

The transactions demand for money: A discrete choice approach

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Abstract

This paper develops a model of the transactions demand for money using a characteristics approach. It then estimates the model using data from the Survey of Consumer Finances. The results indicate that unobservables that affect payment choice are correlated with the amount of money families hold in checking accounts. This indicates that information on preferences over payment instruments may help to estimate micro-level money demand.

1 Introduction

Cash, checks, credit cards, debit cards and direct payments are the financial backbone of today's market economy.¹ Known as payment instruments, each consumer purchase at every grocery store, website or restaurant and every mortgage payment involves one of these. No exchange can be completed without them. But, there is a key distinction between cash and the other four payment instruments. When a consumer uses cash, value is transferred instantaneously and an exchange is completed. In contrast, checks, debit cards, credit cards and direct payment do not transfer value directly. Rather, when consumers use one of these

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¹Direct payments are known as automated clearing house, or ACH payments. They transfer money electronically from one bank account to another bank account. Common uses include mortgage, utility bill and insurance premium payments.

payment instruments, they use them to access funds in a bank, and in general, they use them to access funds in their checking account. Operationally, when a consumer pays by check, credit card, debit card and direct payment, the consumer creates a link between the payment instrument and a checking account in order to complete an exchange.

Given this operational connection, one may start to wonder whether there may be other links between payment instruments and checking account balances. Consumers have four different ways to access checking account funds. And oftentimes, checks, debit cards, direct payments and credit cards access the same checking account balances. But, consumers may prefer one payment instrument to another. In addition, depending on how these funds are accessed, there may be benefits or costs to the consumer. Thus there is a potential link between payment instrument choice and checking account balances, or in other words, transactions and money demand.²

This paper investigates whether there is a link between the payment instruments used to access checking account balances and the balances themselves. It presents a model that formally presents the problem, and then empirically tests the model using data from the Survey of Consumer Finances. The results indicate that unobserved factors that affect payment choice are correlated with unobserved factors that affect checking account balances.

There are two explanations for why there may exist a correlation between checking account balances and payment choice. First, previous research shows families choose to use or hold these payment instruments based on income, age and demographic characteristics. These are the same factors that affect asset allocation. Although checks and debit cards have similar timing of payment, younger people may be more likely to use debit cards. Homeowners may be more likely to use direct payments from a banking account for a mortgage in order to take advantage of its regularity and convenience. These factors – age and other asset holdings – are the same factors that affect consumer’s decisions on how to allocate their financial assets. As checking accounts are one type of financial asset, this fact points to a link between payment instrument use and checking account balances.

Second, in the spirit of the transaction demand for money models, it may be the case that families make this choice jointly. Consumers use different payment instruments keeping in mind the potential effect on assets and asset balances. An example is convenience credit card use. Families use a credit card throughout the month, and then pay the balance in full at the end of the month. By doing so, families receive an interest-free loan from the credit card issuer. At the same time, these families can keep funds in interest-earning assets or a checking account until the credit card bill is due. In contrast, if families use a debit card, which if used as a signature-based debit card is accepted in all locations where a credit card is accepted, the funds are debited from the checking account immediately, and the family

²See Baumol (1952) and Tobin (1956).

receives no such interest-free loan.³ These differences can influence how consumers choose to pay, and thus provides another potential link between payment choice and checking account balances.

The manner in which payment instruments act on checking account balances provides natural groupings for the analysis. The analysis focuses on three sets of payment instruments. Debit card, direct payment and check use comprise the first set of payment instruments. If a consumer uses one of these instruments, funds are drawn from the account directly. ATM card holdings comprises its own set. Many do not consider ATM cards themselves a payment instrument, but rather, a device used to obtain another payment instrument, namely cash. If a consumer uses an ATM card, funds are drawn from the account and transformed into currency. Credit card holdings and convenience use of credit cards, which indicates that families have a bank credit card, had had new charges on their last bill, and had no balance after the last payment was made on the account. If a consumer uses a credit card, payment of funds is delayed and the consumer receives an extension of a line of credit. Having a credit card and convenience use represent "overlapping" specifications. Specifically, families may be divided into three classes of credit card holdings. The first is not holding a credit card, and the other four depend on

The results indicate that there are correlations between payment instruments and checking account balances. Specifically, use of debit cards is significantly correlated with a higher share of financial assets in checking accounts, while convenience use of credit cards is significantly correlated with higher checking account balances. Other use and holdings are not significantly correlated with checking account balances.

This paper builds on previous literature in a few ways. From a theoretical point of view, it provides a formal characteristics framework in which to study individual money demand. The Baumol-Tobin models assumed a uniform arrival rate of transactions, one type of money available for transactions, and one relevant interest rate. Subsequent theoretical and empirical work built on these assumptions. Extensions include allowing for more than one type of payment (Santomero (1974, 1979) and Santomero and Seater (1996)), and allowing for transaction costs that differ by type of payment and value of the sale (Whitesell (1989)).

The model here allows for heterogeneity in preferences for payments and assets, and importantly, provides a framework for examining different costs associated with the same asset. Indeed, the first logical grouping of payment instruments – debit cards, direct payments and checks – all share the same opportunity cost of funds and effective interest rate. But, these instruments clearly have different costs associated with them. For example, it is relatively easy to buy groceries with a debit card, but relatively difficult to do so with a direct payment

³There are two ways to authorize a debit transaction: signature-based and PIN-based. Signature-based transactions require consumers to "sign" for a purchase, and PIN-based transactions require consumers to enter a personal identification number, or PIN. Authorization choices by the consumer may affect transaction routing priorities. In 2001, many debit cards had both functionalities.

from a checking account. The model allows for heterogeneity in these costs, and allows for consumers to differ according to these costs and according to their preferences over payment instruments.

From an empirical point of view, the paper builds on the previous literature by estimating money demand equations on new data and by controlling for unobserved factors that may affect parameter estimates. Other studies, including Duca and Whitesell (1995) and Mulligan and Sala-i-Martin (2000), use earlier waves of the Survey of Consumer Finances for similar purposes. Recent work by Attanasio et al. (2002) uses an Italian family survey. Duca and Whitesell (1995) found that credit card holdings were negatively and significantly related to transactions deposits, Mulligan and Sala-i-Martin (2000) found that adoption costs of new financial products are significant and can affect asset holdings, and Attanasio et al. (2002) found that individuals who adopt new technologies are more responsive to interest rates.

Using the discrete/continuous framework of Dubin and McFadden (1984), the transaction characteristics construct leads to a simple instrumental variable to control for unobserved factors that may affect family money demand. This instrumental variable is necessary for two reasons. First, returns that families receive on money assets are unobserved in the Survey of Consumer Finances data. Thus, these unobserved factors could affect the asset allocations observed in the data. Second, even if these rates were observed, estimating a money demand equation with an included interest rate may introduce simultaneity bias, because rates are endogenous to the model and are affected by other, unobserved supply-side factors.

The paper proceeds by presenting background in section 2. Section 3 presents the model. Section 4 presents the data and estimation results. Section 5 concludes.

2 Background and descriptive statistics

2.1 The U.S. payments system: 1995-2001

Other than cash, consumers pay using "noncash retail payments" – debit card, credit and charge card, automated clearing house (ACH) and check payments. Debit card, ACH payments and checks are similar, in that these types of transactions deduct money directly from a user's account. Credit cards differ because they provide users with a line of credit.

Table 1 shows data on noncash retail payments from 1995 to 2001. The left side shows the number of payments and the right side shows shares. The total number of noncash retail payments grew from approximately 65.7 billion in 1995 to 78.8 billion in 2001. Concurrently, the estimated number of checks paid fell from 49.5 billion in 1995 to 42.5 billion in 2000. With an assumed 3 percent decline, the number of checks paid fell to 41.2 billion in 2001. The right half of the table shows the change in composition of the number of noncash retail

payments. The share of the number payments made by debit card increased 13 percentage points, from 3 percent in 1995 to 16 percent in 2001. The credit card share increased 5 percentage points, and the ACH share increased 5 percentage points. At the same time, the estimated check share fell from 75 percent in 1995, to 57 percent in 2000, to 52 percent in 2001. Overall, the share of payments made electronically increased 23 percentage points, from approximately 25 percent in 1995 to 48 percent in 2001.

The bottom half of the table shows the value and shares of noncash retail payments, adjusted to 2001 dollars. Check and ACH payments represent relatively larger shares of the value of payments than their numbers reflect. This is due to the fact that debit cards and credit cards are used primarily at the point of sale, and checks and ACH may be used to pay mortgages and employees, and other relatively higher-dollar value uses. Consistent with this view, while debit card's share of the number of payments increased 8 percentage points from 1998 to 2001, its the share of the value of payments increased only one percentage point.

2.2 Survey of Consumer Finances: Descriptive statistics

The SCF surveys a cross-section of U.S. households, and is conducted triennially by the Federal Reserve in conjunction with the National Opinion Research Center at the University of Chicago (NORC). The strength of the SCF is its ability to report accurately demographic and financial data. The Survey of Consumer Finances data on use and holdings of debit cards, credit cards and the ACH are consistent with aggregate trends. Table 2 gives definitions of the variables used from the SCF.

Families' use of these financial products grew substantially from 1995 to 2001.⁴ Table 3 presents payment use and holdings statistics from the complete SCF samples. From 1995 to 2001, debit card use increased 29.4 percentage points, from 17.6 percent of families in 1995 to 47.0 percent of families in 2001.

From 1995 to 2001, credit card holdings increased 1.8 percentage points, to 76.2 percent of families. The relatively slight increase in total holdings masks a change in composition: "Bank" credit card holdings, or cards issued on the Visa, MasterCard, Discover or Optima networks, increased 6.3 percentage points while retailer card holdings decreased 12.4 percentage points and gas card holdings decreased 8.6 percentage points.⁵ In addition, the proportion of "convenience users" – families who had new charges on their last bill and had no balance after the last payment was made on the account – increased 4.1 percentage points from 1995 to 2001. This represents a growing proportion of bank credit card users overall.

⁴A "family" or "primary economic unit" is defined as the "economically dominant single individual and couple (whether married or living together as partners) and all other persons in the household who are financially interdependent with that person or persons." See Aizcorbe et al. (2003).

⁵The SCF credit card data do not conform exactly to the credit card data series presented in tables 1(a) and (b).

In 1995, convenience users were 36.8 percent of bank credit card holding families; in 1998, 37.2 percent, and in 2001, 39.3 percent.

ACH use also increased over this period. From 1995 to 2001, direct deposit use increased 20.6 percentage points, to 67.3 percent of families in 2001, and direct payment use increased 18.5 percentage points, to 40.3 percent of families. Families most frequently reported that they use direct deposit for payroll and direct payment for insurance premiums across all survey years.

Identifying check use in the SCF is more complicated. The SCF contains both direct and indirect questions on payment choices. The direct questions ask respondents whether they use or hold a particular instrument, where answers are either "yes", "no" or "not applicable". The statistics in the upper part of this table reflect these types of questions. The indirect questions ask respondents to name the main ways they interact with financial institutions. Respondents may answer these questions by choosing from a list of potential responses on the screen, or choose another response. Respondents may also choose more than one response. Included in these provided responses are check use in the 1998 and 2001 waves of the Survey, but not in the 1995 wave. These questions provide the statistics on check use. .

These data items show that from 1998 to 2001, the proportion of families who report using a check as one of the main ways they do business with their financial institution increases 1.2 percentage points, to 76.6 percent of families. In addition, the proportion of families who use a cash machine, ATM or debit card increased from 31.6 percent of families in 1995 to 54.0 percent of families in 2001.

Table 4 presents cross tabulations of checking account balances as a share of family financial and family liquid assets from the 1995, 1998 and 2001 Survey of Consumer Finances. In general, using a debit card represents a slight increase in the percent of financial assets held in a checking account, while using direct payment generally represents a decrease in the percentage of financial or liquid assets held in a checking account. Interestingly, the percent of financial assets held in checking accounts does not differ as much for debit card nonusers versus users, as it does for direct payment users versus nonusers. The model presented below implicitly addresses this discrepancy.

3 The model

The model examines the transactions demand for money that builds on the traditional Baumol-Tobin framework using discrete choice modeling techniques. It explicitly connects payment instrument characteristics with money demand, and the model's results provide an "instrument" for estimating money demand equations.

The model proceeds as follows. First, families choose an allocation of financial assets between money and bonds. Then, given this allocation, families choose how to conduct

transactions. This is a traditional cash-in-advance constraint, but with a twist: it allows money assets to differ by transaction characteristics. The model is presented in reverse – first describing the second stage transaction problem, and then the first stage asset allocation problem. The section proceeds by describing the framework, the econometric problem, and the proposed solution and reformulation.

3.1 Preliminaries

There are three types of entities – families (consumers), banks (producers) and sellers. Families and banks take actions in the model, and sellers passively offer goods for sale.

Suppose there are n assets. A subset of these assets are for transactions. Let m be the number of assets associated with transactions, denoted by $M = (M_1, \dots, M_m)$, where $m \leq n$. The other subset of assets is bonds, $B = (B_{m+1}, \dots, B_n)$, which cannot be used for transactions. Each family has an expected number of transactions, which we denote by t .⁶ The transaction assets have associated fixed costs and returns. Let $b = (b_1, \dots, b_m)$ denote the vector of fixed costs of the transaction assets, and let $\rho = (\rho_1, \dots, \rho_m)$ denote the vector of return on these assets. Fixed costs and returns associated with each asset may also equal zero. The bonds also have associated costs and returns, denoted $b = (b_{m+1}, \dots, b_n)$ and $\rho = (\rho_{m+1}, \dots, \rho_n)$. For clarity of exposition, funds in a checking account used for checking, funds in a checking account used for debit card payments, and funds in a checking account held as an asset are all considered different assets. Similarly, funds in a checking account used for checking, and funds in a money market account used for checking are also considered different assets. Transaction assets are different from other types of assets. Because all purchases must be made with a payment instrument, families must hold a positive amount of at least one of these assets. Without loss of generality, this asset is currency, denoted M_1 .

Families differ according to income, age and demographic characteristics. Denote income by Y and age and demographic characteristics by X . Furthermore, family net worth is denoted by $M + B + A - L = W$, where A denotes nonfinancial household assets, and L denotes family liabilities.

3.2 Transactions

The construct that follows examines the demand for transactions at a very fine level. Each transaction has a set of characteristics. Two examples are the goods purchased or the method of conducting the transaction (for example, at a store or over the telephone). Assuming that

⁶We abstract from the timing of these transactions. As noted by Clower and Howitt (1978), abstracting from the timing of transactions may provide misleading comparative statics results.

there are g of these types of characteristics, for each family, one can construct the matrix of transactions with the amount of each characteristic:

$$\varsigma = \begin{pmatrix} \tau_{11} & \dots & \tau_{1g} \\ & \ddots & \\ \tau_{t1} & \dots & \tau_{tg} \end{pmatrix}.$$

Each family has preferences over these transaction characteristics. Families may prefer one asset over another for certain types of transactions. Any particular transaction asset has an associated transaction characteristic preference matrix:

$$b = \begin{pmatrix} b_{11} & \dots & b_{1g} \\ & \ddots & \\ b_{m1} & \dots & b_{mg} \end{pmatrix}.$$

This implies a transaction-preferences matrix, $b\varsigma'$,

$$b\varsigma' = \begin{pmatrix} \sum_{i=1}^g b_{1i}\tau_{1i} & \dots & \sum_{i=1}^g b_{1i}\tau_{ti} \\ & \ddots & \\ \sum_{i=1}^g b_{mi}\tau_{1i} & \dots & \sum_{i=1}^g b_{mi}\tau_{ti} \end{pmatrix}.$$

Each family chooses a transaction asset that maximizes utility. Denote the family's Bernoulli utility function by $u(\cdot)$. For any particular transaction j , the family chooses the transaction asset such that

$$u\left(\sum_{i=1}^g b_{ki}\tau_{ji}; B, Y, X\right) \geq u\left(\sum_{i=1}^g b_{k'i}\tau_{ji}; B, Y, X\right), k \neq k', k, k' = 1, \dots, m.$$

Let t_1, \dots, t_m represent the subset of transactions t that are made with a particular asset, where $t_1 + \dots + t_m = t$. For each asset, the vector

$$\varsigma_k b_k = \begin{pmatrix} \tau_{11} & \dots & \tau_{1g} \\ & \ddots & \\ \tau_{t_k 1} & \dots & \tau_{t_k g} \end{pmatrix} \begin{pmatrix} b_{k1} \\ \vdots \\ b_{kg} \end{pmatrix} = \begin{pmatrix} \sum_{i=1}^g b_{ki}\tau_{1i} \\ \vdots \\ \sum_{i=1}^g b_{ki}\tau_{t_k i} \end{pmatrix}, k = 1, \dots, m$$

describes the associated transactions interacted with the family's preferences. The utility

for a particular transaction asset is a function of the transaction characteristics,

$$U((\varsigma_k b_k)'; B, Y, X) = \int u\left(\sum_{i=1}^g b_{ki} \tau_{1i}, \dots, \sum_{i=1}^g b_{ki} \tau_{ki}\right); B, Y, X \Big) dG(\tau_1, \dots, \tau_g), k = 1, \dots, m.$$

Note that utility is based not on assets, but on characteristics of transactions. Implicit in this construct is a vector of choice parameters, which are not observed. However, one can assume that these cost or preference parameters depend not only on the characteristics of the asset, but on the characteristics of the consumer as well. In essence, each family has its own b matrix.

3.3 The maximization problem

Following Dubin and McFadden (1984), in order to recover transaction asset demand from the utility characteristics construct, we use Roy's identity and write

$$M_i = \frac{-\frac{\partial U}{\partial \rho_i}}{\frac{\partial U}{\partial W}}.$$

This reformulates utility constraints as partial differential equations.

This utility specification leads to the asset allocation problem. Families choose M and B to maximize returns,

$$\max_{M_1, \dots, M_n} \rho(M + B) - \sum_{i=m+1}^n b_i \tag{1}$$

subject to

$$U((\varsigma_i b_i)'; B, Y, X) \geq U((\varsigma_{i'} b_{i'})'; B, Y, X), \quad i' \neq i, i, i' = 1, \dots, m, \text{ and} \\ M + B + A - L = W.$$

Note that this formulation implies that there is more than one utility constraint. Each asset is optimal for some purpose, and the entire portfolio is optimal.

Solving the optimization problem implies a family's optimal financial asset allocation,

$$(M_1^*, \dots, M_m^*, B_{m+1}^*, \dots, B_n^*).$$

3.4 The econometric problem

There are empirical problems with the model presented above.

First, these assets are not observed independently. The SCF asks families how much money they have in each of their checking accounts, and not how much money they spend using debit cards, checks, or direct payments. Thus, funds in a checking account used for

checking, funds in a checking account used for debit card payments, and funds in a checking account held as an asset cannot be observed independently. The econometrician observes a blended portfolio that contains all of the transaction assets and the bonds.

Second, the econometrician does not observe the transaction characteristics. The advantage of the SCF is its well-documented and rigorous sampling structure; the disadvantage is the lack of information on factors that may influence payment choice. As noted elsewhere, data on payment systems are scarce.⁷ The SCF does not ask questions that would be useful to determine the influence of transaction characteristics, such as whether families use debit cards at the grocery store and credit cards at restaurants because grocery stores have PIN pads and restaurants do not. The econometrician only observes an indicator y_i where

$$y_i = 1 \text{ if and only if} \\ U((\varsigma_i b_i)' ; B, Y, X) \geq U((\varsigma_{i'} b_{i'})' ; B, Y, X), \quad i' \neq i, i, i' = 1, \dots, m.$$

Third, the econometrician does not observe the supply side – the financial institutions' decisions on the assets and the rates from which families choose a financial portfolio. Because transaction characteristics and asset supply are unobserved, estimates of how a family's income and demographic characteristics affect a family's portfolio allocation may be biased, due to selection on the part of families in their asset allocation.

3.5 The proposed solution and reformulation

Given the general problem, the utility function is reformulated as

$$U((\varsigma_i b_i)' ; B, Y, X) = V((\varsigma_i b_i)', \varepsilon_i; B, Y, X, \eta),$$

where ε_i represents the unobserved portion of the transaction characteristics, and η represents the unobserved consumer characteristics.⁸ This implies that a family's probability of using or holding a particular payment instrument is

$$P_i = \Pr \{ (\varepsilon_1, \dots, \varepsilon_r, \eta) : V((\varsigma_i b_i)', p_i, \varepsilon_i; B, Y, X, \eta) > V((\varsigma_{i'} b_{i'})', p_{i'}, \varepsilon_{i'}; B, Y, X, \eta), \quad i' \neq i \}. \quad (2)$$

If the unobserved transaction characteristics ε_i are independently and identically distributed with an extreme value distribution, $\Pr(\varepsilon_i \leq \varepsilon) = \exp\left(-e^{-\varepsilon\pi/\lambda\sqrt{3}-\gamma_e}\right)$, where γ_e is Euler's constant. McFadden (1973) shows that this distribution satisfies the properties necessary and sufficient to be consistent with utility maximization.

There are three potential biases in the estimation procedure. As noted above, transaction

⁷Hancock and Humphrey (1997).

⁸The notation for the distribution assumptions follows Dubin and McFadden (1984).

and payment instrument characteristics are not observed. The only transaction assets that have an associated ρ_i in the data are credit cards, and it is only reported for one credit card. In addition, some of these consumer characteristics may be unobserved – the η – and thus, parameter estimates in an asset allocation equation may be biased. Finally, there is a classic selection bias problem in estimating the asset allocation equations, as not all families have a checking account.⁹

In order to control for these biases, the estimation proceeds in two stages. The first stage estimates the probability of using or holding different payment instruments in conjunction with holding a checking account. There are four potential combinations: use a payment instrument, have a checking account; do not use a payment instrument, have a checking account; use a payment instrument, do not have a checking account; do not use a payment instrument, do not have a checking account. The number of families who have certain payment instruments and no checking account is relatively small in most cases, but there are exceptions. Thus, the two options with no checking account are combined into one, and the multinomial logit model is estimated on three choices. These multinomial logits are estimated using maximum likelihood, and the predicted probabilities, P_i are used as instrumental variables in the asset allocation equation.

These predicted probabilities are used to estimate the family’s asset allocation equation using ordinary least squares. The second stage estimation is performed on the subsample of families who have a checking account. The predicted probabilities control for both selection and unobservables. A key assumption is that the observed asset allocation equation in the data is the result of each family’s maximization problem. Given that assumption, the first stage asset allocation equation estimated is

$$\ln(F/C) = \beta_0 + \ln\left(\sum B_i\right)\beta_b + \sum_{i=1}^n b_i\beta_q + \beta_\eta E(\eta|i) + \xi, \quad (3)$$

where F/C is the inverse share of a family’s financial assets that are in checking account. This construct is similar to that in Mulligan and Sala-i-Martin (2000).¹⁰ β are coefficients to be estimated, and ξ is a normally distributed mean zero error term. As shown in Dubin and McFadden (1984), the expected value of the unobserved consumer characteristics, given

⁹See Heckman (1979).

¹⁰Household portfolio models using the SCF take different approaches. Duca and Whitesell (1995) use absolute values of assets and then control for portfolio composition, Bertaut and Starr-McCluer (2002) use shares of assets, and Mulligan and Sala-i-Martin (2000) use the approach here. Because of the sampling structure of the SCF, the distribution of assets is skewed in the data. An inspection of the data shows that the $\ln(F/C)$ creates a linear dependent variable, which is econometrically useful for the approach in this paper.

that the family uses payment instrument i is

$$E(\eta|i) = \frac{\sigma\sqrt{6}}{\pi} \left[\sum_{k=1}^m \frac{R_k P_k}{1 - P_k} \ln P_k - \frac{R_i}{1 - P_i} \ln P_i \right]. \quad (4)$$

Furthermore, the distribution of η conditional on $(\varepsilon_1, \dots, \varepsilon_m)$ has mean $(\sqrt{2}\sigma/\lambda) \sum_{i=1}^m R_i \varepsilon_i$, and variance $\sigma^2 \left(1 - \sum_{i=1}^m R_i^2 \right)$, where $\sum_{i=1}^m R_i = 0$, $\sum_{i=1}^m R_i^2 < 1$, and R_i is the correlation between η and ε_i . Thus, the estimated coefficient β_η gives us information on how unobserved characteristics that affect payment choice are correlated with unobserved characteristics that affect checking account balances.

The approach in this paper is similar to that in Attanasio et al (2002) using Italian data. They estimate an endogenous switching model via two binomial probit equations on the decision to have a bank account and the decision to use an ATM card. One way they justify this approach is that they observe that a person must hold a bank account in order to obtain an ATM card. This is generally true. However, a checking account may not be a prerequisite for all types of payment instruments. One notable example is debit cards. In the US, there has been a substantial growth in the use of debit cards across all parts of the income distribution. In the 2001 SCF data, approximately 9.9 percent of debit card users in the subsample used in the estimation did not have a checking account. The econometric construct presented here allows for this possibility, and in addition, is consistent with the model presented above.

4 Estimation results

There are two sets of estimation results. In order to establish a baseline, the first set presents results from estimating multinomial logits on the decisions to use or hold the particular payment instruments. The second set presents results from the two stage instrumental variable specification. The estimation procedure is maximum likelihood for the first stage and ordinary least squares for the second stage instrumental variable estimation. A ** indicates that the estimated coefficient is significantly different from zero at the 95% confidence level. All results are in 2001 dollars.

As noted elsewhere, utility is a relative concept. Adding the same constant to the utility of each choice does not alter the family's decision problem. This feature makes it necessary to normalize the coefficients relative to one of the possible outcomes.¹¹ The specification uses the "do not have a checking account" as the normalized outcome, and the reported coefficients are relative to this outcome.

¹¹See Train (1996).

The first stage estimation is performed on a subsample of families who have positive income, positive assets, and at least one affiliated financial institution. Table 5(a) presents summary statistics on the subsample used in the estimation procedure. Standard errors of the means are in parentheses. Standard errors are corrected for sampling error, imputation variance and nonresponse.

The estimation results reflect a specification where probabilities depend on three groups of consumer characteristics. The first group is financial characteristics and assets – income, number of financial institutions, and homeownership. The second group is demographic – age of head, education, number of children, marital status, female headed household, or ethnicity. The third group reflects employment status – self-employed, retired, number of years with employer, and an indicator of the number of years with employer being less than one.

The second set presents results from the second stage estimation. The multinomial logit probabilities are used to construct the expectation of unobserved characteristics detailed in equation (4). The dependent variable in this estimation is $\ln(F/C)$, where F is a family’s financial asset portfolio, and C are balances in all of a family’s checking account. Financial assets are checking accounts, savings accounts, money market accounts, call accounts at brokerages, CDs, non-money market mutual funds, stocks, bonds, quasi-liquid retirement assets, savings bonds, cash value of life insurance, and other managed and financial assets. With this construction, the second stage examines the relationship between the log of checking account balances, and the log of total financial assets, savings behavior, proxies for costs associated with checking accounts (attitudes towards risk), and an indicator for the percentile distribution of net worth. This specification is consistent with previous research on asset allocation using household data (for example, Bertaut and Starr-McCluer (2002)).

4.1 Multinomial logit results

Tables 6 (a) through (g) report the multinomial logit results. The first column under each year reports the parameter estimate, the second reports the Eicker-White standard error, and the third reports the marginal effect of the variable. These are calculated as the change in the marginal probability of use or holding with a change in the independent variable. The parameters used to evaluate these changes are the estimated parameter, minus the mean of the parameters across choices. Thus, it is possible that a reported coefficient and a marginal effect have different signs. The discussion below refers to marginal effects.

In general, the results reveal the following trends. For payment instruments that act directly on checking account balances, the results indicate that debit card and direct payment use are positively correlated with income, while check use is negatively correlated. The coefficients on the squared terms indicate that these effects decrease with respect to income for

debit card and direct payment use, but increase with respect to check use. Not surprisingly, the number of institutions with which a family has accounts is positively correlated with use of all payment instruments. The age effects are significant for debit card use only; they indicate that older families are less likely to use debit cards. Higher education indicates more likely to use a debit card. Nonwhite families are more likely to use a debit card, and less likely to use direct payments and checks. Homeowners are less likely to use debit cards, but more likely to use direct payments and checks.

Turning now to methods to obtain cash, the results indicate that the marginal effect of income on having an ATM card is negative, but the number of institutions has a positive effect. Although the age dummies are not significant, the marginal effects of age on having an ATM card are negative. Having an ATM card is also positively correlated with education, and negatively correlated with the number of children. Nonwhite families are less likely to have an ATM card, as are retired individuals. Homeowners are more likely to have an ATM card.

Finally, looking at the credit card results, the marginal effects of log income and log income squared are the reverse signs of what one would expect: log income is negative and log income squared is positive. More education indicates a higher credit card holding rate, and the number of children and nonwhite families indicate a lower holding rate. The convenience user results are generally consistent with bank credit card holdings overall, and indicate

One caveat to the results is that the data do have significant multicollinearity. This is shown by calculations of the condition number defined by Belsley et al. (1980). The condition number is calculated as the square root of the ratio of the largest eigenvalue to the smallest of the independent variables matrix, normalizing the independent variables to be unit length vectors. Complete independence yields a condition number of one. Belsley et al. state that condition numbers over 100 are not uncommon in econometric analysis, but indicate significant collinearity. The condition numbers for 1995, 1998 and 2001 data sets are approximately 246, 231 and 266, respectively. This collinearity potentially explains the credit card income results. Another potential reason for the credit card income results is that the SCF oversamples wealthy families. Interpreting income coefficients without sample weights can be difficult, but using sample weights in nonlinear estimation routines can be problematic.

Thus, with these results in mind, we turn to the second stage estimation.

4.2 Instrumental variable results

As explained above, the dependent variable in the second stage estimation is $\ln(F/C)$. Thus, a positive coefficient on an independent variable indicates that the share of financial

assets in checking accounts is relatively low. In general, the second stage results agree with intuition.

Table 5 (b) shows the baseline estimated asset allocation equation. The results show that income is negatively correlated with the dependent variable, while the square of the log of income is positively correlated. As one might suspect higher income families place a smaller share of their financial assets in checking accounts than other families. Age and educations are positively correlated with the dependent variable, indicating that families with an older head of household and/or more education have a relatively smaller share of their total financial assets in checking accounts. Families with an above-average risk preference have a relatively lower share of financial assets in checking accounts.

Tables 7 (a) through (c) report the instrumental variables results. The specification estimated rearranges the terms in equation (3) in order to isolate the R_i terms. The term R_2 indicates the correlation with not using the payment instrument and holding a checking account, and the term R_3 indicates the correlation with using the payment instrument and holding a checking account. If one expects from the theory that using or holding a particular payment instrument would be correlated with a higher share of financial assets in a checking account, then one would expect the coefficient on the instrumental variable term to be negative.

The results indicate the following. Turning first to payment instruments that act directly on a checking account, the results indicate that not using a debit card is significantly correlated with a higher value of $\ln(F/C)$, while using a debit card is negatively correlated. Other ways that directly pay from a checking account are not significantly correlated. The results indicate that unobserved factors that affect the probability of debit card use are significantly correlated with unobserved factors that affect the share of financial assets in checking accounts. The coefficients on the other variables in the specification do not change considerably. One notable exception are the income variables, which change in magnitude from the original specification, but not sign. This could indicate that there is attenuation bias in the baseline results due to a potential correlation of income with an unobserved term that affects asset allocation. As seen in the multinomial results, income is generally a significant predictor of payment choice, specifically debit card use. Thus, the first stage and the second stage results are consistent.

The cash use results indicate that unobserved factors that affect the probability of having an ATM card are significantly correlated with unobserved factors that affect checking account balances. Because there is a substantial correlation with debit card use and ATM card holdings (due to the nature of the payment instrument, in that most cards have both functionalities), this result is consistent with those presented above.

Finally, turning to the delayed payment results, these indicate that not being a convenience user of a credit card is negatively correlated with $\ln(F/C)$. Convenience use is

positively correlated, but it is not statistically significant. The definition of convenience user is such that not being a convenience user encompasses four categories of credit card holdings: not holding a credit card, holding a credit card but no new charges and no balance, holding a credit card but no new charges and a balance, and holding a credit card with new charges and a balance. Thus, borrowers and the credit constrained have a relatively higher share of financial assets in checking accounts than other families.

To summarize, the results indicate that for some payment choices, unobserved factors that affect payment choice are correlated with unobserved factors that affect the share of assets held in checking accounts.

5 Conclusion

This paper develops a model of the transactions demand for money using discrete choice modeling techniques. It shows that payment choice is correlated with money demand and checking account balances. It also controls for biases that may be inherent in any demand equation estimation.

In general, the first stage results show that payment choice is determined in part by income, age and demographic characteristics – the same factors that affect family asset allocation. Indeed, the second stage results indicate that unobserved family characteristics that affect payment choice may also affect money demand.

Extensions of this framework include examining money market mutual fund allocation with respect to convenience credit card spending. Families that hold money market mutual funds may be more interest-rate sensitive than others, and convenience use of credit cards could control for potential biases that may occur in estimating asset allocation.

The results in this paper show that payment choice and checking account balances are correlated. From a theoretical point of view, the results show that families may choose one monetary asset over another based on preferences over transaction characteristics. From an empirical point of view, the results show that payment choice may be an effective instrumental variable to control for unobservables and selection biases when estimating cross-sectional money demand equations.

Table 1: Noncash retail payments: Number, value and share, 1995, 1998, 2001

| | Number of payments | | | Share of payments | | |
|--|--------------------|------------------|-----------------|-------------------|-------------|-------------|
| | 1995 | 1998 | 2001 | 1995 | 1998 | 2001 |
| <i>Number of payments</i> ¹ | | | | | | |
| Debit cards ² | 1,553.8 | 5,730.7 | 12,452.7 | 0.03 | 0.08 | 0.16 |
| Credit cards ³ | 11,172.0 | 13,422.4 | 17,090.1 | 0.17 | 0.19 | 0.22 |
| Bank cards | 6,682.5 | 8,522.9 | 11,391.4 | 0.10 | 0.12 | 0.14 |
| Mastercard | 2,321.7 | 2,839.7 | 4,094.5 | 0.04 | 0.04 | 0.05 |
| VISA | 3,727.1 | 4,948.4 | 6,236.9 | 0.06 | 0.07 | 0.08 |
| ACH items | 3,489.7 | 5,329.9 | 8,060.9 | 0.05 | 0.08 | 0.10 |
| Federal Reserve ACH ^{5, 6} | 2,645.0 | 3,719.0 | 5,348.7 | 0.04 | 0.05 | 0.07 |
| Private ACH ⁷ | 249.7 | 553.9 | 754.1 | 0.00 | 0.01 | 0.01 |
| "On-us" ACH | 595.0 | 1,057.0 | 1,958.1 | 0.01 | 0.02 | 0.02 |
| <i>Subtotal: Electronic payments</i> | <i>16,215.5</i> | <i>24,483.0</i> | <i>37,603.7</i> | <i>0.25</i> | <i>0.35</i> | <i>0.48</i> |
| Checks paid | 49,500.0 | 45,169.7 | 41,222.6 | 0.75 | 0.65 | 0.52 |
| Total | 65,715.5 | 69,652.7 | 78,826.3 | 1.00 | 1.00 | 1.00 |
| | Value of payments | | | Share of payments | | |
| | 1995 | 1998 | 2001 | 1995 | 1998 | 2001 |
| <i>Value of payments</i> ¹ | | | | | | |
| Debit cards ² | 73.0 | 259.1 | 571.8 | | 0.00 | 0.01 |
| Credit cards ³ | 991.6 | 1,228.6 | 1,514.4 | | 0.02 | 0.02 |
| Bank cards ⁴ | 625.4 | 815.1 | 1,013.1 | | 0.01 | 0.02 |
| MasterCard | 230.1 | 299.4 | 421.2 | | 0.00 | 0.01 |
| VISA | 395.3 | 515.7 | 591.9 | | 0.01 | 0.01 |
| ACH items | 14,213.9 | 20,158.0 | 23,057.9 | | 0.31 | 0.36 |
| Federal Reserve ACH ^{5, 6} | 10,383.9 | 13,393.0 | 15,235.8 | | 0.21 | 0.24 |
| Private ACH ⁷ | 1,272.7 | 2,719.2 | 2,400.7 | | 0.04 | 0.04 |
| "On-us" ACH | 2,558.3 | 4,045.8 | 5,421.4 | | 0.06 | 0.08 |
| <i>Subtotal: Electronic payments</i> | <i>15,278.50</i> | <i>21,645.70</i> | <i>25,144.1</i> | <i>n.a.</i> | <i>0.33</i> | <i>0.39</i> |
| Checks paid | n.a. | 43,650.3 | 38,909.1 | | 0.67 | 0.61 |
| Total | n.a. | 65,296.0 | 64,053.2 | <i>n.a.</i> | 1.00 | 1.00 |

1. In millions.
2. Includes PIN-based (online) and signature-based (offline) transactions.
3. Includes bank, travel and entertainment, retailer, and oil company card transactions.
4. Bank cards include Visa and MasterCard credit cards.
5. Includes all government and commercial items.
6. Includes items sent by private automated clearing houses to the Federal Reserve for transmission to the receiving bank.
7. Does not include "on-us" items.

Sources: The Nilson Report (HSN Consultants Inc., Oxnard, CA); Federal Reserve; National Automated Clearing House Association.

Table 2: Variable definitions

| | |
|----------------------------|---|
| Use a debit card | Equals 1 if family uses a debit card |
| Have a bank card | Equals 1 if family has a bank credit card |
| Use direct deposit | Equals 1 if family uses direct deposit |
| Use direct payment | Equals 1 if family uses direct payment |
| Convenience user | Equals 1 if family has a bank credit card, who had new charges on their last bill, and had no balance after the last payment was made on the account. |
| Income, log | Log of family income, in 2001 dollars |
| (Income, log) ² | Log of family income squared, in 2001 dollars |
| No. of institutions | Number of institutions where family has accounts or financial business |
| Age of head | |
| 35-44 | Indicates head of family is between 35-44 years old |
| 45-54 | Indicates head of family is between 45-54 years old |
| 55-64 | Indicates head of family is between 55-64 years old |
| 65-74 | Indicates head of family is between 65-74 years old |
| 75 or more | Indicates head of family is over 75 years old |
| Education | |
| High school | Indicates head of family's highest attained education level |
| Some college | |
| College degree | |
| Number of children | Number of children in family |
| Unmarried | Indicates head of family is unmarried |
| Female | Indicates head of family is female |
| Nonwhite | Indicates head of family is nonwhite |
| Self-employed | Indicates head of family is self-employed |
| Retired | Indicates head of family is retired |
| Years with employer | Number of years head of family worked for current employer |
| (indicates less than one) | If years with employer is less than one |
| Does not own home | Indicates nonhomeowner |
| Saved | Equals 1 if saved |
| $\ln(F/C)$ | Financial assets divided by checking account balances, log |
| Risk preference | |
| Above average | Equals 1 if respondent is willing to take above average financial risks expecting to earn above average returns |
| Average | Equals 1 if respondent is willing to take average financial risks expecting to earn average returns |
| No risk | Equals 1 if respondent is not willing to take any financial risks |
| Net worth | |
| 25-49.9 | Equals 1 if respondent is in the 25-49.9 percentile of net worth |
| 50-74.9 | Equals 1 if respondent is in the 50-74.9 percentile of net worth |
| 75-89.9 | Equals 1 if respondent is in the 75-89.9 percentile of net worth |
| 90-100 | Equals 1 if respondent is in the 90-100 percentile of net worth |
| R ₂ | Dubin-McFadden correction term, do not use/hold instrument |
| R ₃ | Dubin-McFadden correction term, use/hold instrument |

Table 3: Use and holdings of payment instruments¹

| | 1995 | 1998 | 2001 |
|--|----------------|----------------|----------------|
| Use a debit card | 17.6 (0.04) | 33.8 (0.07) | 47.0 (0.04) |
| Use a debit card, have checking account | 16.5 (0.00) | 31.7 (0.00) | 42.1 (0.00) |
| Use a debit card, no checking account | 1.1 (0.00) | 2.1 (0.00) | 4.9 (0.00) |
| Do not use a debit card, checking account | 64.4 (0.00) | 49.8 (0.00) | 39.7 (0.00) |
| Do not use a debit card, no checking account | 18.0 (0.00) | 16.4 (0.00) | 13.3 (0.00) |
| Have a credit card | 74.4 (0.04) | 72.5 (0.14) | 76.2 (0.08) |
| Bank card ² | 66.4 (0.07) | 67.5 (0.18) | 72.7 (0.10) |
| Convenience users ³ | 24.5 (0.17) | 25.1 (0.33) | 28.6 (0.18) |
| Retailer card | 57.6 (0.08) | 50.0 (0.16) | 45.2 (0.07) |
| Gas card | 24.7 (0.06) | 19.2 (0.12) | 16.1 (0.06) |
| Use direct deposit ⁴ | 46.7 (0.11) | 60.5 (0.11) | 67.3 (0.11) |
| Paycheck | 26.9 (0.08) | 38.3 (0.18) | 45.2 (0.17) |
| Social Security | 17.3 (0.11) | 21.0 (0.07) | 22.0 (0.08) |
| Use direct payment ⁵ | 21.8 (0.11) | 36.0 (0.06) | 40.3 (0.15) |
| Utility bills | 4.5 (0.04) | 8.4 (0.07) | 11.7 (0.14) |
| Mortgage/Rent | 6.0 (0.06) | 9.2 (0.07) | 12.8 (0.12) |
| Insurance | 8.9 (0.07) | 17.2 (0.04) | 18.6 (0.06) |
| "Main ways" to do business with financial institution: | | | |
| Check | n.a. | 75.4 (0.00) | 76.6 (0.00) |
| Cash machine/ATM/Debit card | 31.6 (0.00) | 50.1 (0.00) | 54.0 (0.00) |

1. In percent of families. For details, see Aizcorbe et al. (2003).

2. Bank credit cards include Visa, MasterCard, Discover and Optima cards.

3. Percent of all families. Defined as families who had new charges on their last bill and had no balance after the last payment was made on the account.

4. Percent of all families. Families may use more than one direct deposit.

5. Percent of all families. Families may use more than one direct payment.

Standard errors of the means are in parentheses. Standard errors are corrected for sampling error, imputation variance and nonresponse.

Source: Survey of Consumer Finances, Federal Reserve.

Table 4: Financial asset holdings, 1995, 1998, 2001¹

| | 1995 | 1998 | 2001 |
|---|------|------|------|
| Percent of financial assets (includes zero checking balance) ² | 25.6 | 21.8 | 21.7 |
| Do not use a debit card | 26.4 | 21.6 | 21.1 |
| Use a debit card | 22.2 | 22.2 | 22.4 |
| Do not use direct payment | 28.3 | 26.1 | 26.1 |
| Use direct payment | 17.3 | 15.3 | 16.2 |
| Percent of financial assets (nonzero checking account balance) ² | 27.7 | 24.4 | 24.5 |
| Do not use a debit card | 28.8 | 24.9 | 24.5 |
| Use a debit card | 23.5 | 23.6 | 24.4 |
| Do not use direct payment | 31.0 | 29.9 | 30.1 |
| Use direct payment | 18.1 | 16.4 | 17.7 |
| Percent of liquid assets (includes zero checking balance) ³ | 62.5 | 52.2 | 50.9 |
| Do not use a debit card | 62.4 | 49.9 | 48.3 |
| Use a debit card | 63.0 | 56.0 | 53.5 |
| Do not use direct payment | 63.7 | 54.2 | 52.4 |
| Use direct payment | 58.9 | 49.2 | 48.9 |
| Percent of liquid assets (nonzero checking account balance) ³ | 67.7 | 58.3 | 57.3 |
| Do not use a debit card | 67.9 | 57.9 | 56.3 |
| Use a debit card | 66.7 | 59.6 | 58.2 |
| Do not use direct payment | 69.7 | 62.0 | 60.5 |
| Use direct payment | 61.6 | 53.0 | 53.4 |

1. Statistics reflect subsample with positive liquid assets, financial assets, income and at least one affiliated financial institution.
2. Financial assets are liquid assets plus CDs, non-money market mutual funds, stocks, bonds, quasi-liquid retirement assets, savings bonds, cash value of life insurance, and other managed and financial assets.
3. Liquid assets are checking accounts, savings accounts, money market accounts and call accounts at brokerages.

Table 5(a): Sample summary statistics

| | 1995 | 1998 | 2001 |
|----------------------------|-----------------|-----------------|-----------------|
| Use a debit card | 19.1 (0.04) | 36.0 (0.07) | 49.5 (0.04) |
| Have a bank card | 71.6 (0.08) | 71.6 (0.20) | 76.8 (0.10) |
| Use direct deposit | 50.4 (0.09) | 64.0 (0.11) | 71.1 (0.10) |
| Use direct payment | 23.6 (0.11) | 38.4 (0.06) | 42.7 (0.16) |
| Convenience user | 26.3 (0.00) | 26.7 (0.00) | 30.2 (0.00) |
| Income, log | 10.3 (0.00) | 10.4 (0.01) | 10.6 (0.00) |
| (Income, log) ² | 107.3 (0.10) | 109.9 (0.22) | 113.9 (0.10) |
| No. of institutions | 3.3 (0.02) | 3.5 (0.02) | 3.4 (0.01) |
| Age of head | | | |
| 35-44 | 22.8 (0.02) | 23.6 (0.01) | 22.4 (0.01) |
| 45-54 | 18.3 (0.02) | 19.6 (0.01) | 21.0 (0.02) |
| 55-64 | 12.6 (0.01) | 13.2 (0.02) | 13.4 (0.01) |
| 65-74 | 12.5 (0.01) | 11.4 (0.01) | 10.8 (0.01) |
| 74 or more | 10.2 (0.01) | 9.9 (0.02) | 10.6 (0.01) |
| Education | | | |
| High school | 31.7 (0.09) | 31.9 (0.16) | 31.6 (0.13) |
| Some college | 19.3 (0.04) | 19.0 (0.09) | 18.9 (0.12) |
| College degree | 33.0 (0.12) | 35.1 (0.29) | 35.8 (0.17) |
| Number of children | 0.8 (0.00) | 0.8 (0.00) | 0.8 (0.00) |
| Unmarried | 38.7 (0.11) | 39.6 (0.19) | 37.9 (0.15) |
| Female | 26.6 (0.11) | 26.5 (0.14) | 25.3 (0.14) |
| Nonwhite | 19.1 (0.04) | 19.6 (0.15) | 21.4 (0.09) |
| Self-employed | 10.5 (0.11) | 11.6 (0.24) | 12.1 (0.09) |
| Retired | 24.8 (0.05) | 23.3 (0.06) | 22.3 (0.04) |
| Years with employer | 6.5 (0.02) | 6.8 (0.03) | 7.3 (0.02) |
| (indicates less than one) | 6.7 (0.02) | 5.9 (0.02) | 6.4 (0.02) |
| Does not own home | 30.7 (0.01) | 30.4 (0.01) | 29.1 (0.01) |
| No. of observations | 4,033 | 4,070 | 4,227 |

Table 5(b): Baseline results

| | Estimate | Std error |
|----------------------------|----------|-----------|
| Intercept | 2.714** | 1.272 |
| Income, log | -0.484** | 0.218 |
| (Income, log) ² | 0.027** | 0.009 |
| Age of head | | |
| 35-44 | 0.040 | 0.094 |
| 45-54 | 0.199** | 0.098 |
| 55-64 | 0.307** | 0.118 |
| 65-74 | 0.054 | 0.136 |
| 75 and over | 0.298** | 0.140 |
| Education | | |
| High school | 0.390** | 0.119 |
| Some college | 0.369** | 0.122 |
| College degree | 0.570** | 0.119 |
| Saved | 0.116 | 0.066 |
| Risk Preference | | |
| Above average | 0.373** | 0.138 |
| Average | 0.178 | 0.134 |
| No risk | -0.209 | 0.143 |
| Net worth | | |
| 25-49.9 | 0.992** | 0.102 |
| 50-74.9 | 1.727** | 0.102 |
| 75-89.9 | 2.252** | 0.128 |
| 90-100 | 2.877** | 0.146 |
| Adjusted R ² | 0.431 | |
| No. of observations | 3,547 | |

Table 6(a): Direct payment from a checking account

| | Debit card | | | Direct pay | | |
|---|-------------------------|-----------|-----------------|---------------------------|-----------|-----------------|
| | Do not use a debit card | | | Do not use direct payment | | |
| | Estimate | Std error | Marginal effect | Estimate | Std error | Marginal effect |
| Income, log (Income, log) ² | 0.072 | 0.273 | -0.442 | 0.277 | 0.275 | -0.298 |
| No. of institutions | -0.012 | 0.011 | 0.019 | -0.021 | 0.011 | 0.012 |
| Age of head | 0.129** | 0.023 | -0.003 | 0.090** | 0.024 | -0.019 |
| 35-44 | 0.330 | 0.173 | 0.104 | -0.052 | 0.160 | -0.022 |
| 45-54 | 0.326** | 0.174 | 0.154 | -0.221 | 0.164 | -0.030 |
| 55-64 | 0.484** | 0.200 | 0.245 | -0.143 | 0.192 | 0.013 |
| 65-74 | 0.823** | 0.236 | 0.392 | 0.100 | 0.231 | 0.056 |
| 75 and over | 1.048** | 0.258 | 0.489 | 0.239 | 0.254 | 0.044 |
| Education | | | | | | |
| High school | 0.277 | 0.165 | -0.028 | 0.258 | 0.159 | -0.055 |
| Some college | 0.291 | 0.188 | -0.114 | 0.365** | 0.182 | -0.113 |
| College degree | 0.131 | 0.172 | -0.097 | 0.119 | 0.167 | -0.117 |
| No. of children | -0.055 | 0.046 | 0.008 | -0.111 | 0.045 | -0.013 |
| Unmarried | -0.083 | 0.150 | 0.019 | -0.148 | 0.147 | -0.018 |
| Female | 0.078 | 0.165 | 0.004 | 0.049 | 0.160 | -0.011 |
| Nonwhite | -0.746** | 0.128 | -0.073 | -0.528** | 0.121 | 0.026 |
| Self-employed | -0.059 | 0.131 | 0.082 | -0.189 | 0.133 | 0.030 |
| Retired | -0.120 | 0.187 | 0.048 | -0.262 | 0.188 | -0.005 |
| Yrs. with employer (less than one) | 0.008 | 0.006 | 0.002 | 0.010 | 0.006 | 0.002 |
| Does not own home | 0.413 | 0.257 | 0.028 | 0.406 | 0.243 | 0.028 |
| Intercept | -0.601** | 0.130 | -0.109 | -0.224 | 0.125 | 0.073 |
| | 0.999 | 1.691 | 2.462 | 0.604 | 1.702 | 2.034 |
| Pseudo R ² | 0.1650 | | | 0.1242 | | |
| Likelihood ratio | 1532.5 | | | 1153.1 | | |
| No. of observations | 1,894 | | | 1,904 | | |
| | | | | Estimate | Std error | Marginal effect |
| | | | | 1.602** | 0.331 | 0.263 |
| | | | | -0.073** | 0.013 | -0.010 |
| | | | | 0.173** | 0.024 | 0.016 |
| | | | | 0.044 | 0.167 | 0.019 |
| | | | | -0.087 | 0.170 | 0.027 |
| | | | | -0.200 | 0.200 | -0.011 |
| | | | | -0.147 | 0.243 | -0.049 |
| | | | | 0.044 | 0.270 | -0.039 |
| | | | | 0.503** | 0.183 | 0.049 |
| | | | | 0.865** | 0.202 | 0.099 |
| | | | | 0.638** | 0.188 | 0.103 |
| | | | | -0.052 | 0.046 | 0.012 |
| | | | | -0.066 | 0.155 | 0.016 |
| | | | | 0.099 | 0.171 | 0.010 |
| | | | | -0.643** | 0.130 | -0.023 |
| | | | | -0.324** | 0.135 | -0.027 |
| | | | | -0.239 | 0.197 | 0.005 |
| | | | | -0.001 | 0.006 | -0.002 |
| | | | | 0.282 | 0.255 | -0.025 |
| | | | | -0.548** | 0.134 | -0.064 |
| | | | | -8.427** | 2.053 | -1.792 |

Direct payment from checking account (continued)

| | Use check | | | | | |
|---|------------------|------------|-----------------|-----------|------------|-----------------|
| | Do not use check | | | Use check | | |
| | Estimate | Std. error | Marginal effect | Estimate | Std. error | Marginal effect |
| Income, log (Income, log) ² | 0.993 | 0.401 | 0.022 | 0.639** | 0.261 | -0.129 |
| No. of institutions | -0.047 | 0.016 | -0.001 | -0.036 | 0.010 | 0.004 |
| Age of head | 0.108** | 0.029 | -0.002 | 0.139** | 0.023 | 0.011 |
| 35-44 | 0.186 | 0.209 | 0.014 | -0.038 | 0.154 | -0.081 |
| 45-54 | -0.056 | 0.217 | 0.007 | -0.169 | 0.157 | -0.041 |
| 55-64 | 0.113 | 0.251 | 0.020 | -0.210 | 0.185 | -0.117 |
| 65-74 | 0.273 | 0.299 | 0.019 | -0.039 | 0.223 | -0.113 |
| 75 and over | 0.544 | 0.323 | 0.027 | 0.094 | 0.247 | -0.163 |
| Education | | | | | | |
| High school | 0.231 | 0.207 | -0.007 | 0.351** | 0.157 | 0.043 |
| Some college | 0.328 | 0.235 | -0.016 | 0.593** | 0.178 | 0.096 |
| College degree | -0.029 | 0.220 | -0.026 | 0.395** | 0.163 | 0.154 |
| No. of children | -0.044 | 0.059 | 0.003 | -0.090 | 0.043 | -0.017 |
| Unmarried | 0.084 | 0.187 | 0.015 | -0.154 | 0.142 | -0.087 |
| Female | 0.217 | 0.202 | 0.012 | 0.023 | 0.155 | -0.070 |
| Nonwhite | -0.418** | 0.158 | 0.012 | -0.607** | 0.116 | -0.069 |
| Self-employed | -0.095 | 0.172 | 0.011 | -0.271** | 0.126 | -0.064 |
| Retired | 0.011 | 0.244 | 0.019 | -0.306 | 0.180 | -0.115 |
| Yrs. with employer (less than one) | 0.011 | 0.007 | 0.000 | 0.004 | 0.005 | -0.002 |
| Does not own home | 0.327 | 0.310 | -0.002 | 0.356 | 0.237 | 0.011 |
| Intercept | 0.074 | 0.159 | 0.032 | -0.445** | 0.121 | -0.188 |
| | -5.974** | 2.460 | -0.284 | -1.314 | 1.617 | 1.690 |
| Pseudo R ² | 0.3193 | | | | | |
| Likelihood ratio | 2965.5 | | | | | |
| No. of observations | 516 | | | 3,065 | | |

Table 6(b): Obtain cash

| | Do not have an ATM card | | Have an ATM card | |
|---------------------------------------|-------------------------|-----------|------------------|-----------|
| | Estimate | Std error | Estimate | Std error |
| Income, log | -0.237 | 0.314 | 1.169** | 0.287 |
| (Income, log) ² | -0.003 | 0.013 | -0.055** | 0.011 |
| No. of institutions | 0.081 | 0.027 | 0.148** | 0.023 |
| Age of head | | | | |
| 35-44 | 0.371 | 0.221 | -0.062 | 0.154 |
| 45-54 | 0.435** | 0.219 | -0.243 | 0.158 |
| 55-64 | 0.754** | 0.243 | -0.362 | 0.186 |
| 65-74 | 1.099** | 0.280 | -0.289 | 0.226 |
| 75 and over | 1.577 | 0.298 | -0.498 | 0.254 |
| Education | | | | |
| High School | 0.294 | 0.182 | 0.388 | 0.162 |
| Some college | 0.275 | 0.210 | 0.682** | 0.182 |
| College degree | -0.121 | 0.193 | 0.493** | 0.168 |
| No. of children | -0.074 | 0.057 | -0.082 | 0.043 |
| Unmarried | -0.306 | 0.175 | -0.064 | 0.143 |
| Female | 0.154 | 0.192 | 0.030 | 0.158 |
| Nonwhite | -0.832 | 0.157 | -0.480** | 0.118 |
| Self-employed | 0.008 | 0.157 | -0.326 | 0.127 |
| Retired | 0.061 | 0.213 | -0.371 | 0.183 |
| Yrs. with employer (less than one) | 0.016 | 0.006 | 0.002 | 0.005 |
| Does not own home | 0.159 | 0.322 | 0.382 | 0.237 |
| Intercept | -0.624 | 0.153 | -0.252 | 0.123 |
| | 2.564 | 1.933 | -4.990** | 1.778 |
| Pseudo R ² | | | | |
| Likelihood ratio | | | | |
| No. of observations | | | | |
| Pred. prob. at data means | | | | |

Table 6(c): Delayed payment

| | Do not have a bank credit card | | | Have a bank credit card | | | Have a bank credit card | | | Not a convenience user | | | Convenience user | | | |
|---|--------------------------------|------------|-----------------|-------------------------|------------|-----------------|-------------------------|------------|-----------------|------------------------|------------|-----------------|------------------|------------|-----------------|--|
| | Estimate | Std. error | Marginal effect | Estimate | Std. error | Marginal effect | Estimate | Std. error | Marginal effect | Estimate | Std. error | Marginal effect | Estimate | Std. error | Marginal effect | |
| | | | | | | | | | | | | | | | | |
| Income, log (Income, log) ² | 1.261** | 0.457 | 0.011 | 1.107** | 0.270 | -0.055 | 2.285** | 0.359 | 0.255 | 1.210** | 0.321 | 0.255 | 1.210** | 0.321 | -0.200 | |
| No. of institutions | -0.080** | 0.022 | -0.002 | -0.053 | 0.011 | 0.010 | -0.124** | 0.016 | -0.017 | -0.052** | 0.012 | -0.017 | -0.052** | 0.012 | 0.013 | |
| Age of head | -0.022 | 0.038 | -0.012 | 0.147** | 0.023 | 0.060 | 0.130** | 0.025 | -0.005 | 0.150** | 0.024 | -0.005 | 0.150** | 0.024 | 0.004 | |
| 35-44 | -0.308 | 0.195 | -0.027 | 0.092 | 0.157 | 0.142 | -0.002 | 0.157 | -0.063 | 0.264 | 0.189 | -0.063 | 0.264 | 0.189 | 0.050 | |
| 45-54 | -0.396 | 0.205 | -0.022 | -0.080 | 0.159 | 0.112 | -0.193 | 0.162 | -0.097 | 0.217 | 0.188 | -0.097 | 0.217 | 0.188 | 0.076 | |
| 55-64 | -0.169 | 0.243 | -0.001 | -0.150 | 0.187 | 0.007 | -0.273 | 0.192 | -0.123 | 0.244 | 0.214 | -0.123 | 0.244 | 0.214 | 0.096 | |
| 65-74 | -0.189 | 0.300 | -0.017 | 0.060 | 0.225 | 0.088 | -0.364 | 0.237 | -0.226 | 0.589** | 0.252 | -0.226 | 0.589** | 0.252 | 0.177 | |
| 75 and over | 0.573 | 0.308 | 0.038 | 0.023 | 0.250 | -0.195 | -0.009 | 0.259 | -0.150 | 0.623** | 0.279 | -0.150 | 0.623** | 0.279 | 0.118 | |
| Education | | | | | | | | | | | | | | | | |
| High school | -0.043 | 0.178 | -0.045 | 0.611** | 0.163 | 0.232 | 0.216 | 0.158 | -0.114 | 0.696** | 0.208 | -0.114 | 0.696** | 0.208 | 0.089 | |
| Some college | -0.008 | 0.210 | -0.062 | 0.901** | 0.183 | 0.323 | 0.416** | 0.181 | -0.154 | 1.064** | 0.226 | -0.154 | 1.064** | 0.226 | 0.121 | |
| College degree | -0.589** | 0.205 | -0.088 | 0.696** | 0.167 | 0.456 | -0.058 | 0.167 | -0.300 | 1.207** | 0.207 | -0.300 | 1.207** | 0.207 | 0.236 | |
| No. of children | 0.054 | 0.057 | 0.012 | -0.128** | 0.044 | -0.064 | -0.052 | 0.045 | 0.020 | -0.137** | 0.050 | 0.020 | -0.137** | 0.050 | -0.016 | |
| Unmarried | -0.035 | 0.185 | 0.005 | -0.108 | 0.143 | -0.026 | -0.097 | 0.149 | -0.001 | -0.091 | 0.162 | -0.001 | -0.091 | 0.162 | 0.001 | |
| Female | 0.063 | 0.192 | 0.004 | -0.002 | 0.158 | -0.023 | 0.020 | 0.160 | 0.014 | -0.037 | 0.184 | 0.014 | -0.037 | 0.184 | -0.011 | |
| Nonwhite | -0.381** | 0.146 | 0.019 | -0.657** | 0.118 | -0.098 | -0.434** | 0.117 | 0.181 | -1.198** | 0.153 | 0.181 | -1.198** | 0.153 | -0.142 | |
| Self-employed | -0.357 | 0.203 | -0.007 | -0.257** | 0.126 | 0.035 | -0.351** | 0.137 | -0.078 | -0.023 | 0.134 | -0.078 | -0.023 | 0.134 | 0.061 | |
| Retired | -0.277 | 0.238 | 0.001 | -0.297 | 0.182 | -0.007 | -0.430** | 0.192 | -0.112 | 0.041 | 0.202 | -0.112 | 0.041 | 0.202 | 0.088 | |
| Yrs. with employer (less than one) | -0.005 | 0.009 | -0.001 | 0.006 | 0.005 | 0.004 | 0.007 | 0.006 | 0.001 | 0.004 | 0.006 | 0.001 | 0.004 | 0.006 | -0.001 | |
| Does not own home | 0.389 | 0.276 | 0.004 | 0.334 | 0.241 | -0.019 | 0.374 | 0.238 | 0.069 | 0.085 | 0.289 | 0.069 | 0.085 | 0.289 | -0.054 | |
| Intercept | 0.018 | 0.149 | 0.037 | -0.526** | 0.122 | -0.193 | -0.272** | 0.122 | 0.132 | -0.827** | 0.147 | 0.132 | -0.827** | 0.147 | -0.103 | |
| | -3.781 | 2.485 | 0.069 | -4.792** | 1.680 | -0.359 | -8.868** | 2.069 | -0.341 | -7.430** | 2.017 | -0.341 | -7.430** | 2.017 | 0.268 | |
| Pseudo R ² | 0.368 | | | 0.245 | | | 0.245 | | | 0.245 | | | 0.245 | | | |
| Likelihood ratio | 3414.8 | | | 2277.0 | | | 2277.0 | | | 2277.0 | | | 2277.0 | | | |
| No. of observations | 580 | | | 3,001 | | | 2,007 | | | 2,007 | | | 2,007 | | | |

Table 7(a): Direct payment from checking account

| | Use debit card | | Use direct pay | | Use check | |
|----------------------------|----------------|-----------|----------------|-----------|-----------|-----------|
| | Estimate | Std error | Estimate | Std error | Estimate | Std error |
| Intercept | 5.921** | 1.400 | 3.910** | 1.326 | 5.009** | 1.626 |
| Income, log | -1.339** | 0.258 | -0.749** | 0.230 | -0.648** | 0.233 |
| (Income, log) ² | 0.063** | 0.011 | 0.037 | 0.010 | 0.035** | 0.010 |
| Age of head | | | | | | |
| 35-44 | 0.325** | 0.104 | 0.002 | 0.095 | 0.017 | 0.097 |
| 45-54 | 0.657** | 0.122 | 0.164 | 0.100 | 0.192 | 0.100 |
| 55-64 | 0.995** | 0.165 | 0.341** | 0.121 | 0.272** | 0.125 |
| 65-74 | 1.056** | 0.222 | 0.128 | 0.140 | -0.006 | 0.146 |
| 75 and over | 1.453** | 0.241 | 0.350** | 0.145 | 0.173 | 0.155 |
| Education | | | | | | |
| High school | 0.320** | 0.126 | 0.361** | 0.127 | 0.332** | 0.133 |
| Some college | 0.079 | 0.137 | 0.281** | 0.134 | 0.304** | 0.136 |
| College degree | 0.306** | 0.131 | 0.461** | 0.130 | 0.542** | 0.135 |
| Saved | 0.117 | 0.066 | 0.119 | 0.066 | 0.110 | 0.066 |
| Risk preference | | | | | | |
| Above average | 0.383** | 0.137 | 0.377** | 0.138 | 0.375** | 0.138 |
| Average | 0.195 | 0.134 | 0.192 | 0.133 | 0.187 | 0.134 |
| No risk | -0.171 | 0.143 | -0.169 | 0.143 | -0.190 | 0.143 |
| Net worth | | | | | | |
| 25-49.9 | 1.089** | 0.107 | 0.959** | 0.105 | 0.998** | 0.111 |
| 50-74.9 | 1.912** | 0.112 | 1.660** | 0.108 | 1.731** | 0.113 |
| 75-89.9 | 2.475** | 0.139 | 2.184** | 0.135 | 2.250** | 0.141 |
| 90-100 | 3.200** | 0.162 | 2.802 | 0.153 | 2.868** | 0.156 |
| Indicator | 2.619** | 0.460 | 1.154** | 0.529 | -1.347 | 0.788 |
| R ₂ | 0.792** | 0.181 | 0.378 | 0.277 | -0.563 | 0.281 |
| R ₃ | -0.901** | 0.178 | -0.288 | 0.157 | -0.056 | 0.211 |
| Adjusted R ² | 0.436 | | 0.432 | | 0.431 | |
| No. of observations | 3,547 | | 3,547 | | 3,547 | |

Table 7(b): Obtain cash

| | Have ATM card | |
|----------------------------|---------------|-----------|
| | Estimate | Std error |
| Intercept | 5.983** | 1.433 |
| Income, log | -1.316** | 0.262 |
| (Income, log) ² | 0.061** | 0.011 |
| Age of head | | |
| 35-44 | 0.191** | 0.099 |
| 45-54 | 0.461** | 0.106 |
| 55-64 | 0.770** | 0.142 |
| 65-74 | 0.682** | 0.177 |
| 75 and over | 1.286** | 0.227 |
| Education | | |
| High school | 0.224 | 0.129 |
| Some college | 0.025 | 0.142 |
| College degree | 0.169 | 0.143 |
| Saved | 0.114 | 0.066 |
| Risk preference | | |
| Above average | 0.389** | 0.138 |
| Average | 0.209 | 0.133 |
| No risk | -0.114 | 0.143 |
| Net worth | | |
| 25-49.9 | 1.015** | 0.106 |
| 50-74.9 | 1.786** | 0.107 |
| 75-89.9 | 2.321** | 0.135 |
| 90-100 | 2.959** | 0.151 |
| Indicator | 2.486** | 0.465 |
| R ₂ | 0.505** | 0.138 |
| R ₃ | -1.052** | 0.212 |
| Adjusted R ² | 0.436 | |
| No. of observations | 3,547 | |

Table 7(c): Delayed payment

| | Have bank card | | Convenience user | |
|----------------------------|----------------|-----------|------------------|-----------|
| | Estimate | Std error | Estimate | Std error |
| Intercept | 3.202** | 1.403 | 3.398** | 1.415 |
| Income, log | -0.532** | 0.244 | -0.606** | 0.240 |
| (Income, log) ² | 0.030** | 0.010 | 0.036** | 0.010 |
| Age of head | | | | |
| 35-44 | 0.055 | 0.093 | 0.092 | 0.093 |
| 45-54 | 0.223** | 0.098 | 0.305** | 0.101 |
| 55-64 | 0.325** | 0.117 | 0.449** | 0.122 |
| 65-74 | 0.068 | 0.134 | 0.275 | 0.151 |
| 75 and over | 0.282 | 0.144 | 0.462** | 0.152 |
| Education | | | | |
| High school | 0.367** | 0.140 | 0.359** | 0.124 |
| Some college | 0.339** | 0.148 | 0.335** | 0.128 |
| College degree | 0.556** | 0.150 | 0.686** | 0.137 |
| Saved | 0.110 | 0.066 | 0.100 | 0.066 |
| Risk preference | | | | |
| Above average | 0.362** | 0.138 | 0.369** | 0.135 |
| Average | 0.172 | 0.134 | 0.180 | 0.131 |
| No risk | -0.195 | 0.143 | -0.174 | 0.141 |
| Net worth | | | | |
| 25-49.9 | 0.986** | 0.109 | 0.968** | 0.103 |
| 50-74.9 | 1.697** | 0.114 | 1.714** | 0.105 |
| 75-89.9 | 2.213** | 0.141 | 2.254** | 0.136 |
| 90-100 | 2.834** | 0.156 | 2.920** | 0.163 |
| Indicator | -0.175 | 0.360 | -1.005 | 0.347 |
| R ₂ | -0.249** | 0.122 | -0.684** | 0.155 |
| R ₃ | -0.089 | 0.155 | 0.170 | 0.109 |
| Adjusted R ² | 0.389 | | 0.438 | |
| No. of observations | 3,547 | | | |

A ** indicates that the estimated coefficient is significantly different from zero at the 95% confidence level.

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