. (Results for other covariates are reported in Appendix Table 1 for the pooled specifications reported here in columns 1 and 5.) The dependent variable =1 if the household reports using debit regularly, and point estimates can be multiplied by 100 to translate the magnitudes into percentage point terms. All standard errors are calculated using the implicate correction provided in the SCF codebook. Covariate specifications are described in Section V of the text. All samples exclude households without a checking account or with nonpositive income. The "base" sample includes only bank credit card holders. Specifications featured in Column 7 assign R=1 only to those households that compiled no bank credit card charges on their most recent statement and exclude other revolvers from the sample.

Table 3. Means for Selected Regressors and Covariates

Bank Credit Card Holders Sample

SCF Year(s)	*Has Bankcard*	*Revolves*	*Vacation borrow*	*Jewelry borrow*	*ATM card*	*Income > normal*	*Income < normal*	*Spend > income*	*E-Payments*	*Computer Banking*
1995	1.0	0.56	0.17	0.07	0.74	0.08	0.14	0.18	0.66	0.04
1998	1.0	0.55	0.15	0.06	0.77	0.10	0.13	0.17	0.80	0.08
2001	1.0	0.53	0.16	0.07	0.79	0.13	0.13	0.15	0.84	0.25
Pooled	1.0	0.54	0.16	0.07	0.77	0.11	0.13	0.16	0.77	0.13

Full Sample

SCF Year(s)	*Has Bankcard*	*Revolves*	*Vacation borrow*	*Jewelry borrow*	*ATM card*	*Income > normal*	*Income < normal*	*Spend > income*	*E-Payments*	*Computer Banking*
1995	0.76	0.42	0.16	0.07	0.70	0.08	0.15	0.18	0.63	0.04
1998	0.76	0.41	0.14	0.06	0.73	0.10	0.14	0.17	0.76	0.07
2001	0.80	0.42	0.15	0.07	0.76	0.12	0.13	0.16	0.81	0.21
Pooled	0.77	0.41	0.15	0.06	0.73	0.10	0.14	0.17	0.74	0.11

Each cell presents a weighted SCF sample mean for the variable listed in the column heading. The first panel considers the "base" sample, containing only bank credit card holders with checking accounts and positive annual income. The second panel includes households without a bank credit card as well. Please refer to Appendix 3 for variable definitions.

Table 4. The Correlation Between Credit Card Holding and Debit Use

	(1)	(2)	(3)	(4)	(5)
Revolver	0.089***	0.097***	0.082***		
	(0.018)	(0.018)	(0.018)		
Has Credit Card		-0.072***	-0.047*	-0.060**	-0.030
		(0.025)	(0.026)	(0.025)	(0.026)
Observations	6528	7810	7810	5190	5190
Sample	Base	Full	Full	No revolvers	No revolvers
Control Variables	Base	Base	Add Supply Controls	Base	Add Supply Controls

* significant at 10%; ** significant at 5%; *** significant at 1%

Each column presents results from a single probit and reports marginal effects. The dependent variable =1 if the household reports using debit regularly, and point estimates can be multiplied by 100 to translate the magnitudes into percentage point terms Results on control variables are not reported here to conserve space. Sample frame is 1998 and 2001 pooled SCFs. 1995 SCF is dropped due to very low prevalence of debit users without credit cards (see Table 5). 'Full' sample includes all SCF households with checking accounts and positive income. Credit card supply variables added to base specification include: quadratics in time-at-residence, time-at-job, and debt-to-income ratio, and a dummy for loan delinquency. Standard errors are corrected for SCF imputation.

Table 5. Debit Use x Credit Use

SCF survey(s)	1 *Debit, revolving (R=1)*	2 *No debit, revolving*	3 *Debit, R=0, has credit card (H=1)*	4 *No debit, R=0, H=1*	5 *Debit, H=0*	6 *No debit, H=0*
1995	0.11	0.31	0.06	0.27	0.03	0.21
1998	0.20	0.21	0.11	0.24	0.08	0.16
2001	0.26	0.16	0.17	0.21	0.09	0.11
Pooled	0.19	0.23	0.12	0.24	0.07	0.16

Each cell reports the weighted proportion of households in the full estimation sample. Proportions may not sum to 1 across rows due to rounding.

Table 6. Credit Limit Utilization and Debit Use

SCF Sample	N	*0<utilization<0.25*	*0.25-0.75*	*>0.75*	*0<utilization<0.13*	*0.13-0.42*	*>0.42*	*0<utilization<0.10*	*0.10-0.25*	*0.25-0.50*	*>0.50*
1995	3152	.028 (.023)	.009 (.026)	-.040 (.033)	.032 (.027)	.023 (.026)	-.020 (.026)	.038 (.030)	.020 (.030)	.016 (.031)	-.027 (.028)
1998	3147	.061* (.031)	.121*** (.035)	.115** (.051)	.054 (.036)	.111*** (.036)	.111*** (.035)	.048 (.039)	.086** (.041)	.123*** (.042)	.114*** (.039)
2001	3380	.053* (.031)	.100*** (.034)	.183*** (.047)	.046 (.036)	.104*** (.036)	.111*** (.036)	.057 (.037)	.054 (.042)	.128*** (.040)	.111*** (.039)
Pooled	9679	.050*** (.017)	.081*** (.020)	.089*** (.028)	.046** (.020)	.082*** (.020)	.071*** (.021)	.053** (.022)	.052** (.023)	.094*** (.023)	.069*** (.022)
Emergency Funds	2782	.044 (.035)	.093** (.040)	.186*** (.059)	.037 (.040)	.086** (.042)	.116*** (.042)	.048 (.042)	.043 (.049)	.107** (.048)	.120*** (.045)
No Emergency Funds	599	.098 (.076)	.189*** (.072)	.175* (.098)	.092 (.088)	.191** (.078)	.134* (.077)	.114 (.100)	.097 (.089)	.246*** (.080)	.117 (.083)

*** Significant at the 99% level. ** Significant at the 95% level. * Significant at the 90% level.

Each cell presents the probit marginal effects coefficient and implicate-corrected standard error on the bank credit card credit limit utilization variable listed in the column heading, from estimation on a sample of bank credit card holders with checking accounts and positive income from the SCF survey year listed in the row heading. Debit use is the dependent variable, and point estimates can be multiplied by 100 to translate the magnitudes into percentage point terms. Households with zero utilization (convenience users) comprise the omitted category. Each probit contains the base specification covariates described earlier. Each panel presents results for a different demarcation of utilization categories, as motivated in the text. The emergency funds variable is taken from SCF variable x6443, "In an emergency could you or your (spouse/partner) get financial assistance of $3,000 or more from any friends or relatives who do not live with you?", which first appeared in the 2001 SCF.

Table 7. Revolvers Have Lower Credit Card Charges

R defined as:	1 *Currently revolving*	2 *Habitual too*	3 *Non-habitual revolvers excluded*
Sample			
2001 Sample	-428*** (58)	-364*** (51)	-454*** (61)
Pooled sample	-344*** (33)	-355*** (29)	-395*** (32)
2001 debit users	-430*** (79)	-398*** (62)	-480*** (78)
2001 nonusers	-393*** (89)	-276*** (89)	-374*** (99)
Pooled debit users	-328*** (53)	-390*** (44)	-412*** (48)
Pooled nonusers	-343*** (40)	-314*** (39)	-364*** (43)

*** Significant at the 99% level. ** Significant at the 95% level.

Each cell presents the coefficient and implicate-corrected standard error on a measure of revolving behavior R, from a weighted OLS regression of level bank credit card charges in the previous month on R and the usual ("base") set of covariates. Bank credit card charges are measured in 2001 dollars and censored at the 99th percentile to reduce the influence of outliers. All definitions of R start with the standard 1/0 variable for whether the household revolved bank credit card balances after their most recent statement (Column 1). Column 2 modifies this definition by only counting those who are both currently revolving *and* report habitually revolving as R==1; column 3 modifies it by excluding current revolvers who do not report habitual revolving from the sample.

Table 8. Measurement Issues and Their Impact on β_R

Baseline Results	
Pooled:	2001:
0.063	0.083
(0.014)	(0.026)

Alternate Methods	Alternate Results	
	A	B
Misclassified R: Use Interviewer Observations	0.088 (0.020)	0.104 (0.036)
Misclassified R: Mahajan Correction	0.064 (0.014)	0.066 (0.014)
Strategic Bankruptcy: Incorporate SCF Credit Scores	0.079 (0.072)	0.186 (0.139)
Time and Hassle Cost Motive: Simulate	0.107 (0.011)	0.161 (0.011)
Security Precaution: Simulate	0.087 (0.012)	0.136 (0.012)
Rewards Motive: Simulate	0.116 (0.012)	0.292 (0.013)

Each cell presents the probit marginal effects coefficient and standard error on R, the revolving variable, for a specification described in the row title, using the base set of covariates described earlier. As in previous tables, debit use is the dependent variable and one can multiple the point estimates by 100 to translate the magnitudes into percentage point terms. Please see Appendix 4 for additional details on sample restrictions, variable construction, and estimation procedures. Estimates are based on the pooled sample of credit card holders unless noted otherwise.

Interviewer observation samples are limited to those who report "truthfully" (column A), and both "truthfully" and "accurately" (column B).

The Mahajan correction estimates are calculated two ways: first, assuming misclassification of R to be independent of covariates (column A); second, allowing the misclassification to vary with race, education, income, age, gender, and industry (column B).

Strategic bankruptcy estimates use a sample of "high-risk" borrowers only, using the pooled sample (column A) and 2001 sample (column B).

Time and hassle cost motive simulations randomly assign this motive to 20% (column A) and 44% (column B) of non-revolving debit users.

Security precaution simulations estimate the impact of a fraud risk motive that leads consumers to prefer online debit and credit card transactions over offline debit, and hence to borrow-to-charge due to the relative scarcity of PIN terminals. Columns A and B explore cases where 10% and 27.5% of revolvers who do not use debit are assumed to have this preference, respectively.

Rewards motive simulations estimate the impact of a borrow-to-charge motive arising from rewards that produce marginal benefits exceeding the marginal financing cost. Columns A and B explore cases where 20% and 60% of revolvers who do not use debit are assumed to have this motive.

Table 9. Debit Use: A Puzzle for Neoclassical Consumer Choice Theory?

Household Type	Debit-Using Households		
	1995	1998	2001
No credit card	12%	17%	15%
Revolves credit card balances	59%	56%	54%
No obvious cost advantage to debit use	**29%**	**26%**	**31%**

Sample: Debit users in the SCF. All tabulations are weighted. "Revolves credit card balances" is defined as either currently revolving on a bank credit card or reporting habitually revolving a balance.

Table 10. Correlates of Credit Card Holding

	(1)	(2)	(3)	(4)
Highest ed= high school	0.100***	0.090***	0.082***	0.080***
	(0.021)	(0.022)	(0.031)	(0.030)
Some college	0.124***	0.117***	0.113***	0.111***
	(0.018)	(0.020)	(0.026)	(0.026)
College degree+	0.203***	0.195***	0.167***	0.166***
	(0.028)	(0.029)	(0.045)	(0.044)
Income quartile 2	0.076***	0.068***	0.084***	0.080***
	(0.019)	(0.020)	(0.025)	(0.025)
Income quartile 3	0.105***	0.097***	0.121***	0.114***
	(0.020)	(0.021)	(0.023)	(0.024)
Income quartile 4	0.163***	0.151***	0.192***	0.181***
	(0.024)	(0.026)	(0.034)	(0.034)
Owns home	0.070***	0.072***	0.050*	0.059**
	(0.020)	(0.020)	(0.027)	(0.028)
Years current residence	0.004**	0.004**	0.007**	0.007**
	(0.002)	(0.002)	(0.003)	(0.003)
Years in job	0.004	0.004	0.000	-0.000
	(0.003)	(0.003)	(0.004)	(0.004)
Debt-to-income ratio	0.010*	0.008	0.010	0.008
	(0.005)	(0.006)	(0.012)	(0.012)
Late loan payments	-0.088***	-0.093***	-0.073***	-0.076***
	(0.020)	(0.021)	(0.022)	(0.022)
Head age 35-54	0.020	0.027	-0.007	0.001
	(0.019)	(0.019)	(0.023)	(0.022)
Head age 55-64	-0.031	-0.024	-0.037	-0.025
	(0.033)	(0.032)	(0.047)	(0.045)
Head age 65+	0.022	0.041	0.069**	0.076**
	(0.031)	(0.029)	(0.033)	(0.031)
Married	0.014	0.017	0.011	0.018
	(0.023)	(0.023)	(0.028)	(0.027)
White	0.062***	0.060***	0.042*	0.038
	(0.021)	(0.021)	(0.024)	(0.024)
Male head	-0.001	-0.001	-0.010	-0.007
	(0.021)	(0.021)	(0.026)	(0.026)
Unusual high inc last yr	0.038*	0.040*	0.016	0.016
	(0.021)	(0.022)	(0.028)	(0.027)
Unusual low inc last yr	0.031*	0.034*	0.020	0.021
	(0.019)	(0.018)	(0.023)	(0.022)
Self-employed	0.026	0.029	0.034	0.040
	(0.024)	(0.024)	(0.027)	(0.026)
Has an ATM card	0.099***	0.092***	0.090	0.078
	(0.020)	(0.021)	(0.075)	(0.073)
Ok borrow vacation		0.029		0.022
		(0.020)		(0.024)
Ok borrow income cut		0.022		0.020
		(0.015)		(0.018)
Ok borrow luxury item		0.026		0.053**
		(0.028)		(0.026)
Ok borrow buy car		0.080***		0.017
		(0.022)		(0.026)
Ok borrow education		0.004		0.024
		(0.019)		(0.028)
Ok borrow: general		0.034**		0.023
		(0.015)		(0.019)
Wald test p-value on debt attitudes		0.001		0.17
Pseudo R-squared	0.21	0.23	0.18	0.19
Sample	2001 SCF	2001 SCF	2001 debit users	2001 debit users
Observations	3989	3989	1847	1847

* significant at 10%; ** significant at 5%; *** significant at 1%;

Dependent variable = 1 if the household has one or more bank-type credit cards Estimator is probit, with marginal effects reported. Standard errors are corrected for SCF implicates. Sample frame is checking account holders with positive income in the 2001 SCF. Industry/employment status dummies, household size dummies, and residence type dummies are each jointly insignificant in all specifications and not reported to save space. Quadratic terms on years in residence (always significant) and years in job and debt-to-income (never significant) are also not reported to conserve space.

Appendix Table 1. Correlations Between Debit Use & Control Variables

	(1)	(2)
Revolver	0.063***	0.063**
	(0.014)	(0.025)
Lives in trailer	0.060	0.055
	(0.039)	(0.039)
Lives on farm/ranch	-0.032	-0.023
	(0.045)	(0.046)
2 person h/hold	0.016	0.020
	(0.023)	(0.023)
3 person h/hold	0.022	0.026
	(0.027)	(0.027)
4 person h/hold	0.039	0.039
	(0.029)	(0.029)
5+ person h/hold	0.036	0.040
	(0.032)	(0.033)
Head age 35-54	-0.099***	-0.092***
	(0.018)	(0.018)
Head age 55-64	-0.128***	-0.117***
	(0.022)	(0.023)
Head age 65+	-0.163***	-0.160***
	(0.025)	(0.025)
Married	-0.002	-0.004
	(0.022)	(0.022)
White	0.002	-0.001
	(0.019)	(0.019)
Male head	0.003	0.005
	(0.023)	(0.023)
Highest ed= high school	-0.002	-0.005
	(0.044)	(0.043)
Highest ed= some college	0.046	0.041
	(0.046)	(0.045)
College degree+	0.039	0.029
	(0.044)	(0.043)
Income quartile 2	0.050	0.045
	(0.033)	(0.032)
Income quartile 3	0.049	0.039
	(0.034)	(0.033)
Income quartile 4	0.086**	0.080**
	(0.033)	(0.034)
Owns home	-0.042**	-0.044**
	(0.017)	(0.017)
Unusually high income last year	0.016	0.020
	(0.022)	(0.022)
Unusually low income last year	0.029	0.028
	(0.021)	(0.021)
Self-employed	-0.067***	-0.042**
	(0.019)	(0.020)
Ever in military	-0.015	-0.018
	(0.017)	(0.017)
Not working	0.007	0.007
	(0.029)	(0.029)
Works in ag/forestry	0.006	0.009
	(0.066)	(0.066)
Works in mining/construction	0.058*	0.068**
	(0.032)	(0.032)
Works in wholesale/retail	0.030	0.037
	(0.027)	(0.027)
Works in FIRE	0.083***	0.075***
	(0.027)	(0.028)
Works in transport/services	0.020	0.017
	(0.022)	(0.022)
Works in govt/military	-0.034	-0.044
	(0.032)	(0.032)
Ok borrow for vacation	0.006	0.005
	(0.018)	(0.019)
Ok borrow for jewelry/fur coat	0.026	0.026

	(0.026)	(0.026)
Has an ATM card	0.434***	0.429***
	(0.010)	(0.010)
Yr98	0.210***	0.198***
	(0.018)	(0.018)
Yr01	0.344***	0.317***
	(0.017)	(0.018)
Net worth		-0.000***
		(0.000)
Net worth squared		0.000***
		(0.000)
Spending = income last year		-0.001
		(0.020)
Spending < income last year		-0.027
		(0.020)
Uses other electronic payments		0.077***
		(0.016)
Uses computer banking		0.101***
		(0.022)
Credit card charges		-0.000***
		(0.000)
Number of credit cards		0.009
		(0.007)
Credit card interest rate		-0.001
		(0.002)
#Cards*revolver		-0.006
		(0.008)
Observations	9679	9679
Specification	Base (same probit reported in Table 2, Column 1)	Big Spender (same probit reported in Table 2, Col. 5)

* significant at 10%; ** significant at 5%; *** significant at 1%

Each column presents marginal effects from a single probit where debit use is the dependent variable. Please see Appendix 3 for detailed variable definitions. The omitted industry category is manufacturing. The "FIRE" industry category includes "business & repair services" in addition to finance, insurance, and real estate. The "transport" industry category also includes communications, utilities, personal services, entertainment and recreational services, and professional & related services. The results from each probit indicate that industry dummies are jointly significant and household size dummies are not jointly significant. All standard errors are corrected for SCF implicates.

Appendix Table 2.
Debit on Revolving, Excluding Households That Borrow "High" and Lend "Low"

	Full Sample	Drop BHLL: weak transaction motive	Drop BHLL: transaction and min balance motives
Revolver Variable	.063	.055	.063
	(.014)	(.015)	(.014)
Number of Observations	9679	9196	9581

Cells in "Revolver Variable" row present marginal effects on the revolving variable from a single probit. Each probit uses the base specification on the pooled sample *(a la* Table 2, Column 1). Borrow-high-and-lend-low ("BHLL") motives based on transactions and minimum balance checking accounts are described in Appendix 1. Here households are counted as BHLL if it appears they could save $5 per month or more by using checking account balances to pay down credit card debt.

Appendix 1. A Behavioral Mirage?
The Low Prevalence of Households that Truly Borrow "High" and Lend "Low"

Many U.S. households *seem* to simultaneously borrow high and lend low. The table below (Row 5, Column 1) shows that 23% of households appear to forego an arbitrage opportunity valued at $10 per month or more by failing to use checking account balances to pay down credit card debt.

Although this and related borrowing high and lending low ("BHLL") phenomena have been widely noted (Gross and Souleles 2002; Hilgert, Hogarth and Beverly 2003; Laibson, Repetto and Tobacman 2003a), specific explanations for the behavior are scarce.[47] Without exception, papers commenting on this "puzzle" have conjectured that this behavior must be due to something "behavioral"; i.e., there seems to be a growing presumption that BHLL can not be explained by a neoclassical model of consumer choice. But in fact simultaneously holding checking account balances and credit card debt is a rational response to financial incentives provided by banking and payments institutions. (I focus here on checking account balances given that debit transactions draw on these.)

Unadjusted BHLL (Column 1) ignores the fact that most credit cards can not be used for many large (and many very small) payments; mortgages and rent, utilities, and auto loans, for example.[48] Given small transaction or time costs of moving funds across asset accounts, and/or some cash flow uncertainty in the face of large penalties for checking account overdrafts, it is perfectly rational for a borrowing household to simultaneously hold a nontrivial stock of low-yielding assets for transaction purposes. Columns 2-5 adjust for this motive by subtracting one-half or one month's income from unadjusted BHLL. Even the conservative adjustment (one-half month's income) reduces BHLL amounts and prevalence dramatically (Column 2); e.g., the proportion of households foregoing arbitrage of more than $10 per month falls to 0.04 .

Columns 3 and 5 take the additional step of adjusting for minimum balance checking accounts. Stavins (1999) estimates that such an account saves the holder $13.53 (2001 dollars) in check, teller, and ATM fees, and that the average account requires a minimum balance of $976. In the SCF one does not observe checking account yields or whether an individual household in the actually has a minimum balance account;[49] accordingly, I assume zero yield, use Stavins' means, and deduct $976 from the BHLL amount in Column 2 and 4 if $13.53 exceeds the monthly credit card interest cost on that $976, using the household's credit card interest rate. This minimum balance adjustment further reduces the prevalence of BHLL a bit.

Calculating the real arbitrageable amount requires additional adjustments; e.g., for (strategic) default, balance transfer pricing that incents lumpy transactions, and downpayment constraints. These all further reduce BHLL but are omitted for simplicity.

In all it appears that no more than a handful households are actually violating arbitrage between their checking accounts and credit card debt.

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[47] Bertaut and Haliassos (2002) and Bogan and Hammami (2004) are exceptions.

[48] Although it is difficult to calculate precisely the percentage of consumer expenditure that could be (or even *is*) paid for by credit card, it is clearly small (perhaps on the order of 10%). See, e.g., Gerdes and Walton (2002).

[49] In the December 1996 SOC, 36% of checking account holders, and 32% of revolvers with checking accounts, had minimum balance accounts.

Table (Appendix 1). No BHLL Puzzle at All?

		1	2	3	4	5
		Unadjusted	Less 0.5 month's income	Less min balance adjustment	Unadjusted, less one month's income	Less min balance adjustment
1	BHLL amount	713 [100] (1606)	145 [0] (893)	104 [0] (814)	50 [0] (611)	37 [0] (565)
2	Any BHLL	0.55	0.11	0.07	0.03	0.02
3	Foregone arbitrage	8.1 [0.96] (19.2)	1.6 [0] (10.3)	1.2 [0] (9.7)	0.53 [0] (6.6)	0.42 [0] (6.3)
4	Foregone >$5 / month	0.35	0.07	0.05	0.02	0.01
5	Foregone > $10 / month	0.23	0.04	0.03	0.01	0.01

Each cell lists the mean for the variable defined by the row and column headings. Some cells also list the median (in brackets) and the standard deviation (in parentheses). All results are for the sample of 9,679 credit card holders in the 1995-2001 pooled SCFs. All dollar amounts in $2001. The unadjusted BHLL amount in Column 1 is: min(checking balances, revolving credit card balances). Column 2 subtracts one-half of monthly household income from the unadjusted BHLL amount. Column 3 then subtracts an additional amount equal to the "minimum balance adjustment" described in the text above. Columns 4 and 5 use the same definitions as Columns 2 and 3, respectively, except that 4 and 5 subtract a full month's income from the unadjusted BHLL amount. "Foregone arbitrage" is the household's BHLL amount as defined in the column heading, multiplied by the household's monthly credit card interest rate. This overstates nominal the arbitrageable amount by assuming that the nominal yield on checking account balances is zero.

Appendix 2. Debit Use Variable Survey Question

Question wording and interviewer instruction is identical across the 1995, 1998, and 2001 surveys, and goes as follows:

```
X7582      A debit card is a card that you can present when you buy
           things that automatically deducts the amount of the
           purchase from the money in an account that you have.

           Do you use any debit cards?

           Does your family use any debit cards?

           INTERVIEWER: WE CARE ABOUT USE, NOT WHETHER R HAS A DEBIT
           CARD

            1.  *YES
            5.  *NO
```

Source:
Codebook for 2001 Survey of Consumer Finances, Board of Governors of the Federal Reserve System

Question wording and interviewer instructions differ in 1992, producing less emphasis on debit *use*:

```
7582       B4.     Do you (or anyone in your family living here) have
                   any debit cards?
                   (A debit card is a card that you can present when
                   you buy things that automatically deducts the
                   amount of the purchase from the money in an account
                   that you have).

                   1.  YES
                   5.  NO
```

Source:
Codebook for 1992 Survey of Consumer Finances, Board of Governors of the Federal Reserve System

Appendix 3. Data Definitions

Variable	Definition and SCF variable number(s)
Uses a debit card	x7582=1
Revolves a credit card balance ("most recent" or "current" measure)	Total bank credit card balances after last payments made were greater than zero (from x413)
Has a credit card	x7973 = 1 (question asks about bank credit cards; i.e., Visa, Mastercard, Discover, Optima)
Number of credit cards	X411 (bank credit cards), SCF top-codes at 10
Reports carrying a credit card balance regularly ("habitual" measure)	Doesn't always pay off balances each month on bankcards and store cards; (x432=3 or x432=5)
Credit card credit limit utilization*	(Bank credit card balances)/(total credit card limit), where latter variable is x414; censored at 1
Has one credit card	x411= 1; x411 asks about bank credit cards
Credit card interest rate	x7132 (interest rate on new balances); censored at 99th percentile, missing for those without bankcards
Credit card charges	x412 (bankcards); censored at 99th percentile
Age categories	18-34, 35-54, 55-64, 65+; from x14 (household head's age)
Married	Married and living together; x8023=1
White	Household head is white; x6809=1
Male	Household head is male; x8021=1
Education (highest attainment categories)	Maximum of spouses' attainment where relevant (from x5901 and x6101); Categories are: no high school, high school, some college, college degree+
Number of persons in household categories	Censored at 5 in base specification; from x101
Housing type categories	Ranch/farm, mobile home/RV, and other; from x501.
Owns home	(x508=1 or x601=1 or x701=1)
Industry, occupation	x7402, x7401 (public use data provides only seven industry and six occupation categories). Omitted category is "not doing any work for pay".
Self-employed	x4106 = 2
Ever in Military	x5906 = 1
Region (9-level Census Division)	x30074 (not available in 2001 public use data)

Income: total last year	x5729 censored at 99th percentile, then divided into four categories (approximately quartiles) based on pooled sample distribution in 2001 dollars.
Income last year relative to normal	High/Low/Normal categories, from x7650
Has an ATM card	x306 = 1
O.K. to borrow for vacation	"whether you feel it is all right for someone like yourself to borrow money... to cover the expenses of a vacation trip"; x402 = 1
O.K. to borrow for fur coat/jewelry	see above for question scripting; x404 = 1
Net worth	Calculated per routine provided in SCF codebook; censored at 99th percentile; then divided into four quartiles (approximately) based on pooled sample distribution in 2001 dollars.
Spending relative to income in past year	x7510 (exceeded/equaled/less)
Uses electronic payments (direct deposit, auto billpay, and/or smart card)	(x7122 = 1 or x7126 = 1 or x7130 = 1)
Uses computer banking	x6600 = 12, or any other "institution" variable = 12; see Stata code below**
Emergency Funds Available	x6443 = 1
Reported truthfully (interviewer observation)	please see Appendix 4
Reported accurately (interviewer observation)	please see Appendix 4
Appetite for financial risk	x3014
Late loan payments	Behind schedule paying back any loan, sometimes got behind in past year, turned down due to bad credit, or committed bankruptcy in past 10 years.***
Self-reported credit constrained	Turned down, rationed, or discouraged during past 5 years... if did not reapply and get full amount.****
Debt-to-income ratio	Debt as calculated in the SCF codebook, bank credit card balances
Sample weight	x42001

* I use bankcard balances rather than total credit card balances in the numerator of the utilization variable in part for conceptual reasons, and in part because a) the credit limit variable (x414) is always >0 for those with bankcards (but sometimes zero for those with other credit cards but no bankcard), and b) total credit card balances exceed the credit limit variable far more frequently than bankcard balances do.

** gen computerbank=0; for var x6600 x6601 x6602 x6603 x6604 x6605 x6606 x6607 x6870 x6871 x6872 x6873 x6608 x6609 x6610 x6611 x6612 x6613 x6614 x6615 x6874 x6875 x6876 x6877 x6616 x6617 x6618 x6619 x6620 x6621 x6622 x6623 x6878 x6879 x6880 x6881 x6624 x6625 x6626 x6627 x6628 x6629 x6630 x6631 x6882 x6883 x6884 x6885 x6632 x6633 x6634 x6635 x6636 x6637 x6638 x6639 x6886 x6887 x6888 x6889 x6640 x6641 x6642 x6643 x6644 x6645 x6646 x6647 x6890 x6891 x6892 x6893: replace computerbank=1 if X==12

*** Code available upon request. No bankruptcy questions in 1995.

**** gen srconstr= (x407==1 | x407==3 | x409==1); replace srconstr=0 if x408==1

Appendix 4.
Sample Construction and Estimation for Selected Models in Table 8

Exploiting interviewer observations: I label a household "truthful" if the interviewer judges that the respondent had at least good understanding of the questions (variable x6525), was not suspicious about the study before the interview (x6527), and exhibited average or better interest in the interview (x6529). I label a household "accurate" if the household referred to documents at least "sometimes" when answering questions (x6536). 55% of households are labeled truthful in the pooled sample, 22% are labeled accurate, and 15% qualify as both.

Strategic Bankruptcy: Estimates are calculated on a sample including only "high-risk" borrowers, where "high-risk" is defined by applying a standard industry cutoff to an imputed credit rating in the SCF. See Barakova, et. al. (2004) for more details on this variable. Specifically, SCF credit scores were transformed to match the distribution of FICO scores, and only households with scores below 660 (approximately the 15^{th} percentile) were included in the estimation. In specifications where the score was included as a control variable, linear and quadratic functions produced virtually identical results.

Time and hassle cost motive: This is simulated by randomly assigning a "time and hassle cost" motive to a proportion C of non-revolving debit users in the SCF. I do this, using only the first implicate per household, by generating a binary variable E that takes the value of one for those assigned the exclusive cash back motive, and including E as an additional covariate in the base specification. This is done with two alternative values of C, a weak version (20%) chosen arbitrarily, and a strong version (44%) motivated by the calculations in Section VII.

Security precaution: This is simulated using the same procedure described above for the cash back motive; in the security case, however, the simulated motive is assigned to a different sub-sample, namely revolvers who do not use debit. The hypothetical weak and strong versions of this motive are discussed in the text and Table 8.

Rewards motive: This is simulated using the same procedure described above for the security case.