Effect of Consumer Characteristics on the Use of Payment Instruments

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Even though predictions about a cashless and checkless society have been made for many years, retail payment transactions made with electronic payment instruments still constitute only a small fraction of all payments made in the United States.[1] The rate of growth of electronic payments is estimated to exceed that of paper checks, but the number of checks written still increases each year, and the transition to electronic payments has been slower than forecasted (Bank for International Settlements 2000).

The slow rate of adoption of electronic payment instruments could be caused by supply-related or demand-related factors. While the literature on the supply side of payment systems in the United States is extensive, relatively few empirical studies analyze the demand side. Several articles have examined the cost structure of individual payment instruments (see, for example, Bauer and Hancock 1995; Bauer and Ferrier 1996; Hancock, Humphrey, and Wilcox 1999), and a few others have compared the costs of various payment instruments. The evidence shows that electronic payments are less costly to process than are paper instruments. For example, previous studies have found that automated clearinghouse (ACH) items and electronic check presentments (ECP) cost less to process than do paper checks (Humphrey and Berger 1990; Wells 1996; Stavins 1997).

Yet despite the differences in cost and despite marketing and educational campaigns conducted by the Federal Reserve and other institutions, the volume of electronic payments constitutes a fraction of the number of check or cash transactions. One of the reasons the cost differences have little effect is that the differences in cost among payment instruments typically are not evident to consumers. For example, even though surveys show that retailers consider credit cards to be a more expensive form of payment than cash (Food Marketing Institute 1998), consumers are charged the same amount regardless of how they pay; even differentiated

gasoline prices, common in the past, have largely been eliminated, either because including the cost of processing payments in retail prices is more acceptable to consumers than differentiated prices, or because it is too costly to employ differentiated prices.[2]

Thus, the reasons for the slow adoption of electronic payment instruments may lie on the demand side. This article examines the effect of consumer characteristics on the use of electronic payments. Employing data from the 1998 Survey of Consumer Finances (SCF), the study evaluates the effect of demographic attributes such as education and income on the probability of using electronic payment instruments. The article begins with an overview of the most common types of payment instruments used by households, such as checks, credit and debit cards, direct deposit, and direct payment. Following a brief summary of market research findings, we estimate the effect of several demographic characteristics on the probability of using various electronic payment instruments. The results show a strong effect of demographic characteristics on consumers' use of payment instruments. And even after controlling for many individual characteristics of the consumers, their location also has a large influence on the use of payment instruments. In particular, the fraction of other people in the region using the same type of payment instrument is highly significant in affecting consumers' usage patterns, suggesting that factors other than demographics are important as well. We employ reduced-form regressions, which do not control for supply-related factors. Therefore the effect of consumer characteristics on their use of electronic payments indicates their *choice* of payment instruments only in the absence of supply-side constraints, such as limited access to credit cards for low-income consumers.[3]

The existing literature suggests that consumers' preferences are not uniform and that demographic characteristics influence consumer choice of payment methods. Using data from the 1995 SCF, Kennickell and Kwast (1997) analyzed the use of various types of payment instruments by households. They found that income, assets, age, and education affect consumers' choice of payment instruments. Carow and Staten (1999) used a survey of consumer gasoline purchases to examine which factors affect consumers' decisions about whether to use cash, credit cards, or debit cards. They found that middle-aged consumers with less education, lower income, and fewer credit cards were more likely to use cash compared to the rest of the sample. Mantel (2000) investigates consumers' decisions about whether to use paper checks or direct debit for bill payments and finds some demographic characteristics important in influencing consumers' choice of payment instruments. Daniels and Murphy (1994) found that ATM usage increases with education and income, while the usage of transaction accounts decreases with age.

Table 1
Volume of Transactions in the United States by Payment Instrument, 1997

Payment Instrument	Volume of Transactions (billions)
Cash [a]	482.3
Check	66.1
Credit Card	16.9
Debit Card	3.9
ATM	11.0
ACH credit (direct deposit)	2.3
ACH debit (direct withdrawal)	1.3
ACH commercial on-us	.9

[a] Cash is measured in billions of dollars (not number of transactions). Because the average cash transaction is very small (most transactions are below $2), the number of cash transactions is higher than the number of check transactions.

Source: Cash, checks, credit card, debit card, and ATM data from Bank for International Settlements (2000); ACH data from National Automated Clearing House Association (http://www.nacha.org).

I. Overview of the Structure of Retail Payments in the United States

This section provides a brief overview of retail payment instruments used in the United States. The U.S. retail payment system is dominated by cash transactions. Table 1 shows 1997 U.S. payment volumes by the type of payment instrument. The 1998 Survey of Consumer Finances reports the 1997 data.

Cash

Statistics on cash transactions are not very reliable, but it is widely believed that cash is still the

[1] Wholesale payments, that is, those exchanged among financial institutions, are not discussed here.

[2] Credit cards are an example of a payment instrument where customer convenience increased demand, leading to a high growth of volume despite higher costs of processing than alternative instruments.

[3] Supply-side constraints have become less important over time. Bird, Hagstrom, and Wild (1999) found that from 1983 to 1995, the percent of low-income families (those with incomes below the poverty line) with at least one credit card more than doubled.

most common payment instrument in the United States. Based on an estimate by Killen and Associates, approximately 100 billion cash transactions occurred in 1995, the vast majority (95 percent) made by households. Even though cash is used more often than any other payment method, cash transactions have the lowest average value. According to a survey done by Dove Associates, 85 percent of respondents stated that their use of cash would drop in the near future.

Cash transactions are relatively inexpensive to process. The Food Marketing Institute (1998) compared the average cost of a retail transaction using various payment instruments in 1997. According to their survey, using cash cost retailers less than other types of payments. However, the cost to consumers of using cash has increased over time because of the increase in the cost of ATM transactions (see Hannan 2001).

Checks

Paper checks are the most popular noncash means of making payments. Despite many predictions to the contrary, the number of checks has been growing each year. However, electronic payments have been growing at a faster rate, and the fraction of payments made electronically is slowly rising. Between 1990 and 1997, the share of household bill payments (such as utilities, telephone, insurance, loans, cable TV, and credit cards) paid by check decreased from 86 percent to 79 percent, while the share paid electronically increased from 4 percent to 9 percent (Chambliss and Taylor 1997).

The exact number of checks written in the United States each year is unknown, but the number is currently estimated to be around 68 billion and growing at about 2 percent a year. More than half of all checks are written by households, compared to approximately 40 percent that are written by businesses (*The Green Sheet Quarterly*). Even though the rate of growth for checks is below that for credit or debit cards, the increase in the number of checks written each year is believed to exceed the increase in the number of all types of electronic transactions combined. In marketing surveys, consumers state that they prefer checks to other forms of payment because of their convenience, acceptance, and float.

Traditional paper check collection involves manual processing, entailing considerable costs for the sorting and transporting of checks, but these costs are not generally passed on to the consumer on a per-item basis. Over the past several years, more checks have been processed electronically. Electronic check processing means that at some point during the collection process, information from a paper check is transmitted electronically as a digital data file or as a digital image. However, the vast majority of checks that are sent electronically continue to be followed by the originals, and thus they still involve the physical sorting and transport of paper.[3]

Credit Cards

Most credit card transactions are conducted using general-purpose credit cards. The other types include store and gasoline company cards. While those who use credit cards cite convenience and float as advantages of the payment instrument, others tend to be afraid of incurring too much debt and prefer debit cards, which prevent them from overcharging. Food retailers consider credit cards to be the most expensive form of payment, with a transaction cost five times higher than the cost of a cash transaction (Food Marketing Institute 1998). Despite the high cost, credit cards have gained in popularity because of strong demand from consumers, who do not directly face differences in transaction costs.

Debit Cards

The number of debit card transactions at the point of sale is small compared to cash and checks. Two types of debit cards are distinguished: on-line (PIN-based) and off-line (signature-based). During an on-line transaction, funds are withdrawn from a cardholder's account, while an off-line transaction resembles a credit card payment, where a cardholder signs a receipt and funds are withdrawn after the transaction takes place. In 1997, there were more off-line transactions than on-line (Faulkner & Gray 2000), even though merchants' fees and risk are higher for off-line debit card payments. Because debit card transactions are similar to credit card transactions, similar factors may affect consumers' choice of the two payment mechanisms, and the two types of cards may be viewed as substitutes. An increase in the prevalence of ATM surcharges and foreign fees has made debit cards more attractive over time, because a debit card allows the user to avoid fees for obtaining cash during a point-of-sale transaction.

[3] A small fraction of checks are stopped at some point during the collection process, or "truncated."

Automated Clearinghouse

The Automated Clearinghouse (ACH) is an electronic payment system typically used for small recurring payments between consumers and businesses, such as automatic payroll deposits or utility bill payments. ACH transactions can be one of two types: credit or debit. A credit transaction, or a direct deposit, is initiated by the payer; for instance, direct deposit of payroll is originated by the employer's bank, which transfers the money to the employee's bank account. A debit transaction, or a direct payment, is originated by the payee; for example, utility bill payments are originated by the utility's bank, which initiates the payment from the customer's bank account.

In 1997, there were approximately 4.5 billion ACH transactions (www.nacha.org). Although the vast majority of ACH transactions were non-government, the fraction of government payments processed with ACH has increased substantially during the last few years as a result of the Electronic Funds Transfer Act, a government regulation that requires that all federal payments be made by electronic funds transfer instead of check. For example, 70 percent of Social Security recipients and 95 percent of government employees used direct deposit in 1997, compared to less than 50 percent of private sector employees.[4] Although ACH has become more common over time, surveys have shown that many people prefer writing and receiving checks rather than having money automatically deposited into or withdrawn from their accounts.

II. Market Research

Market research studies have shown that people have different preferences for using various types of payment instruments. According to the 1998 market research survey conducted by Vantis International for the Federal Reserve Bank of St. Louis, 73 percent of households had at least one payment directly deposited, mainly payroll, Social Security, or pension. The survey indicated that consumers have different tastes and preferences. In particular, the tolerance of risk and the importance of privacy and security varied among consumers. Although some consumers did not wish to enroll for direct deposit of their paycheck, the majority (70 percent) of nonusers claimed that with sufficient incentives (such as free checking or earlier availability of funds) they would sign up. The number of respondents who used direct payment was much smaller—only 37 percent of households had at least one bill paid directly, and the most common direct payment was an insurance premium. Households were more likely to use direct withdrawal for fixed-amount payments (such as a mortgage) than for variable-amount payments (such as utility, telephone, or credit card bills).

Households are more likely to use direct withdrawal for fixed-amount payments such as a mortgage than for variable-amount payments.

Market research studies also show patterns in the use of electronic payments. The focus group study conducted by Shugoll Research for the Federal Reserve Bank of St. Louis in 1998 found that use of various types of electronic payment methods was correlated: ATM and debit card use, as well as PC banking use, was more prevalent among those who use direct deposit than among others. Market research surveys indicate that consumers with similar education, income, and age share similar preferences for payment methods. This study estimates whether and which demographic characteristics affect the choice of payment instruments, while controlling for other relevant variables.

III. Data

We use the data from the 1998 Survey of Consumer Finances (SCF), a survey of U.S. households sponsored by the Board of Governors of the Federal Reserve System and conducted every three years. The survey collects detailed information on family finances, including assets and liabilities, income, and the use of financial instruments. The data allow us to estimate which characteristics are associated with the use of particular payment instruments.

To account adequately for assets held by U.S. households, the SCF oversamples relatively wealthy households that hold a disproportionately large share

[4] NACHA and Federal Reserve Bank of St. Louis (1998). "ACH Market Research." http://www.stls.frb.org/banking/ach.

Table 2
Use of Payment Instruments and Financial Institutions in the SCF Sample, 1997.

Payment Instrument	Percent Who Have/Use It
Check	75.1
Credit Card	72.5
ATM Card	67.2
Direct Deposit	60.5
Direct Payment	36.0
Debit Card	33.8
Smart Card	1.9
Type of Financial Institution	
Any Financial	94.4
Commercial Bank	78.4
Credit Union	34.7
Financial or Loan Company	29.9
Brokerage	28.9
Savings Bank	22.5
How Transactions Are Conducted (most common)	
In Person	75.8
By Mail	51.5
By Phone	39.7
Other Electronic Transfer	7.9
PC or Internet	5.9

Source: 1998 SCF, weighted to be representative of the U.S. population.

of all assets. The 1998 survey interviewed 4,305 families. To deal with missing data, the survey employed the multiple imputation technique, whereby missing data were imputed five times by drawing repeatedly from an estimate of the conditional distribution of the data (for details on the technique, see Kennickell 1998). The technique produces five complete data sets, or implicates. As a result, the 1998 survey data contain 21,525 observations, or five times the number of respondents. All the variable means reported here, as well as the data used in regression estimation below, were adjusted for the imputation technique employed in the survey data and for the relative oversampling of wealthy households in the original data, in order to mirror the underlying population distribution. In general, binary variables were coded as 1 if the answer was "yes," and 0 if the answer was "no." If the answer was labeled "inappropriate," the variable was coded as missing.

Table 2 shows the use of each payment instrument, based on weighted (rebalanced) survey responses. Checks were the most common noncash payment instrument, followed by credit cards. Over 75 percent of respondents used checks, 73 percent had at least one credit card, 67 percent had an ATM card for cash deposit or withdrawal at a cash machine, and 34 percent had at least one point-of-sale debit card. Of the two types of ACH payment—direct deposit and direct payment—the former was more common, consistent with NACHA's statistics. Sixty percent of the sample used direct deposit for at least one type of transaction. The most common use of direct deposit was for paycheck deposit (38 percent), followed by Social Security deposit (21 percent). In contrast, only 36 percent of the sample used direct payment for at least one type of payment, most commonly to pay insurance bills (17 percent). Only 1.9 percent of the respondents had a smart card.[5]

Consumers were asked about the types of financial institutions where they conducted personal business and the ways they typically used those institutions. Respondents could list up to eight different types of institutions. Over 94 percent of the respondents used at least one financial institution, the most common type being a commercial bank (78 percent). Other types of financial institutions included credit unions, brokerages, and savings banks. For each institution, the respondents were asked to list up to eight different ways in which they conducted their business. Three-quarters of the respondents mentioned "in person" as one of the main ways they conducted business with their financial institution. Slightly over half listed "by mail," and almost 40 percent conducted business by phone. In contrast, none of the electronic banking methods compared in popularity to those traditional business interactions. Only 8 percent used electronic transfers (other than cash withdrawals from ATMs) and only 6 percent used any PC or Internet banking services.

IV. Who Uses Electronic Payments?

Previous studies have found that younger, more educated consumers with higher incomes were more likely to use electronic payments. Table 3 shows the percentage of each subgroup that used each type of payment, based on the weighted 1998 SCF sample. Note that the numbers indicate only whether or not a respondent used a particular type of payment instrument, not the frequency of use. The table confirms

[5] Following the SCF definition, smart card is defined here as "a type of payment card containing a computer chip, which is set to hold a sum of money." That type of card can also be labeled a stored-value card.

Table 3
Payment Instrument Use by Demographic Groups

Group Characteristic	ATM	Checks	Direct Deposit	Direct Payment	Debit Card	Credit Card	Other Electronic Transfers	PC or Internet	Smart Card
Age									
17–34	77.1	72.0	50.1	32.3	45.9	63.3	9.7	8.4	3.0
35–54	76.5	77.0	56.7	38.8	37.9	77.1	9.5	6.9	2.3
55 and over	49.0	75.7	72.1	35.1	20.6	73.1	4.6	2.6	.7
Census Division									
New England	71.1	89.2	67.1	35.9	25.1	78.0	7.4	6.4	1.3
Mid-Atlantic	72.2	71.9	55.1	32.2	35.2	72.9	4.6	7.5	1.8
South Atlantic	69.6	76.0	60.7	36.3	34.9	71.7	5.7	4.9	1.9
ES Central	49.5	79.2	55.8	36.4	27.8	61.6	9.1	.6	1.3
WS Central	61.2	74.9	59.2	38.5	32.0	68.1	7.3	8.0	1.4
EN Central	63.0	70.6	62.6	33.2	32.2	75.3	8.1	3.2	2.2
WN Central	62.4	83.2	64.9	39.2	24.7	70.2	11.7	4.2	3.6
Mountain	71.6	76.4	66.2	42.4	39.3	77.0	14.1	7.8	1.5
Pacific	76.2	73.4	59.0	36.5	41.9	75.9	9.0	9.0	1.8
Marital Status									
Single	60.5	67.4	55.9	28.6	28.7	59.6	6.7	3.6	1.6
Married	72.0	81.1	63.7	41.3	37.5	81.7	8.8	7.3	2.1
Income									
Less than $25,000	50.5	62.2	48.1	20.1	22.8	49.4	3.1	1.6	2.2
$25,001 to $75,000	76.3	83.0	66.8	44.6	40.3	84.1	9.2	4.9	1.5
$75,001 or more	82.8	86.6	73.3	51.4	42.5	97.4	16.3	19.0	2.3
Net Worth									
Less than $40,000	64.9	64.3	47.2	24.1	33.3	52.4	6.0	3.3	2.8
$40,000 - $300,000	66.4	82.6	68.6	42.8	35.3	82.3	7.6	5.1	1.3
More than $300,000	74.1	83.5	71.0	46.8	31.3	94.4	12.7	12.9	1.5
Education									
Less than 12 years	40.6	54.7	40.3	18.1	15.4	42.5	1.5	1.1	1.3
12 to 15 years	68.4	77.3	60.7	35.6	35.2	72.8	7.1	3.3	2.0
16 years or more	83.1	85.9	73.6	49.0	43.6	92.3	13.7	13.6	2.1
Homeownership									
Does not own	66.0	63.0	48.5	23.0	32.8	53.1	6.9	4.4	2.1
Owns a home	67.9	82.0	66.8	43.0	34.3	82.8	8.4	6.5	1.8
Job Class									
Does not work	43.7	67.4	64.9	27.1	18.0	59.8	3.8	1.8	.6
Blue-collar	69.1	73.9	48.4	32.0	33.5	68.2	6.0	2.6	2.5
White-collar	83.7	82.8	67.1	46.3	46.3	85.9	12.6	11.4	2.4

Source: 1998 SCF, weighted to be representative of the U.S. population. Entries represent percentages of the population who use a given type of payment instrument.

previous findings that consumers' use of payment instruments varies by demographic characteristics. Regardless of the type of instrument, the fraction of users increased with income or net worth and was higher among homeowners, white-collar workers, people with more years of education, and those who were married, compared to the rest of the sample. Age affects the use of payments differently. Those over 55 were more likely to use direct deposit, probably because of the government regulation to switch Social Security and other federal government payments to electronic transfers. Debit card use was highest among the group ages 17 to 34, while other types of payments were most common among the middle group of 35- to 54-year-olds. New England had the highest fraction of check and credit card users, while

Table 4
Average Demographic Characteristics of Consumers, by Use of Different Payment Methods

Payment Instrument	Use?	Age (Years)	Married (1 = yes 0 = no)	Income ($)	Net Worth ($)	Education (Years)	Own home (1 = yes 0 = no)	Job Class (1 = white-collar 0 = blue-collar)
Whole Sample		48.73	.585	52,295	286,031	13.05	.654	.384
ATM	no	58.29	.533	41,617	292,547	12.03	.723	.208
	yes	45.00	.627	59,676	302,781	13.71	.660	.478
Checks	no	47.84	.450	35,103	188,221	11.87	.479	.268
	yes	49.01	.629	57,905	317,945	13.44	.711	.422
Credit Card	no	47.83	.390	20,035	60,474	11.27	.409	.197
	yes	49.07	.659	64,521	371,508	13.73	.747	.455
Direct Deposit	no	44.55	.568	45,757	252,715	12.56	.603	.351
	yes	51.45	.617	59,304	326,907	13.59	.722	.426
Direct Payment	no	49.01	.556	48,118	277,813	12.78	.618	.341
	yes	48.78	.671	64,599	335,881	13.92	.779	.494
Debit Card	no	52.14	.572	51,319	325,246	12.86	.687	.329
	yes	43.08	.648	59,859	253,379	13.86	.664	.526
Other Electronic Transfers	no	49.55	.598	51,110	280,394	13.10	.682	.381
	yes	43.39	.648	94,505	545,158	14.64	.696	.613
PC or Internet	no	49.45	.593	49,489	273,596	13.10	.680	.377
	yes	42.59	.742	135,174	745,919	15.27	.737	.760
Smart Card	no	48.88	.584	52,301	287,916	13.04	.654	.382
	yes	40.61	.645	51,987	188,507	13.55	.620	.482
Any electronic payment	no	48.25	.358	15,403	44,098	10.20	.369	.118
	yes	48.78	.609	56,226	311,807	13.36	.684	.413

Source: 1998 SCF, weighted to be representative of the U.S. population. Entries are weighted means of each variable.

ATMs and debit cards were most common in the Pacific region.

A comparison between average characteristics of users and nonusers confirms definite patterns. Table 4 shows the averages of the demographic variables discussed above for users and nonusers, for each payment instrument. The average age of those who used electronic payments differed somewhat from the rest, but differences in their financial status were more pronounced. On average, people who used ATMs and debit cards were younger than others, but the reverse was true for those who used direct deposit or credit cards. However, users of any payment instruments were wealthier than nonusers, whether measured by their annual income or net worth. In particular, those who did not use any electronic payments (next to bottom row) had an average annual income of $15,400, compared to $56,200 for those who used at least one type of electronic payment. The average net worth figures for the two groups were $44,000 and $312,000, respectively. As above, electronic payments included ATMs, direct deposit, direct payment, debit card, credit card, electronic transfers, and PC or Internet banking.

V. Regression Analysis

We applied regression analysis to isolate the effects of individual characteristics on people's likelihood of using specific payment instruments, when other attributes are held constant. We constructed a dummy variable indicating whether or not a respondent used any type of electronic payment or electronic banking method (ATMs, direct deposit, direct payment, debit card, credit card, electronic transfers, and PC/Internet banking). We also constructed a discrete variable equal to the number of electronic payment instruments the respondent used.

We estimated the following equation using logit regressions:

electronic = $\beta_0 + \beta_1$ income + β_2 networth + β_3 age + β_4 education + β_5 female + β_6 homeowner + β_7 married + β_8 family + β_9 employment + $\bar{\beta}$ census + ω (1)

where:

electronic	equals 1 if the respondent uses any type of electronic payments;
income	is the respondent's annual household income;
networth	is the respondent's household net worth;
age	is the respondent's age;
education	equals 1 if the respondent has less than high school education, 2 if the respondent has at least high school but less than college education, and 3 if the respondent has at least college education;[6]
female	equals 1 if the respondent is a female, 0 if a male;
homeowner	equals 1 if the respondent's family own their house or farm;
married	equals 1 if the respondent is married;
family	is the number of people in the respondent's household;
employment	is the type of employment: 0 for unemployed, 1 for blue-collar workers (including production, transportation, and farming), and 2 for white-collar workers (including professional, technical, and administrative occupations);
census	is a set of dummy variables denoting each of the nine Census divisions but one;
β	are coefficients to be estimated; and
ω	is a random error term.

The above equation was also estimated for each type of electronic payment separately: for ATMs, debit cards, credit cards, smart cards, direct deposit, direct payment, other electronic transfers, and PC/Internet banking. In each case, a 0-1 dummy variable indicating whether the respondent used a given payment instrument was used as the dependent variable.

To compensate for unequal probabilities of selection of households, we applied weighted logit regressions. The weights, provided in the SCF data, are equal to the inverse probability of observing each case, based on a comparison of each surveyed household to aggregate control totals estimated from the Current Population Survey.[7]

The regression results are reported in Table 5. Because we use logit estimation, the estimated coefficients are interpreted according to the following formula:

$$\Delta \log \frac{P}{1-P} = \beta \Delta x, \quad (2)$$

where P is the probability of using the given electronic payment instrument, β is the estimated coefficient, and x is the variable whose effect we are trying to evaluate. Rewriting the above equation, the effect of an increase in x by 1 is:

$$\Delta P \approx \beta[P\,(1-P)]. \quad (3)$$

In addition to the logit regressions, the number of different types of electronic payment instruments used by a respondent was estimated as a function of the same set of demographic characteristics.

In general, white-collar workers who had higher income or education, were married, or owned their home were more likely to use almost any type of electronic payment. Some specific results are described below.

Income

Evaluated at the mean, increasing household income by $10,000 raised the probability of using any electronic payments by 2.7 percentage points. Higher income had an especially strong positive effect on the probability of using credit cards, but it was also found to raise the likelihood of using ATMs, direct deposit, PC or Internet banking, and other electronic transfers.

Net Worth

Contrary to Kennickell and Kwast (1997), when controlling for income and job classification, greater net worth was found to lower the probability of using some electronic payments, and it was not statistically significant in the case of others. Only in the case of

[6] When education was measured as the number of years completed by the respondent, the results were qualitatively similar, but the variable used here provided a better fit.

[7] For a summary description of the weights provided with the 1998 SCF data, see http://www.federalreserve.gov/pubs/oss/oss2/98/codebk98.txt. For more details, see http://www.federalreserve.gov/pubs/oss/oss2/method.html (Kennickell and Woodburn 1997 and Kennickell 1999).

Table 5
Weighted Logit Regressions of Electronic Payments Use as a Function of Demographic Characteristics

Demographic Characteristic	Any Electronic Payments	ATM Card	Debit Card	Credit Card	Direct Deposit	Direct Payment	Smart Card	Other Electronic Transfers	Personal Computer/ Internet
Income	.00004	3.62E-07	1.61E-07	.00003	6.71E-07	1.29E-07	1.45E-08	7.26E-07	1.38E-06
	(13.06)	(2.45)	(1.36)	(21.29)	(3.52)	(1.36)	(.67)	(4.49)	(5.04)
Net Worth	9.46E-07	–1.78E-08	–6.79E-08	4.68E-07	–3.96E-08	–4.68E-08	–1.04E-07	–1.51E-10	–2.91E-08
	(1.65)	(–3.06)	(–4.47)	(2.37)	(–4.51)	(–4.52)	(–1.78)	(–0.02)	(–2.24)
Age	.009	–.037	–.027	.0084	.028	.005	–.029	–.019	–.026
	(4.13)	(–22.80)	(–18.54)	(4.91)	(19.58)	(3.63)	(–5.20)	(–7.91)	(–8.17)
Education Level (1, 2, or 3)	1.115	.613	.389	.899	.690	.494	.011	.669	.951
	(18.51)	(18.23)	(12.19)	(22.40)	(21.54)	(15.95)	(.10)	(12.23)	(12.09)
Female (1=female, 0=male)	.331	.099	–.061	.114	.392	.088	.106	.053	–1.236
	(3.80)	(1.48)	(–1.01)	(1.75)	(6.63)	(1.44)	(.58)	(.55)	(–8.84)
Home Ownership (1=yes, 0=no)	.475	–.084	.107	.809	.181	.663	.032	.139	.352
	(5.54)	(–1.72)	(2.37)	(15.06)	(4.22)	(14.95)	(.22)	(1.79)	(3.84)
Marital Status (1=married, 0=single)	.603	.394	.230	.625	.601	.333	.281	.090	.203
	(6.12)	(5.79)	(3.78)	(8.60)	(9.89)	(5.48)	(1.68)	(.88)	(1.83)
Number in Family	–.125	–.045	.0004	–.150	–.059	.017	–.022	–.006	–.228
	(–5.32)	(–2.44)	(.03)	(–8.00)	(–3.83)	(1.12)	(–.49)	(–.19)	(–6.18)
Business Ownership (1=yes, 0=no)	.457	–.275	–.228	.445	–.640	–.084	.129	.313	.418
	(2.38)	(–4.41)	(–4.21)	(4.64)	(–11.96)	(–1.58)	(.70)	(3.93)	(4.63)
Job Classification (0=unemployed, 1=blue-collar, 2=white-collar)	.406	.365	.269	.285	.061	.288	.290	.243	.560
	(8.02)	(11.85)	(9.25)	(8.20)	(2.13)	(10.28)	(3.06)	(4.66)	(7.41)
Intercept	–1.313	1.164	–1.110	–3.046	–2.687	–2.999	–3.520	–3.780	–4.433
	(–4.24)	(7.27)	(–7.75)	(–16.74)	(–18.10)	(–20.68)	(–7.46)	(–15.70)	(–15.25)
Census Dummies?	yes	yes	yes	yes	yes	yes	yes	yes	yes
Log Likelihood	–4970	–10468	–12318	–8982	–12495	–12891	–1945	–5444	–3879
Chi-squared	1461.90	2300.37	1332.11	2590.16	1373.77	1093.92	98.35	707.12	951.53
No. of Observats.	21,525	20,693	20,693	21,525	20,693	20,693	21,525	20,535	20,535

The dependent variables are dummy variables equal to 1 if the respondent uses a given payment instrument, and 0 if he does not.
t-statistics in parentheses.
Source: Author's calculations.

credit card use was higher net worth found to have a positive and statistically significant effect.

Age

Even though younger respondents were found to be more likely to use some types of electronic payments, the effect varied by payment method. Younger consumers had a significantly higher probability of using ATMs, debit cards, computer banking, and smart cards, but were less likely to use credit cards, direct deposit, or direct payment. The overall effect of age on the probability of using any type of electronic payment was positive.

Education

Increasing education by one level (see the variable definition above) was estimated to raise the probability of using any type of electronic payment by 7.6 percentage points. Higher education increased the probability of using every type of payment except for smart

cards, for which the effect was also positive, but statistically insignificant. The effect was especially strong in the case of credit cards and computer banking.

Gender

Women were found to have a 2-percentage-point higher likelihood of using any type of electronic payment, although the effect was strong only in the case of direct deposit. Men had a substantially higher probability of using computer banking. Gender was not statistically significant in other regressions.

Homeownership

Homeowners had a 3.2 percent higher probability than renters of using any type of electronic payment, even after controlling for income and net worth. In particular, homeowners were more likely to use credit cards, direct deposit, and direct payment. This result could be expected given that direct payment is commonly used for paying mortgage and utility bills, while credit cards are used to pay for the large-ticket items homeowners buy.

Marital Status

Married people were significantly more likely to use almost every type of electronic payment than single respondents, even after controlling for age, income, and homeownership. A married respondent was found to have a 4 percent higher probability of using any type of electronic payment, and the effect was even higher in the case of credit cards and ATMs: Married consumers had an 11 percent higher probability of having credit cards and an 8 percent higher probability of using ATMs than did single persons.

Family Size

Larger households were less likely to use electronic payments, although the effect was small—a household with one additional family member had a 0.9 percent lower probability of using electronic payments than a household with fewer members. The effect was greater in the case of direct deposit, credit cards, and computer banking, where the difference in probability was over 2 percent.

Business Ownership

The effect of business ownership on the personal use of electronic payments was mixed. Business owners were 9 percent more likely to use credit cards or computer banking and 6 percent more likely to use other types of electronic transfers, but 7 percent less likely to use ATM cards and 15 percent less likely to use direct deposit, possibly because direct deposit is usually used to deposit paychecks for corporate employees or Social Security payments for retirees. The survey responses described personal and not business use of payment instruments.

Job Classification

White-collar workers—defined as those working in managerial, professional, or technical specialties—were found to have a higher likelihood of using every type of electronic payment than blue-collar workers and those who were unemployed, even after controlling for income and education. The effect was most pronounced in the case of computer banking, where white-collar workers were 3 percent more likely to use PC or Internet banking than blue-collar workers, and blue-collar workers than those who were unemployed. For any type of payment, white-collar workers were estimated to have a 2 percent higher likelihood of use than blue-collar workers.

Consumers' use of payment instruments varies by demographic characteristics, with younger, more educated consumers with higher incomes more likely to use electronic payments.

Location

Even after controlling for the demographic characteristics described above, geographic location matters—residing in certain Census divisions was associated with a lower probability of using electronic payments compared to New England, the omitted division. We analyze the significance of location below.

Even though the results presented above confirm certain aspects of "conventional wisdom"—namely that younger and more educated consumers are more

likely to use electronic payments than older or less educated ones—the effect of demographic characteristics on the use of electronic payments is not uniform. To avoid broad generalization, the effect of each attribute has to be measured while controlling for all other factors. The results show that consumers have heterogeneous tastes and preferences. Any policy designed to "convert" payment habits from checks to a particular type of electronic payment is likely to be more successful with the demographic group that already favors that type of payment than with the population at large.

VI. Network Externalities

There are at least two possible reasons why the volume of electronic payments has not grown as fast as early forecasts predicted. The first one is related to cost differences: Although some electronic payments are less costly to process than paper checks, the comparison is between the marginal costs of processing a paper check and an electronic transaction. Banks already have an infrastructure to process paper checks, while they often have to bear large fixed costs in establishing a new infrastructure to process electronic transactions. The second reason is related to demand: We showed that consumers' demand for different types of electronic payments varies with demographic characteristics. But there could be still another reason why the use of electronic payments has not grown faster, namely, network externalities.

A good or a service is characterized by a network externality when an increase in the number of users of the good increases the value to other users, regardless of price or other characteristics of the good. Electronic payments have some characteristics of network industries—consumers or businesses conducting a transaction have to agree on the method of the payment, and their financial institutions have to coordinate technologies and standards. There is some evidence that network externalities exist in electronic payments.[8] People are more likely to use debit cards or direct deposit the more others in their "network" use them. Depending on the type of payment instrument, the network may include residents of a city or another geographic area, or employees of a single organization.

As was mentioned above, the use of electronic payment instruments varies by geographic region. Table 3 shows the percentages of respondents in each of the nine Census divisions who use each type of electronic payment instrument. Although the vast majority of respondents in each division use some type of electronic payments, the differences across areas in the use of specific types of payments are substantial. For example, while less than half of respondents in the East South Central division own ATM cards, over three-quarters of respondents in the Pacific division do. The Pacific division also had the highest fractions of debit card and computer banking users—the former 70 percent higher and the latter ten times higher than the division with the lowest fraction of users. New Englanders had the highest probability of using any electronic payment, and New England dominated other divisions in the use of direct deposit and credit cards.

One way to test for the presence of network externalities is to test whether a given payment instrument is more widely used in areas with more users, controlling for all the other characteristics of the service. We test whether the probability of using a payment instrument is affected by the fraction of people using that instrument in the region, controlling for demographic characteristics of consumers (following Goolsbee and Klenow 1998). However, the only information on geographic location of the respondents is their Census division, an area larger than that where network externalities are likely to exist.[9] Because of the data limitations, our test is very crude—it is unlikely that people would be affected by the payments habits of others residing in such a broad geographic area.

For each type of electronic payment discussed above, we estimated a logit regression of whether or not the payment instrument is used (equation 1), but instead of Census dummy variables, we included the fraction of respondents in the respondent's Census division that use the same instrument. In each case, the estimated coefficient on the fraction was positive and statistically significant. Moreover, the effect was large compared to the effect of the demographic variables, although the remaining coefficients did not change substantially. Even after controlling for demographic characteristics, location affects consumers' usage of payment instruments.

[8] For a discussion of network effects in payments markets see Roberds (1998), Weinberg (1997), Osterberg and Thomson (1998), and Gowrisankaran and Stavins (1999).

[9] To test for network externalities among financial institutions, Gowrisanakarn and Stavins (1999) assumed that a network is an area within 30 kilometers of each bank or all banks within the same MSA or non-MSA county.

Table 6
Estimated Effect of Others' Payment Habits on Own Use

Payment Instrument	(1) Probability of Use[a]	(2) Estimated Coefficient	(3) Estimated Effect of a 1% Increase in the Fraction of Users on Probability
Any Electronic	.951	7.683	.0036
ATM	.774	2.941	.0051
Debit	.367	3.364	.0078
Direct Deposit	.590	3.501	.0085
Direct Payment	.408	5.282	.0128
Credit Card	.834	3.748	.0052
Smart Card	.023	51.932	.0117
Other Electronic Transfer	.137	12.548	.0148
PC/Internet	.106	20.584	.0195

[a] The probabilities are based on the same sample that was used in corresponding regressions, that is, observations with any missing values are omitted.
Source: Author's calculations.

How important are the habits of others to the respondents' own use of payment instruments? Table 6 shows the probability of using each type of payment for the sample (column 1), the estimated coefficient on the fraction of residents of the respondent's Census division who use the same payment instrument (column 2), and the effect of that variable on the probability of using the payment instrument computed using equation (3) (column 3).

The estimated network effects on payment use can be substantial. For example, if two people with identical demographic characteristics live in two different Census divisions (A and B), and division A has a 1 percent higher fraction of people using computer banking than division B, the person living in A is estimated to have a 2 percent higher likelihood of using computer banking than the person living in B.

The data provide no information about the causes of those disparities. Although some of the differences may arise from demand-related network effects, they are also likely to be caused by supply-related factors such as institutional setups, technology adoption decisions by local banks, payment options offered by employers, availability of debit and credit card payment options in supermarkets, or average distances to the nearest bank. On the demand side, network effects include informational effects. Because electronic payments are technologically intensive, they may be characterized by informational networks, where the value of the good increases with more users because user familiarity lowers costs. Although we cannot distinguish between supply-related and demand-related causes, we find that location affects consumer choice of various payment instruments after controlling for individual demographic characteristics. We cannot rule out the possibility that network externalities in electronic payments exist, even though further information on the supply side would be necessary to verify the hypothesis.

VII. Conclusion

Despite lower costs of processing, electronic payments constitute only a fraction of all retail payment transactions in the United States. The reasons for the slow adoption of electronic payments may lie on the demand side. While most of the literature on the use of retail payment instruments focuses on the cost side, few studies evaluate the demand side. Using the 1998 Survey of Consumer Finances data, this article analyzes the effect of demographic characteristics on the use of various electronic payment instruments.

We show that consumer preferences for payment instruments vary. The likelihood of using different payment instruments varies with attributes such as income, education, and marital status. Regression results show the effect of individual characteristics on the probability of using each type of payment instrument, while controlling for all other variables. Even after controlling for demographic attributes, where consumers live has a significant effect on the use of payment instruments. In particular, others' habits influence respondents' own use of payment instruments. The importance of location may indicate demand-related network effects, although further analysis of the supply side would be needed to test that hypothesis.

The results show that the effects of demographic characteristics on the use of electronic payments are not uniform. Any policy designed to "convert" payment habits from checks to a particular type of electronic payment is likely to be more successful with the demographic group that favors that type of payment than with the population at large.

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