

# Why Are (Some) Consumers (Finally) Writing Fewer Checks? The Role of Payment Characteristics

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**Abstract:** Since the mid-1990s, the U.S. payment system has been undergoing a paper-to-electronics transformation featuring a significant decline in paper checks that has been quite uneven across consumers. The timing, magnitude, and unevenness of the payments transformation have been surprising, and the future direction of payments is quite uncertain, largely because of a lack of data and research on *why* agents choose payment instruments. This paper provides econometric estimates of reduced-form models of consumers' adoption, use, and change in use of checks plus six other common U.S. payment instruments using a comprehensive new data source on consumer payment choice with unique information about payment characteristics. Cost, convenience, timing, recordkeeping, and the like are more important determinants of payment choice than demographics or determinants of money demand.

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## 1. Introduction

Two main facts about checks motivate this paper. First, paper check use in the United States (finally) is declining. After a long history of steady increase, aggregate U.S. check volume from all sources – consumers, businesses, government, etc. – declined 38 percent from 1995 to 2006, according to the best data available (see Gerdes and Walton 2002, Gerdes, Liu, Parke, and Walton 2005, and Federal Reserve System 2007). A decline in check use had been predicted at least since the 1960s, and one forecast declared that, “Between 1989 and 1994, personal check volume should decline sharply...” (Federal Reserve Bank of Atlanta, 1983, p. 5). Although the decline was not surprising, the (late) timing, the magnitude, and the swiftness of it were. And while further declines are likely, the path of decline remains uncertain.

A second fact is that (some) consumers are writing fewer checks. Between 2003 and 2006 – while aggregate check volume declined 16 percent – only 31 percent of U.S. consumers reduced their check use, and a scant 0.4 percent stopped using checks, according to new data from the 2006 Survey of Consumer Payment Choice. During this era of supposed check demise, 19 percent of consumers actually reported *increasing* their check use. Unfortunately, the Federal Reserve aggregate check data do not offer hard estimates of check use by consumers only. Thus, one cannot ascertain whether consumer check use declined about 5 percent (31 percent of 16 percent), or the one-third of consumers who reduced their check use cut it by about 48 percent (= 3 times 16 percent), or some other combination of factors prevailed.

The reduction in U.S. check use is being matched by an increase in the adoption and use of newer electronic payment instruments, creating a phenomenon often referred to as the “paper-to-electronics transformation,” or “payments transformation” for short.<sup>1</sup> Many aspects of the payments transformation are not well understood. Why did it begin in the mid-1990s and not earlier (or later)? Why did check volume decline as much and as fast as it did, rather than more or less or faster or slower? How much more will check volume decline, and what payment instruments will dominate in the coming years? And why are only one-third of U.S. consumers writing fewer checks, especially given that checks are so costly relative to other payment

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<sup>1</sup> Cash (currency and coins) often is included in characterizations of this transformation, but there is even less hard data on the use of cash than on the use of checks.

instruments?<sup>2</sup> These questions are vitally important for the Federal Reserve and U.S. payment system.<sup>3</sup> But answers have been elusive.

One reason the payments transformation is not well understood has been a lack of research on consumer behavior and payment choice, as argued by Schreft (2006) and Benton, Blair, Crowe, and Schuh (2007).<sup>4</sup> For example, as of 2006 fewer than 5 percent of the entries in the “Consumer Payment Bibliography” (Federal Reserve Bank of Philadelphia) were studies with theoretical or empirical work focusing on *consumer* payment demand. Another reason has been a lack of comprehensive and publicly available data on consumer payment choice, as explained in Carten, Littman, Schuh, and Stavins (2007). Since the payments transformation began, some new research and data on payments behavior have emerged.<sup>5</sup> But they have primarily improved our understanding of *how* consumers pay and *what types* of consumers make those payments. Much less is understood about *why* consumers choose their payments instruments.

This paper attempts to determine why (some) consumers are (finally) writing fewer checks by estimating an extensive system of reduced-form econometric models of payment choice. Following common practice in the literature, we specify models of payment adoption (extensive margin) and payment use (intensive margin).<sup>6</sup> However, our econometric models extend the literature in two dimensions. First, we estimate models of both adoption and use for all payment instruments, where use is the number of payments per month rather than a qualitative measure, as well as the change in use from 2003 to 2006. Second, we estimate adoption and use simultaneously using the first Heckman (1976) selection model applied to consumer payment choice, which controls for potential selection bias in payment use.

Our econometric estimation also extends the literature by using a comprehensive new data source with unique information on the characteristics of U.S. payment instruments. The 2006 Survey of Consumer Payment Choice (SCPC) was sponsored by the AARP and it contains

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<sup>2</sup> Garcia Swartz, Hahn and Layne-Farrar (2006) suggest that the marginal cost to consumers is highest for cash and check, while marginal benefits are similar across payment methods. Social marginal costs of checks and cash have also been estimated to exceed those of credit or debit cards (Hancock and Humphrey 1998). [ADD NEW CITES]

<sup>3</sup> Declining check volume has severely affected the business operations of the Federal Reserve, which reduced its check processing sites by 51 percent and total employment by 15 percent through 2006 (for more details, see Benton, Blair, Crowe, and Schuh 2007).

<sup>4</sup> For more details, see the Consumer Behavior and Payment Choice conferences sponsored by the Federal Reserve Bank of Boston in 2005, 2006, and 2008 (<http://www.bos.frb.org/economic/eprg/conferences.htm>).

<sup>5</sup> The payment studies by the Federal Reserve are one important example (see Gerdes and Walton 2002, Gerdes, Liu, Parke and Walton 2005, and Gerdes.... 2008). Private industry firms have also contributed (see CITATIONS...).

<sup>6</sup> For examples, see Stavins (2001), Mester (2003), Hayashi and Klee (2003), and Zinman (2007).

data on the adoption and monthly use of checks plus six other U.S. payment instruments, as well as an extensive list of variables on consumer characteristics. The SCPC also includes consumers' assessments of seven payment characteristics: cost, convenience, safety, privacy, accuracy, timing, and recordkeeping. All data are obtained from the same random sample of 1,500 U.S. consumers age 25 and up. Together the data form a more comprehensive source of information on consumer payment choice than was previously available.

Perhaps the most novel feature of our econometric work is the investigation of the role of payment characteristics in consumer payment demand. Although we are not the first to include payment characteristics, our models are more comprehensive and our characteristics data are more objective and well measured than previous studies. Carow and Staten (1999) limited their sample to consumers with payment cards, Klee (2006b) lacked data on individual consumer demographics, and Borzekowski, Kiser and Ahmed (2008) included only a very limited set of payment characteristics in studying one payment method (debit cards). Jonker (2005) took a substantively different approach, modeling consumer payment choice using consumer attitudes and perceptions about payments, which are less objective and measurable than payment characteristics and pose even more serious econometric problems.

We find that payment characteristics, along with the number of payments instruments held by consumers, are the most important determinants of the cross-section variation in consumer payment use.<sup>7</sup> Like previous studies, we also find roles for some demographics and income-related variables in the determination of payment instrument use, but these variables are economically and statistically less significant than the payment characteristics. Our results are robust to instrumental variables estimation that controls for potential simultaneity and/or errors-in-variables biases, which might be associated with the inclusion of payment characteristics.

Convenience is the most important determinant of check and other payment instrument use. Although commonly used, "convenience" is not well defined and requires more research. Cost, recordkeeping, and timing are also important determinants of check and other payment use. A key factor driving the success of payment characteristics is that payment demand is far more heterogeneous within demographic groups than across them, and consumers' assessments of the characteristics explain a significant portion of that variation within groups.

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<sup>7</sup> Kim, Widdows and Yilmazer (2006) obtain qualitatively similar results for internet banking with a more limited set of payment characteristics.

## 2. The Payments Transformation

Figure 1 plots check volume per capita in the United States since 1970 using the best available data. The bars represent total U.S. check volume, and the line represents the core volume of U.S. checks processed by the Federal Reserve only.<sup>8</sup> After rising for approximately 25 years, total U.S. check volume finally began to decline from 186 per person in 1995 to 149 in 2000 (about 25 percent).<sup>9</sup> However, because publicly available, high-quality, high-frequency data on aggregate U.S. check volumes were generally not available before the payments transformation, the estimated decline in check volume was not revealed until 2002 and the exact timing of the underlying trend remains unclear (Gerdes and Walton 2002; Gerdes, Liu, Park, and Walton 2005). Since this announcement, the Federal Reserve has stepped up its estimation of check volumes to every three years, and recently reported a further decline in check volume to 102 per person in 2006 (Federal Reserve 2007).

The volume of checks processed by the Federal Reserve continued to increase through the early 2000s in absolute terms, but began declining in the mid-1990s in per capita terms as well. Figure 1 plots the core Fed volume, which excludes a small portion of highly volatile check processing (see Benton, Blair, Crowe, and Schuh 2007). Although data on core Fed check volume were readily available in real time on a quarterly basis, the Federal Reserve only processes less than half of total U.S. check volume. Therefore, the core Fed check volume could not provide a fully representative picture of aggregate trends in U.S. check volume.

Although checks remain the single most common form of non-cash retail payment, the long-awaited paper-to-electronics transformation is under way and electronic payments together now account for the majority of non-cash payments. According to the Federal Reserve System (2007), the share of checks dropped from 60 percent of all non-cash retail payment transactions in 2000 to 45 percent in 2003 and to 33 percent in 2006; thus the number of electronic retail payments now exceeds the number of checks. To make more electronic payments, consumers are adopting alternative instruments, such as debit cards, bank account deductions via the Automatic Clearing House (ACH) network, and online bill payment, as shown in Figure 2.

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<sup>8</sup> This core processed volume excludes a small proportion of highly variable checks that were affected by special factors; for more details, see Benton *et al* (2007).

<sup>9</sup> As a share of GDP, however, check volume has been declining steadily throughout this period. Thus, assuming no change in the average inflation-adjusted dollar value per check, the use of checks as payment method has been declining for much longer than the volume of checks.

While the adoption of checks and credit cards (traditional payment instruments) remained flat from 1995 to 2004, consumer adoption of debit cards, ACH payments, and online bill payments jumped significantly.

### **3. Literature Review**

Although the literature on the supply side of payments is fairly extensive, little research has been done on the demand side for payment methods. Data on individual consumer payment behavior are especially difficult to obtain.<sup>10</sup> Several papers analyzed the effects of individual consumers' socio-demographic characteristics on the adoption of payment methods (Stavins (2001), Bertaut and Haliassos (2005), Kim, Widdows and Yilmazer (2005), Klee (2006a), Zinman (2007)) or showed adoption rates by demographic cohort (Mester (2003, 2006), Anguelov, et al. (2004)). Those studies use the Survey of Consumer Finances data and find strong effects of demographic characteristics on the adoption of payments. Although the SCF contains a set of questions on consumers' *adoption* of payment methods, it has very limited information on the *use* of payments and on what affects consumers' payment behavior.

Amromin, Jankowski and Porter (2007) used data on actual consumer behavior and found that both income and education were significant in estimating adoption of the electronic tollway payment device in Illinois. A few researchers used proprietary data to explore consumer payment behavior. Rysman (2007) used consumer transaction data from Visa's Payment Systems Panel Study and found demographic attributes to be largely insignificant in predicting the choice of credit card network. Fusaro (2008) found age and income to be significant in debit card adoption using proprietary data on consumers' accounts held at a single small depository institution. In general, debit and online payment adoption and use were found to increase with age, while credit adoption tends to increase with income.

Demographic attributes were found to influence consumer payment behavior, but heterogeneity in payment behavior within demographic groups can be large (see Benton, Blair, Crowe and Schuh 2007) and substantial part of the variation in consumer payment use remains unexplained. Therefore including the characteristics of the payment methods and consumer

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<sup>10</sup> Some studies estimate payment method use or adoption using *country*-level data, such as Amromin and Chakravorti (2007), Humphrey, Kim and Vale (2001), and Humphrey, Pulley and Vesala (1996). However, heterogeneity within each country can be substantial and one cannot infer what payment or consumer characteristics induce specific payment behavior based on aggregate international comparisons.

perception of those methods could supplement or even replace the effect of demographics. A number of researchers used other sources of data to examine the effect of payment characteristics and consumer perceptions on payment behavior.

Anguelov, Hilgert, and Hogarth (2004) showed that the use of electronic banking technologies varies with consumers' perception of electronic banking. Kim, Widdows and Yilmazer (2005) showed that adoption of Internet banking is more likely among consumers who have good computer skills, are experienced with other banking technologies, or work in occupations related to the computer or Internet. Similarly, Hayashi and Klee (2003) found that consumers who used computers were more likely to adopt debit cards or electronic bill payments.

Carow and Staten (1999) estimated the effect of demographic characteristics and selected attributes of payment methods on consumers' choice of payment method at gasoline stations. Age, education, and income had significant effects on payment choice. Payment characteristics, namely convenience, record keeping and acceptance, were also found to have a positive effect on payment choice. However, their sample included cardholders only, and the questions were limited to cash, credit and debit use at gasoline stations.

Jonker (2005) used a survey of Dutch consumers and found consumers' perceptions of payment methods to be important in payment use. Differences in those perceptions were more important than payment location in explaining differences in payment choice among the Dutch consumers. Jonker regressed consumers' perceptions of payment methods, such as speed, cost and safety, on a set of socio-demographic variables. In most of the regressions, the estimated  $R^2$  was below 0.01, indicating that demographic characteristics do not explain differences in consumers' perception of payments.

Klee (2006b) examined what affected consumers' choice between checks and debit cards at grocery stores. Speed and cost of transaction, record keeping, value and type of purchase were found to be significant. Although both transaction and payment method characteristics turned out to be significant in payment choice, the data had no demographic information on individual consumers, and therefore it is impossible to predict whether payment characteristics would remain significant when individual consumer demographic data were included in the estimation. Mantel (2000) explored the effect of consumer preferences on the adoption of electronic bill payment, using the results of a national survey. He found that consumer perceptions of control,

record keeping, convenience and privacy affected consumers' adoption of electronic bill payment.

In two of the very few papers that address the question *why* consumers use or do not use certain payment methods, Borzekowski and Kiser (2007) and Borzekowski, Kiser and Ahmed (2008) used a survey conducted as a special unit of the Michigan Survey of Consumers in 2004. They estimated debit card adoption and use as a function of socio-demographic characteristics of consumers, but also used open-ended responses to analyze the reasons why consumers choose to use or not to use debit cards. Convenience was the main reason to use debit cards, with cost, speed and restraint from spending mentioned as secondary reasons. Although they estimated consumers' preferences with respect to a few characteristics of payment methods—speed; electronic versus paper; and liquidity versus debt—the survey did not fully explore the attributes of various payment methods and thus did not allow for a complete analysis of consumer payment behavior.

Ching and Hayashi (2006) used the 2005 Dove Consulting/ABA survey data to estimate the effect of demographic attributes and consumers' perceptions of payment methods on payment adoption and use. When perceptions of payment methods were included in the regressions, the fit improved substantially and demographic attributes became less significant.

The empirical results in the literature show that both socio-demographic attributes and payment method characteristics affect consumer payment behavior. However, none of the papers cited above include a comprehensive set of payment methods or a broad set of payment method characteristics. The contribution of our paper is to include a wide range of payment characteristics in empirical estimation of payment method adoption and use.

#### **4. Models of Payment Demand**

This section describes the models of payment demand and econometric issues associated with them. First, we provide some theoretical intuition to motivate the reduced-form approach to deriving demand equations for payment instruments. Next we summarize the Heckman (1976) selection model used to characterize consumers' joint decisions to adopt (extensive margin) and use (intensive margin) payment instruments, and the qualitative model of change in payment use. The remainder of this section describes the payment instrument characteristics and our instrumental variables estimation to control for potential endogeneity of the characteristics.

#### 4.1. Intuition from Monetary Theory

The comprehensive scope of the *Survey of Consumer Payment Choice* permits estimation of demand models for seven common U.S. payment instruments: cash ( $CS$ ), paper check ( $CK$ ); debit card ( $DC$ ); credit card ( $CC$ ); stored-value card ( $SVC$ ); automated clearing house ( $ACH$ ) payments; and online banking bill payments ( $OB$ ).<sup>11</sup> Following the literature, we appeal to intuition from models of money demand for guidance on specifying reduced-form models of the demand for payment instruments and combine them with the insights of the applied payments literature summarized earlier.

To begin, consider the relation of the payment instruments to the definitions of money.<sup>12</sup> The classic simple definition of money is  $M1 = CS + DD$ , where  $DD$  denotes demand deposits held at depository institutions.<sup>13</sup> Thus, cash is money by definition. The dollar value stored on a stored-value card essentially is like a form of electronic cash for consumers (although it is likely held in a business demand deposit account), and thus reasonably classified as cash from the perspective of consumers.

Although demand deposits are money, the payment instruments used to access the deposits – checks, debit cards, and the two electronic payments ( $ACH$  and  $OB$ ) – are not. Rather, these instruments probably are better viewed as technologies that provide access to money (demand deposits). It is well known that credit cards are not money. However, nearly half [CHECK] of all consumers who have a credit card use it primarily for payments and do not carry over (or “revolve”) unpaid credit card debt between months (for more details, see Sprenger and Stavins 2008). Thus, non-revolvers essentially use their credit cards like a modified debit card with up to 30 days of free float. To summarize, two payment instruments are money ( $CS$  and  $SVC$ ) while the remaining five are technologies that provide access to money (demand deposits) and facilitate monetary exchange.

The literature does not offer a fully-specified, structural theoretical model of the simultaneous demand for all seven types of payment instruments we consider, but studies with multiple payment instruments provide some guidance. General models of demand for multiple

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<sup>11</sup> Although data are available on the adoption and use of money orders, data are not available for debit card characteristics so money orders are not included in the analysis.

<sup>12</sup> Another way to classify payment instruments is by physical characteristic: Paper ( $CS$ ,  $CK$ ); cards ( $DC$ ,  $CC$ ,  $SVC$ ); and electronics ( $ACH$ ,  $OB$ ). For more details, see Schuh (2008).

monetary assets are found in Barnett, Fisher, and Serletis (1992) and Rotemberg, Driscoll, and Poterba (1995), but these abstract from the specific details of payment instruments. Most theoretical models focus on the choice of allocating resources between the two main monetary assets, cash and demand deposits, with some degree of specificity about the type of demand deposit access. Examples include Whitesell (1989), which examines the role of transaction costs with “debitable accounts,” and He, Huang, and Wright (2006), which examines the role of safety (from theft) with checks.

In each case, these theoretical models introduce money into the consumers’ optimization problem either directly through the utility function (money-in-utility, or MIU) or through the budget constraint (cash-in-advance, or CIA). Monetary assets are distinguished by differential rates of return (costs of capital) or by differential characteristics (physical or other). The demand for monetary assets is derived in the usual fashion and depends on monetary rates of return, consumer income, and monetary characteristics, which are assumed to yield utility either directly (MIU) or indirectly (CIA).

#### **4.2. Adoption and Use of Payment Instruments**

The standard continuous MIU or CIA model abstracts from a discrete practical decision that typically is included in the empirical literature on payment choice. Consumers must first decide whether or not to pay a fixed cost to adopt a payment instrument (the extensive margin) before they can actually use it. Exceptions are the standard Baumol-Tobin money demand model, which is characterized by  $(S, s)$  optimal policy of cash withdrawal, and Duca and Whitesell (1995), which estimates a reduced-form model of cash demand and credit card adoption.

We estimate models with a two-step payment choice for each payment instrument, modified to include the determinants of money demand. The first step is adoption of the payment instrument, as defined by the discrete binary variable,

$$A_{ijt} \equiv \begin{cases} 1 & \text{if consumer } i \text{ has adopted payment instrument } j \text{ in period } t \\ 0 & \text{otherwise,} \end{cases}$$

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<sup>13</sup> The actual definition of *M1* includes currency, traveler’s checks, demand deposits (held by consumers and businesses), other checkable deposits, and super NOW accounts held at commercial banks and thrifts.

where  $j = \{CS, CK, DC, CC, ACH, OB, SVC\}$ . Thus, the first stage of the model is a probit regression that characterizes the consumer's probability of adopting the payment instrument.

Once a consumer adopts a payment instrument, the second step to decide how often (intensively) to use it to pay for their purchases. Use (intensity) is the absolute number of payments,  $n_{ijt}$ , made by consumer  $i$  using instrument  $j$  during period  $t$ . Empirically, payment instrument use is measured by respondents' answers to the Survey question, "About how many payments do you make in a typical month with [Payment Instrument  $j$ ]?" To minimize the effects of potential reporting error by respondents, we define use as the share of a consumer's monthly payments,

$$U_{ijt} \equiv \left( \frac{n_{ijt}}{N_{it}} \right),$$

where  $N_{it} \equiv \sum_j n_{ijt}$  is the total number of payments made by consumer  $i$  in a typical month using all payment instruments used by the consumer.<sup>14</sup> Thus, the second stage of the model is an OLS regression that fits the share of payment instrument use in a typical month.

Schuh (2008) highlights two features of the microeconomic data on consumer payment choice that are important for the econometric models in this paper. First, payment use is measured only for instruments used in a "typical month," and most consumers do not use all of their adopted payment instruments in a typical month. The Survey data indicate whether a consumer used each of the adopted payments instruments during the past five years, but no data are available on the intensity of use during the past five years. Thus, we do not model the margin between typical and non-typical use.

The second important microeconomic fact is that consumers are very heterogeneous in terms of their adoption of payment instruments. The median consumer has adopted less than four of the eight instruments measured in the Survey data. Because we model the *share* of payment use, it is crucial to adjust the econometric models of payment use for  $J_{it}$ , the number of payment instruments adopted by consumer  $i$  at time  $t$ . For example, a consumer who has adopted only two payment instruments is expected to have a larger average payment share (.50)

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<sup>14</sup> This decision assumes the relative number of payments is reported accurately. If respondents have a systematic bias in their payment use reporting across all instruments, such as undercounting due to memory loss, then the share of total payments may still provide an accurate estimate of relative payment use.

than a consumer who has adopted all eight payment instruments (.13). We assume that when consumers choose a payment instrument in period  $t$ , their adopted instruments are predetermined and  $J_{it}$  as a valid independent variable.<sup>15</sup>

Some retrospective questions in the Survey data permit us to specify qualitative models of the *change* in the use of payment instruments. Change in use for each payment instrument is defined as the discrete variable

$$CU_{ijt} \equiv \begin{cases} 1 & \text{if use increased} \\ 0 & \text{if use stayed the same} \\ -1 & \text{if use decreased} \end{cases}$$

Empirically, change in use is measured from 2003 to 2006 by respondents' answers to the Survey question, "*For each of the payment methods that you use, indicate whether your use of each method has increased, decreased, or stayed the same over the past THREE years.*" The change in payment use model is a proportional-odds ordered logit regression that characterizes the consumers' probability of being in a higher change-in-use category.

### 4.3. Heckman Selection Model and Estimation

Estimating the consumer's adoption and use decisions as independent events can lead to sample selection problems because the only consumers who use a payment method are those who have adopted it first. To correct for potential sample selection problems, we estimate models for  $A_{ijt}$  and  $U_{ijt}$  simultaneously using the two-step Heckman (1976) procedure known as "Heckit."<sup>16</sup> The Heckit procedure allows a different set of explanatory variables to predict the binary choice (adoption) from those which predict the continuous choice (use), and is appropriate in the presence of sample selection bias and heteroscedasticity. Heckit estimation is an improvement over the standard Tobit estimation, where the two sets of explanatory variables are constrained to be the same. To our knowledge, we are the first to estimate a Heckman selection model applied to payment choice.

Absent a deep theory of simultaneous consumer choice of payment adoption and use, we estimate the broadest possible reduced-form models to allow the data to identify the most

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<sup>15</sup> Of course, at some horizon this assumption is not true and a consumer may decide to adopt a new payment instrument simultaneous with, or even in advance of, making the payment (especially in the case of credit cards). However, we believe this assumption is reasonable in most cases.

<sup>16</sup> For details, see Greene (1997) or Wooldridge (2002).

empirically relevant factors and to inform future theoretical development. Table 1 lists and describes all of the explanatory variables used in the regression models.

One advantage of the SCPC data is  $CHAR_{ijt}$ , a unique set of consumer-specific assessments of seven fundamental characteristics for each payment instrument: cost or fees, convenience, safety, privacy, accuracy, payment timing, and record keeping. Consumers assess the absolute values of the characteristics on scale of 1 to 10 for each payment instrument. In principle, the characteristic assessments may vary widely across consumers because of heterogeneity in payment instruments, consumer demographics, and consumer preferences; the next demonstrates the extent of this heterogeneity. Due to limitations in the survey design, the characteristics data are only available for consumers who had adopted the payment instrument (“adopters”) and thus can only be included in the  $U_{ijt}$  models.<sup>17</sup>

Because the  $U_{ijt}$  models form a system of demand equations in which consumers choose among seven payment instruments, we use log relative characteristics as explanatory variables,

$$RCHAR_{kit}(j, j') \equiv \log \left( \frac{CHAR_{kijt}}{CHAR_{kij't}} \right),$$

where  $k$  indexes the seven characteristics. This transformation puts the relative characteristics into units similar to the payment use shares and facilitates the interpretation of their marginal effects on use. In principle, all 49 relative characteristics (7 characteristics  $\times$  7 instruments) could influence a consumer’s choice for any payment instrument. However, because  $1 \leq J_{it} \leq 7$  and  $CHAR_{kijt}$  are missing for all payment instruments that a consumer has not adopted, including all 49 relative characteristics yields too many missing values and reduces the sample size too much. Instead, we construct the average relative characteristic for each payment characteristic,

$$\overline{RCHAR}_{kit}(j) \equiv \frac{1}{J_{it}} \sum_{j' \neq j} RCHAR_{kit}(j, j'),$$

over all payment instruments adopted by consumer  $i$ . For example,  $\overline{RCHAR}$  for cost in the check use equation is the average of the log ratios of check cost to the cost of each of the other payment instruments adopted by the consumer. Ideally,  $\overline{RCHAR}$  would be constructed by weighting each relative characteristic by the relevant instrument use to account for variation in

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<sup>17</sup> The 2008 Survey of Consumer Payment Choice remedies this survey design flaw.

use across the consumer's payment instruments. However, such weighting would put the dependent variable on the right-hand-side of the regression models, so we do not weight.

In addition to the characteristics variables, the empirical literature on payment choice emphasizes the importance of demographic variables,  $DEM_{it}$ . The data include a relative comprehensive set of consumer demographics: age, gender, race, education, marital status, and household composition. The monetary theory literature emphasizes the importance of the determinants of money demand,  $Y_{it}$ . The data include several determinants of consumer demand for money and payments: income, checking account interest, labor force status, and financial responsibility in the household. We include  $DEM_{it}$  and  $Y_{it}$  in both adoption and use regressions.

In standard monetary models, money and its determinants (primarily income and interest rates) are endogenously determined, so one might argue that we need to account for potential simultaneity bias in the payment demand models. Although the aggregate stock of money held by a consumer may be endogenous, it seems unlikely that the consumer's particular choice of payment instrument adoption or use influences his/her income or wealth, so we take income as exogenous to payment choice. However, a stronger case for simultaneity can be made with regard to the checking account interest rate,  $INT_{it}$ , and the adoption of payment instruments, especially those linked closely to the checking account (check, debit card, ACH, etc.).<sup>18</sup> For this reason, we define  $Y_{it}^A \equiv \{INC_{it}, LFS_{it}, FR_{it}\}$ , which excludes  $INT_{it}$ , for the  $A_{ijt}$  models.

The final group of explanatory variables,  $MISC_{it}$ , includes the number of payment instruments adopted  $J_{it}$ , and the intensity of internet use,  $NET_{it}$ , which may signal experience with electronic and information technology and could contribute to consumers' decisions to adopt payment instruments. In the case of online banking, however, the payment instrument itself is internet use by definition. For this reason, we exclude  $NET_{it}$  from the  $A_{ijt}$  model for online banking and from all of the  $U_{ijt}$  models.<sup>19</sup> Furthermore, while  $J_{it}$  is crucial for the

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<sup>18</sup> This argument likely does not hold for the use of payment instruments that have already been adopted because use likely has little or no influence on whether a checking account pays interest.

<sup>19</sup> Although internet use is a problem directly for the online banking use model, it is a problem indirectly for all of the other use models because they are based on shares of payment instrument use.

intercept in the  $U_{ijt}$  models and can be viewed as exogenous, it clearly is simultaneous with the payment instrument adoption decision and must be excluded from the  $A_{ijt}$  models.

Summarizing these reduced-form model specification arguments, the two-step, simultaneous equation Heckman selection model of adoption and use for payment instrument  $j$  can be written as:

$$A_{ijt} = A(DEM_{it}, Y_{it}^A, NET_{it}) + \varepsilon_{ijt}^A \quad (0.1)$$

$$U_{ijt} = U(\overline{RCHAR}_{ijt}, DEM_{it}, Y_{it}, J_{it}, MR_{it}^{-1}) + \varepsilon_{ijt}^U \quad (0.2)$$

where  $MR_{it}^{-1}$  is the inverse Mills Ratio generated from the first-stage Heckman probit model that controls for the simultaneity of the payment adoption decision in the payment use decision. We estimate this model for each of the seven payment instruments.

#### 4.4. Econometric Issues with Characteristics

In theory, using characteristics to explain the demand for payment instruments is valid provided the characteristics satisfy two criteria: 1) they are exogenous; and 2) they are tangible, objective, and measurable. In practice, however, the reported characteristics may not satisfy these conditions. This section discusses these potential difficulties and our proposed econometric solution to them.

One way to think about the characteristics failing to satisfy these two criteria is in terms of a linearly additive errors-in-variables framework,

$$CHAR_{ijt} = C_{ijt}^* + \eta_{ijt} \quad , \quad (0.3)$$

where  $C_{ijt}^*$  represents the true consumer-specific characteristic for payment instrument  $j$ , and  $\eta_{ijt}$  is an error or deviation from that true value. As long as  $\text{Corr}(CHAR_{ijt}, C_{ijt}^*) > 0$ , a condition we assume to be true, then the reported characteristics should provide at least some empirically valid information about their role in consumer payment choice. One reason the payment characteristics offer so much promise as an explanatory variable is that they are consumer- and instrument-specific. For example, two consumers may have different assessments of the cost of a credit card relative to a check because of factual differences in their idiosyncratic choices of the fees, interest rates, and rewards associated with each of these payment methods. However, one

could reasonably argue that each of these cost factors is chosen endogenously by the consumer, certainly at the time of adoption but perhaps also simultaneously with the payment use decision because certain types of use decisions also influence the cost of the payment instrument. Similar arguments can be made for the other characteristics.

If  $CHAR_{ijt} \neq C_{ijt}^*$ , which may well be true, then the explanatory variables contain an error,  $\eta_{ijt}$ . To some extent, each payment characteristic is tangible, objective, and potentially measurable. The cost (which is essentially a price), the timing of the deduction from a bank account, the accuracy of the transaction, and record keeping features are probably the most tangible and objective. At the other end of the spectrum is convenience, a term that is used often but is very imprecise. Some aspects of convenience may be tangible and objective – such as the speed, physical dimensions, and acceptability of the payment instrument – but these concepts are jumbled together in this catchall characteristic and it is easy to imagine consumers forming subjective perceptions of convenience. Safety and privacy likely are related to probabilities of theft and the associated losses of money and information, both of which are relatively tangible and objective.

However, even if the characteristics are tangible and objective in principle, they can be very difficult to measure, even for the most educated payments expert. We can think of at least three types of errors that might arise in consumers' assessments of payment characteristics:

$$\eta_{ijt} = \eta_{ijt}^I + \eta_{ijt}^M + \eta_{ijt}^P . \quad (0.4)$$

The first potential error is associated with limited information (superscript  $I$ ). Limited-information errors may arise because the consumer's information set does not contain all relevant information – for example, a consumer may not know all the fees charged for a payment instrument or may not be aware of the risks associated with identity theft. A second potential error is classic measurement error (superscript  $M$ ), which may arise simply because data collected on the characteristics may be incomplete, biased, or noisy, for example. Finally, a third potential error is subjective perceptions (superscript  $P$ ), which may arise from behavioral effects of decision making, irrational fears, advertising, or other psychological and emotional factors.

To summarize, the  $U_{ijt}$  models may be subject to simultaneity bias because  $C_{ijt}^*$  is endogenous or errors-in-variables due to the presence of  $\eta_{ijt}$ . A traditional correction for both of these potential econometric problems is instrumental variables (IV) estimation, which we explore

with the  $U_{ijt}$  models. Using every possible variable from the 2006 SCPC data set, we constructed a set of 19 valid instruments. See Appendix Table 1 for their definitions.

## 5. Consumer Payments Data

This section describes the data source used for the regression models in this paper and the basic facts about consumer payment choice. First we describe the Survey of Consumer Payment Choice program, focusing on the 2006 version. Then we summarize the evidence on adoption and use of payment instruments by major consumer demographic characteristics, as well as the characteristics of payment instruments.

### 5.1. The Survey of Consumer Payment Choice Program

Our data come from the 2006 Survey of Consumer Payment Choice (SCPC). The SCPC is an ongoing research program initiated by the Federal Reserve Bank of Boston in 2003 designed to produce publicly available, nationally representative data on consumer payment choices. Pilot surveys were conducted with convenience samples of Federal Reserve employees from Boston (2003) and the entire System (2004); for more details about these surveys, see Benton, Blair, Crowe, and Schuh (2007). In 2006, the AARP and Boston Fed developed a new version of the Survey, which the AARP conducted with a random sample of all U.S. consumers (note that it was not conducted with AARP members only). For more details of the 2006 SCPC, see AARP (2006) and Schuh (2008).<sup>20</sup>

The SCPC program is motivated by the paper-to-electronics transformation and designed to gain a better understanding of the main determinants of demand for payment instruments by U.S. consumers. Each Survey thus far contains questions pertaining to three main goals. First, the SCPC asks questions about the adoption and use of a wide range of payment methods to gain breadth of understanding about the consumer payment decision. Second, the SCPC asks questions about both actions and attitudes to provide a better understanding of consumers' perspectives on their payment choices. And third, the SCPC contains a variety of additional questions that probe consumers' experience and reasoning behind payment decisions to help researchers gain a better understanding of why consumers make their payment choice.

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<sup>20</sup> An overview and summary of the 2006 SCPC can be obtained from the at [ADD WEB ADDRESS].

## 5.2. The 2006 SCPC

The 2006 SCPC is a slightly longer and revised version of the 2003 and 2004 surveys. It contains 69 questions with the following components:

- *Adoption and use* – The central part of the survey elicits information about whether respondents’ have the payment methods (adoption) and how often respondents use them. Questions are also asked about the following aspects of payment use:
  - Change in the use of payments over the past three years
  - The types of payment use by location (retail shopping versus the internet), by types of bill payments, and by dollar amounts.
- *Reasons for payment behavior* – The survey asks direct questions about the respondents’ adoption and use decisions. These include:
  - Why they have not adopted payment methods (called “barriers”)
  - What changes would lead them to change their adoption and use
  - How they responded to particular payment choices and why
- *Respondent assessments of their payment characteristics* – The survey elicits information about how respondents rate the fundamental characteristics of payment methods.
- *Respondent characteristics* – The survey contains questions about the characteristics of their respondents, such as demographics, income and wealth, financial sophistication and experience, and other relevant factors.
- *Miscellaneous payment attitudes and experiences* – The remainder of the survey includes various questions about respondents views about payment methods and what their experiences have been (or have not been) when using them especially particular aspects of checks such as conversion of checks to electronic forms by banks, stores, and billers.

Relative to previous versions, the 2006 SCPC survey made several improvements. The most important improvement is that it surveys U.S. consumers rather than Federal Reserve employees. It also includes questions about cash, which was excluded from the 2003-2004 surveys. The survey also contains more variables, including a greatly expanded number of demographic variables, and it provides a more balanced treatment of payment instruments, whereas the 2003-2004 surveys had focused mainly on checks. Finally, the SCPC survey corrected a number of the methodological problems in earlier surveys.

The 2006 SCPC was sponsored by the AARP and administered as a voluntary telephone survey by a private survey firm. The sample of 1,500 was drawn using standard list-assisted Random Digit Dialing (RDD), or Weighted (Type B) RDD, which screens out business and other non-household telephone numbers. Consumers age 65 and older were over-sampled to assist the AARP in analyzing their core constituency. Sample weights for four demographic characteristics (race, education, age-gender jointly) are available and, when applied to the data, help make the survey responses *ex post* consistent with U.S. Census population statistics. However, the 2006 SCPC sample has two limitations relative to previous versions: 1) it excludes respondents under age 25; and 2) it includes only respondents who have or share most of the financial responsibility in their household.

### **5.3. Payment Instrument Adoption and Use**

The top panel of Figure 4 compares rates of adoption for each payment instrument from the 2006 SCPC to the adoption rates from the 2004 Survey of Consumer Finances (SCF), a triennial representative survey conducted by the Federal Reserve that is widely considered to be among the most reliable public data sources on consumer financial behavior.<sup>21</sup> The 2006 SCPC data compare favorably to the 2004 SCF data. The 2006 SCPC adoption rates for traditional payment methods (checks and credit cards) are slightly lower than the 2004 SCF data and slightly higher for the adoption rates of newer electronic payment instruments (debit cards, ACH), perhaps reflecting the paper-to-electronics transformation during the additional two years between surveys. The SCF lacks estimates of store-value card adoption, and the online banking definitions differ between the SCPC and the SCF.

Despite significant changes during the paper-to-electronics transformation, traditional payment instruments are still the most widely held. The top panel of Figure 4 shows that check adoption is near 90 percent and credit card adoption is about 70 percent. In contrast, adoption rates of the newer payment instruments are still generally below 50 percent, although adoption of these instruments is rising as noted earlier (Figure 2). The adoption rate of debit cards is approaching that of credit cards. Because these cards share many similar characteristics as payment instruments but have very different financial characteristics, difference in their use offer an interesting study in consumer behavior. [ADD CITES]

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<sup>21</sup> For more information about the SCF, see <http://www.federalreserve.gov/PUBS/oss/oss2/scfindex.html>.

Table 1 provides additional details on payment adoption rates in the 2006 SCPC data by major consumer demographic categories. Generally speaking, payment instrument adoption rates are correlated with most consumer demographic characteristics, especially age, education, and income. Adoption rates of newer electronic payment instruments tend to be declining in age, especially debit cards and online banking, but adoption rates of older payment instruments (checks, credit cards) do not exhibit large age effects.<sup>22</sup> Adoption rates of most payment instruments tend to rise with education and income. Adoption rates by marital status and race show many potentially interesting differences. Gender differences in adoption rates are relatively small, except for online banking (male higher) and stored value cards (female higher).

The bottom panel of Figure 4 shows monthly use of payment instruments from the 2006 SCPC data. The figure plots the average number of payments per month per consumer for two groups: all consumers and only consumers who have adopted the payment instrument (adopters). The latter grouping removes the influence of variation in adoption rates across payment instruments and provides a clearer indication of how important each instrument is for those who have the option of using it. Among all consumers, cash (more than 8 payments per month) and check (nearly 8 payments per month) accounted for the bulk of the volume of payment use in 2006. Debit cards (almost 6 per month) and credit cards (about 3 per month) account for most of the remaining payments. Among adopters of payment instruments, however, debit cards (about 10 per month) had become the most frequently used instrument among adopters. Cash and checks (each about 9 per month) remain important among adopters; adopters of online banking (about 5 per month) use it about as frequently as adopters of credit cards.

Tables 3a and 3b provide additional details from the 2006 SCPC on payment use for all consumers (3a) and adopters (3b). The tables report payment instrument use as a percent share of all instrument use (for comparison to the econometric models) broken down by major consumer demographic categories. The aggregate numbers in both tables reflect the data portrayed in the bottom panel of Figure 4 for comparison.

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<sup>22</sup> The 2006 SCPC distinguishes between online bill payments made from a bank's website and online bill payments made from a payee's website. Online bill payments made at a payee's website—such as a utility company or an insurance provider—are frequently deducted from a bank account similarly to the payments made on the bank's website, but can also be charged to a credit or debit card. Because we cannot distinguish among the various ways the payments are made online, we limit the category to the bills paid at a bank website. The results showed no significant differences between the two categories of online bill payments.

Payment use often is correlated with demographic characteristics, even for payment instruments for which adoption is fairly uniform across demographic cohorts. Check use is rising in age but does not have any clear education or income effects. Check use also varies widely by race and marital status. Cash use does not exhibit any clear demographic effect except to decline in income, mainly at the very lowest (high use) and highest (low use) income categories. Debit card use is declining in age but other demographic variation is not strong. Credit card use rises in age, education, and income, and varies widely by race. ACH and online banking use does not show large demographic effects, unlike their adoption rates. The correlation between payment use and demographics is similar between Tables 3a and 3b.

An important issue for the regression models is the extent to which the correlation between consumer demographics and payment instrument adoption and use remain statistically and economically significant after including the payment characteristics. One reason the demographics may have some difficulty relative to the payment characteristics is that the demographics are not specific to the payment instrument, whereas the characteristics are. Another reason is that adoption rates appear to have a stronger correlation with demographics than do the shares of payment instrument use.

#### **5.4. Payment Characteristics**

Tables 4a and 4b provide information about the payment characteristics. Table 4a reports averages of the absolute ratings (1–10 scale) of the 49 payment characteristics from adopters of payment instruments. These absolute characteristics are used to form the relative characteristics used in the payment use econometric models.<sup>23</sup> Table 4b reports averages of the log relative characteristic ratings (multiplied by 100), which have all been constructed relative to the relevant check characteristic. Thus, the table entries are approximately the percent differences between the characteristic for a particular instrument and the same characteristic for checks (positive values indicate that the instrument is better than checks, negative indicates worse than checks).

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<sup>23</sup> As indicated earlier, characteristics data are only available for adopters because the SCPC did not ask non-adopters to rate payment characteristics. The original rationale for this survey design choice was that non-adopters are unlikely to be familiar enough with a payment method to provide meaningful and accurate ratings of the characteristics embodied in it. However, this rationale is faulty. Even non-adopters have assessments of the payment characteristics and those assessments – no matter how accurate they are – almost surely influence the payment choice, or non-choice, of consumers. Future versions of the SCPC will solicit assessments of payment characteristics from all respondents.

These relative ratings are similar to, but not quite the same as, the explanatory variables used in the econometric models.

The first notable conclusion from the Table 4a is that the average of all payment characteristics is 7.9, well above the numeric average of 5 in a 1–10 scale. This result may suggest that each of the payment instruments is literally “above average.” But it may reflect the lack of an “anchor,” or relative value, for respondents to judge the payment instruments.<sup>24</sup>

On an absolute scale, Table 4a, consumers rate checks about average (7.8). For record keeping, checks are rated highest (8.9, tied with online banking), a result that accords with the view that U.S. consumers who love checks seem to like the ability to keep careful records of spending and account balances with them. But checks are rated relatively low in cost (7.3) and especially privacy (6.7). Consumers rate cash as the worst overall (7.2) and worst in five characteristics: Convenience, safety, accuracy, timing, and recordkeeping. ACH payments are rates most favorably overall (8.6) and rated highest (or tied for highest) in five characteristics: Cost, convenience, safety, accuracy, and timing. Online banking is also rated highly (8.5).

The relative scales in Table 4b show that other payment characteristics are only about 2 percent better on average than check characteristics. Across all characteristics (last column), consumers rate checks better than cash by 18 percent, credit cards by 9 percent, and stored value cards by 2 percent. But consumers rate checks worse than online banking 23 percent, ACH by 14 percent, and debit cards by 8 percent – the three most likely substitutes for checks. Across all instruments, consumers rate checks as best in recordkeeping by 25 percent, with slight advantages in safety (3 percent) and accuracy (4 percent). But consumers rate checks worse than other instruments in privacy (18 percent), convenience (14 percent), timing (11 percent), and cost (5 percent).

## 6. Econometric Results

This section reports and describes the regression results for the two-stage Heckman selection models of the adoption and use of payment instrument, and the ordered logit models of the change in use of payment instruments. Categories of the  $DEM_{it}$  and  $Y_{it}$  variables are

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<sup>24</sup> In contrast, the 2003 and 2004 SCPC asked respondents to assess the characteristics for each non-check payment instrument relative to the same characteristic for checks explicitly in the questions. There is no evidence yet on

converted to binary dummy variables and included separately. One category from each type of explanatory variable is omitted from the regression. This control group represents the baseline for discussion of the relative results for all other variables of this type of explanatory variable.

## **6.1. Adoption Models**

### **6.1.1. General Results**

Table 5 reports probit regression results of the first-stage adoption models for seven payment instruments (all consumers, excluding missing data observations). In general, the demographics effects in the adoption models are qualitatively consistent with the simple correlations observed in the data as reported in Table 2. However, once the adoption models control for all of the explanatory variables simultaneously, few of the variables are statistically significant. The most statistically significant determinants of adoption are age, income, gender and race; education is much less often significant. The intensity of internet use has a very significant positive effect on adoption of all payment instruments except cash, but the degree of financial responsibility in the household is not significant – perhaps because consumers who have little responsibility are dropped from the survey. The pseudo  $R^2$  of the models runs from .09 to .32.

### **6.1.2. Check Adoption**

The check adoption model explains a higher proportion of the adoption probability than any other payment instrument (pseudo  $R^2$  of .32). Consumers who have very low income or education, who are black, Asian, male, or single, and who are not employed all have significantly lower probabilities of adopting checks for payment. The probability of adopting checks rises with income, but it is significant only for the very lowest income category. Otherwise, there are no systematic demographic effects on check adoption.

### **6.1.3. Other Instrument Adoption**

The determinants of the probability of adopting payment instruments other than checks vary widely across instruments. For example, cash, a traditional alternative to checks, is more

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whether absolute ratings, which are later converted to a relative rating, produce similar results to an explicitly relative rating, so future research on this topic would be useful.

likely to be adopted by consumers who have the highest education or are single or Latino; consumers who are the oldest and who are not employed are less likely to adopt cash. Note, however, the cash adoption results may be somewhat less reliable because adoption is measured from observed use (in a typical month or past five years), whereas it may be more likely that cash adoption is universal.

Consumers who adopt the two main card alternatives to checks – credit cards and debit cards – also exhibit notable differences. The most significant difference is the effect of age on adoption, which is positive for credit cards but negative for debit cards, and highly statistically significant in both cases. The effect of income on adoption is positive for both cards, but quantitatively more important for credit cards. The effects of race and gender are often very significant for credit cards but none are so for debit cards; education appears to have no effect on the adoption of either type of card. Interestingly, consumers with more financial responsibility are less likely to adopt a debit card (the only case in which financial responsibility is significant). Overall, the model explains credit card adoption better than debit card adoption (pseudo  $R^2$  of .30 versus .16).

Consumers who adopt the two main electronic alternatives to checks – ACH and online banking – are generally quite similar. The adoption of these electronic instruments is declining in age, although the age effect is stronger and more significant for online banking. The effect of income on the adoption of both methods is rising and significant, again larger for online banking; the education effect also is rising but generally not statistically significant. Retired consumers are more likely to have adopted ACH, perhaps because the payment of retirement income is more likely to occur through direct deposit.

The adoption of store value cards is not well explained by the models (pseudo  $R^2$  of .09). Consumers who are male, black, or retired are less likely to adopt them.

## **6.2. Use Models**

### **6.2.1. General Results**

Table 6 reports OLS regression results of the second-stage use models for seven payment instruments (adopters only). The estimated coefficients, when multiplied by 100, represent the marginal effects of the explanatory variables on the payment shares in percentage points.

Coefficients on the relative payment characteristics are expected to be positive – that is, consumers who rate the characteristic of a payment instrument higher (lower) should have higher (lower) use of the instrument.

In general, the results suggest that payment characteristics, along with the number of payment instruments, tend to have larger, more significant effects on instrument use than demographics and income-related variables. All but one estimate on the number of payment methods is statistically significant. For most payment instruments, at least two payment characteristics are significant; only online banking has no statistically significant characteristics. Among characteristics, convenience – which is not well defined – and cost are most important. Although the point estimates continue to suggest some correlation of use with demographics and income-related variables, the majority of estimates are statistically insignificant. The  $R^2$  statistics also reveal that most of the cross-section variation is explained primarily by characteristics and the number of instruments. The inverse Mills ratio is significant only for checks and ACH, indicating that potential selection problems associated with the joint adoption and use of payment instruments is not particularly widespread.

### **6.2.2. Check Use**

Two payment characteristics and three other variables have strong influences on the use of checks for payment. Convenience (.08) and cost (.04) are economically and statistically significant determinants of check use. Recalling that most consumers rated checks lower than other payment instruments in cost and convenience (see Tables 4a and 4b), these characteristics help explain why the check share is lower than it would be based on the other explanatory variables alone. The youngest consumers tend to write fewer checks (–.06), while lower income consumers (.05 to .08) and Latinos (.09) tend to write more than middle income and white consumers. Altogether, the model remarkably explains nearly half of the cross-section variation in the use of checks ( $R^2$  of .45). Because check users tend to have more payment instruments and thus lower shares (–.11), this number plays a crucial role in explaining check use (as evidenced by the  $R^2$  statistics).

These results provide a preliminary indication of four possible ways to explain a decline in check use. One possibility is changes in demographics – an increase in the shares of young or Latino consumers – but demographics tend to change more slowly than the rapid decline in

check use. Another possibility is an increase in the proportion of poor consumers. Much attention has been given to widening income inequality in the United States in recent years, but the income gap between rich and poor does not necessarily translate into a larger share of poorer consumers. A third possibility is a change in cost and convenience characteristic ratings for checks (a decrease) or other payment instruments (an increase), or both. Unfortunately, we have no time series data on payment characteristics to test this conjecture. Finally, an increase in the number of alternative payment instruments would have a large, negative effect on check use – provided that consumers adopted the instruments and merchants accepted them for payment. The latter two explanations seem more likely to be consistent with the data.

### **6.2.3. Other Instrument Use**

Payment characteristics are particularly important determinants of the use of cash and credit cards. In both cases, the characteristics explain half or more of the cross-section variation in payment use across consumers. Convenience and record keeping are (.05 each) are economically and statistically significant determinants of cash use. For both characteristics, cash is rated lowest and thus the characteristics help explain lower shares of cash use relative to other explanatory variables. Consumers who are male (.04), most highly educated (.06) and lowest income (.08) tend to use cash more intensively. Credit card use is positively influenced by the cost, convenience, and timing, but negatively influenced by privacy and accuracy. The latter result is a puzzle and the only instance in which characteristics are significant with the wrong sign. The only other economically and statistically significant determinant of credit cards is that consumers who are not employed use them more (.07).

One of the most common substitutions of payment use from checks to another payment instrument has occurred with debit cards. Safety (.06) and timing (.08) are economically and statistically significant determinants of debit card use. On average, most consumers view debit cards as having better timing than checks, which explains this result. But they view debit cards as about equally safe as checks, so that heterogeneity among consumers in their valuations of the safety of checks versus debit cards likely explains this result. Age effects are strongest for debit cards, where the youngest consumers (.07) use debit cards much more and older consumers, aged 55–64, use debit card much less (–.11), a large generational gap in debit card use.

For the electronic payment instruments, ACH and online banking, the payment characteristics generally are not statistically significant but cost (.03 for both instruments) and convenience (.07 for online banking) are economically significant. Consumers who are Latino (.08), black (.11), or widowed (.04) tend to use ACH payments more often. No demographic or income-related variables are statistically significant for online banking. However, in terms of point estimates, online banking generally appears to be declining in age and rising in income and education.

Convenience (.06) and record keeping (.03) are economically and statistically important determinants of stored value card use. Consumers who have very low education (.12) and who are not employed (.07) tend to use stored value cards more often.

### **6.3. IV Estimates of Check Use**

To control for possible simultaneity bias in the coefficient estimates associated with the payment characteristics, we re-estimated the model for check use with instrumental variables (2SLS) and reported the results in Table 7. The first two columns contain estimates for the full model (all explanatory variables); the first column repeats estimates from Table 6 for comparison, and the second column shows the full-model IV results. There are 12 over-identifying restrictions (19 instruments less 7 characteristics), and the table includes p-values from the Sargan and Basman tests reported by Stata.

The IV estimates are relatively encouraging. Although none of the characteristics is statistically significant, all but one point estimate increases (as expected) by plausible magnitudes and the over-identifying restrictions cannot be rejected. In particular, note that record keeping – the most positive check characteristic – now becomes more economically important than convenience, the most statistically significant characteristic in the OLS estimation. The age effect of checks disappears (economically and statistically) in the IV estimates, but most remaining estimates are quantitatively and qualitatively similar to OLS.

Noting that demographic variables qualify as valid instruments, we conducted one additional IV test of the check use model. Because the education and household composition variables are jointly insignificant both estimates of the full model, we estimated a restricted

model using them as eight additional instruments.<sup>25</sup> The Heckman OLS estimates of the restricted model are reported in column three for comparison, and they do not differ much from those of the full model. The final two columns report IV estimates of the restricted model with 19 instruments and with 26 instruments (including education and household composition).

The estimates of the restricted model with all 26 instruments (last column) are even more encouraging. IV point estimates of the characteristics continue to be plausible relative to OLS, but now are close to being statistically significant: Convenience has a p-value of .105; cost and recordkeeping are also much closer to being statistically significant. In addition, IV estimates of several other coefficients become significant as they are in the OLS estimates of the restricted model (widowed, single, Latino, other race), while the American Indian IV coefficient is significant but OLS is not. The age 25–34 and two lower income coefficients still are not significant with IV but the point estimates are relatively similar to OLS. The over-identifying restrictions still cannot be rejected in the restricted model even with the additional instruments.<sup>26</sup>

## 6.4. Change in Use Models

### 6.4.1. General Results

Table 8 reports the ordered logit regression results for the models of change in use of the seven payment instruments. The table entries are odds ratios, which reflect the relative probability of being in a higher change in use category (increased or same relative to decreased, and increased relative to same or decreased) associated with the explanatory variable. Odds ratios greater than 1.0 indicate a greater probability of being in the higher use category; an odds ratio of 1.5 means that the probability is 50 percent greater. Odds ratios less than 1.0 indicate an analogously lesser probability of being in the higher use category.

Broadly speaking, the qualitative results for change in use are similar to the results for

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<sup>25</sup> In separate regressions similar to those in Jonker (2005) but not reported here, we find that the full set of demographic variables have very modest explanatory power for the payment characteristics (cross-section  $R^2$  statistics of about .08 or less).

<sup>26</sup> In the interest of full disclosure, we note that IV estimates with subsets of the instruments are somewhat fragile. We selected the full set of 19 valid instruments from the 2006 SCPC without “peeking” at the results. However, we did check the robustness of the IV results by dropping judgmentally selected groups of instruments. The IV characteristic estimates varied considerably, sometimes becoming negative or implausibly large (in absolute value), and sometimes the over-identifying restrictions were rejected at the 10-percent level or less. However, many of the IV characteristics estimates were significant at the 10 percent level or less (and plausible in magnitude). In the end, we reported results only for our *a priori* choice of instruments to minimize concerns about selective reporting.

use. Payment characteristics tend to have larger, more significant effects on the change in use of payment instruments from 2003 to 2006 than demographics and income-related variables, as measured by coefficient estimates and pseudo  $R^2$  values with and without the characteristics. Overall, the change-in-use models do not fit the data nearly as well as the use models (pseudo  $R^2$  values of .06 to .13), perhaps because we lack changes in the payment characteristics over the same period. The specific payment characteristics that are significant in explaining the change in use of payment instruments generally are similar to the characteristics that are significant in explaining use of payment instruments (compare Tables 6 and 8), but there are interesting differences between the models as well.

#### **6.4.2. Change in Check Use**

Consumers who rate checks relatively high in convenience, privacy, or timing were more likely to have increased or held constant their check use from 2003 to 2006. Convenience (2.96) was particularly important, with a probability three times higher. However, consumers who rated checks high in record keeping (.69) were 31 percent more likely to have decreased or held constant their check use. By itself, this result is a bit puzzling but may be partly explained by the importance of recordkeeping in explaining higher use of ACH and online banking, which together also have good recordkeeping potential. Older, male, and Latino consumers were 50 to 100 percent more likely to have increased or held constant their check use; Asian consumers were 3-1/2 times more likely; and less educated consumers were twice as likely. In contrast, consumers who were retired, not employed, and American Indian were more likely to have decreased or held constant their check use. Cost, which was an important determinant of check use, was not important in determining the change in check use.

#### **6.4.3. Change in Other Instrument Use**

According to Figure 2, the use of cash and credit cards was also more likely to have decreased than increased from 2003 to 2006. Consumer ratings of convenience were also important for explaining which consumers were more likely to have increased or held constant their cash and credit card use. Cost was also important for changes in credit card use, and recordkeeping important for changes in cash use. Consumers with lower education were especially likely to have increased or held constant their cash use, while those not employed were more likely to have decreased or held constant their cash use. Consumers who were single,

retired, or of other races were more likely to have increased or held constant their credit card use, while those who were black or lower income were more likely to have decreased or held constant their credit card use.

Debit card use was more likely to increase or stay constant among consumers who liked the safety and especially the timing of debit cards. The youngest consumers were twice as likely to have increased or held constant their debit card use as well. Consumers who were male and lower income were more likely to have decreased or held constant their debit card use. Debit card use was about 50 percent more likely to have decreased or held constant for all education groups, a result that seems hard to explain.

Cost, convenience, timing, and recordkeeping were all important in explaining higher use of ACH and online banking payments. The youngest consumers were more likely to have increased or held constant ACH use, perhaps because they were more likely to have entered the work force and take advantage of payments through direct deposit of income. But older consumers were more likely to have increased or held constant their use of online banking, perhaps because of increased efforts to help older consumers learn and take advantage of this newer technology. Few other variables were important in explaining change in use of ACH or online banking. Recordkeeping is the only characteristic significant for change in use of stored value cards, which was not well-explained by many variables.

## **7. Conclusions**

Two factors appear to explain why (some) consumers are (finally) writing fewer checks. First, some consumers use fewer checks because of the increased availability and acceptance of alternative payment instruments with more appealing characteristics than checks – at least more appealing to some consumers. Other consumers do not find the characteristics of the newer payment instruments more appealing and do not use fewer checks. Second, because certain payment characteristics are important determinants of the use of checks and other payment instruments, changes in these characteristics are likely to have induced consumers to change their use the instruments. Convenience, cost, recordkeeping, and timing appear to be most important in the payments transformation.

At least two caveats should be applied to these conclusions. First, there are no adequate data on the characteristics of U.S. payment instruments before 2006. Consequently, we cannot

tell whether or how much the payment characteristics may have changed. For this reason, we cannot distinguish between changes in check use caused by changes in the payment characteristics and changes in consumers' understanding (financial literacy) and attitudes (perceptions or preferences) toward the payment characteristics. This distinction is crucial to understanding and especially influencing consumer payment choice. Second, because our econometric models are reduced form we cannot link the results back to the parameters of a structural model of demand for money and payments based on preferences (utility) and technology (production of payments services).

Both caveats suggest two future directions for research. First, more and better data on consumer payment choice are needed. Towards this end, the Federal Reserve Bank of Boston is sponsoring new versions of the Survey of Consumer Payment Choice in 2008 and 2009 conducted with the American Life Panel by the RAND Corporation. Other data development efforts, in the United States or elsewhere, would be helpful too. Second, structural models of consumer demand for money and payments that incorporate realistic features of actual U.S. payment instrument are need to better guide econometric modeling.

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**Table 1: Regression Variable Definitions**

<b>Class</b>	<b>Variable</b>	<b>Definition</b>
<i>CHAR</i>	<i>COST</i>	Cost or fees (1-10)
	<i>CONV</i>	Convenience (1-10)
	<i>SAFE</i>	Safety (1-10)
	<i>PRIV</i>	Privacy (1-10)
	<i>ACC</i>	Accuracy (1-10)
	<i>TIME</i>	Payment timing (1-10)
	<i>REC</i>	Record keeping (1-10)
<i>DEM</i>	<i>AGE</i>	25–34; 35–44; 45–54; 55–64; 65+
	<i>GEN</i>	Male; female
	<i>RACE</i>	White; black; Latino; Asian; American Indian; other
	<i>EDU</i>	Less than HS; high school; less than college; college; some post-graduate or more
	<i>MS</i>	Married; divorced; widowed; single
	<i>HH</i>	Size; children (under 18)
<i>Y</i>	<i>INC</i>	Less than \$25,000; \$25,000–50,000; \$50,000–75,000; \$75,000–100,000; \$100,000 or more
	<i>INT</i>	Does your checking account earn interest? (Yes=1)
	<i>LFS</i>	Labor force status: employed, not employed, retired
	<i>FR</i>	Financial responsibility: shared=1; most=2; all=3
<i>MISC</i>	<i>J</i>	Number of payment methods used in a typical month
	<i>NET</i>	Internet use: None=0; less than monthly=1; less than weekly=2; less than daily=3; daily or more=4

SOURCE: 2006 *Survey of Consumer Payment Choice*

NOTES: “Married” includes respondents who are living with a partner; “divorced” includes respondents who are separated. “Not employed” includes respondents who are unemployed (i.e., in the labor force but not employed) and who are not retired and not employed (i.e., not in the labor force). Due to the survey design, *FR* excludes all respondents with some or none of the financial responsibility in the household. *J* excludes bill payments made online at a company web site because the data do not identify the payment method used for the bill payment.

**Table 2: Rates of Adoption of Payment Instruments by U.S. Consumers (in percent)**

	Checks	Credit Cards	Debit Cards	ACH	Bank Site Online Banking	SVC	
<b>Total</b>	<b>87</b>	<b>74</b>	<b>62</b>	<b>49</b>	<b>24</b>	<b>26</b>	
<b>Age</b>	<b>25-34</b>	88	73	83	54	68	27
	<b>35-44</b>	81	67	68	49	27	24
	<b>45-54</b>	85	79	56	42	20	27
	<b>55-64</b>	92	76	59	50	16	30
	<b>65 or Over</b>	89	74	40	49	8	22
<b>Education</b>	<b>HS or Less</b>	76	60	49	39	11	22
	<b>Some College</b>	94	78	73	53	31	27
	<b>College Degree</b>	94	89	71	58	36	30
	<b>Post-Graduate School</b>	97	93	67	60	42	36
<b>Income</b>	<b>&lt;50,000</b>	80	60	57	39	15	24
	<b>\$50,000 - \$74,999</b>	97	84	77	61	37	26
	<b>75,000-100,000</b>	91	90	66	57	34	30
	<b>&gt;100,000</b>	94	95	84	74	54	29
<b>Marital Status</b>	<b>Married</b>	91	82	65	53	30	27
	<b>Divorced</b>	77	56	56	40	17	16
	<b>Widowed</b>	87	66	43	48	8	24
	<b>Single</b>	79	61	63	39	18	31
<b>Race</b>	<b>White</b>	91	76	61	51	23	28
	<b>Latino</b>	78	79	68	47	29	26
	<b>Black</b>	64	48	61	43	13	13
	<b>Asian</b>	92	89	82	47	35	22
	<b>American Indian</b>	73	49	74	63	20	48
	<b>Other</b>	81	58	52	22	21	21
<b>Gender</b>	<b>Male</b>	86	75	60	48	28	23
	<b>Female</b>	87	73	63	49	20	29

SOURCE: 2006 Survey of Consumer Payment Choice.

NOTES: The definition of adopter varies by payment type. A check adopter must have a checking account and must have used checks in the past five years or in a typical month. An adopter of credit card or debit card must have at least one card. An ACH adopter must use ACH in a typical month. An SVC adopter must either have a stored value card or use one in a typical month. An online banking adopter may either use it in a typical month or may have used it in the past five years. More detailed data on age, income, and education are available in the 2006 Survey of Consumer Payment Choice.

**Table 3a: Use of Payment Instruments by U.S. Consumers (in percent share of all payments)**

	Cash	Checks	Credit Cards	Debit Cards	ACH	Bank Site Online Banking	SVC	
<b>Total</b>	<b>26</b>	<b>34</b>	<b>9</b>	<b>14</b>	<b>8</b>	<b>5</b>	<b>2</b>	
<b>Age</b>	25-34	23	21	6	24	10	9	2
	35-44	32	29	7	17	7	5	2
	45-54	25	36	10	13	6	4	2
	55-64	24	40	11	10	8	3	2
	65 or Over	24	44	12	6	10	2	1
<b>Education</b>	HS or Less	29	35	6	11	8	3	2
	Some College	25	35	8	17	8	5	2
	College Degree	21	30	14	19	9	7	2
	Post-Graduate School	23	32	19	14	7	6	1
<b>Income</b>	<25,000	36	31	3	11	6	1	3
	\$25,000-\$50,000	25	36	9	14	7	4	2
	\$50,000 - \$74,999	22	32	10	17	11	7	1
	75,000-100,000	23	29	14	19	8	4	1
	>100,000	17	28	14	19	10	11	1
<b>Marital Status</b>	Married	23	35	11	15	8	6	1
	Divorced	32	31	5	14	8	3	1
	Widowed	25	43	9	8	10	2	2
	Single	30	24	7	17	6	2	3
<b>Race</b>	White	24	37	10	14	8	4	1
	Latino	25	30	7	14	9	9	4
	Black	34	21	3	16	10	2	1
	Asian	34	27	21	10	4	5	1
	American Indian	33	17	4	24	8	2	3
	Other	25	30	7	14	5	5	2
<b>Gender</b>	Male	25	32	9	15	9	7	1
	Female	26	36	9	14	7	3	2

SOURCE: 2006 Survey of Consumer Payment Choice.

NOTES: Share is calculated as the number of monthly payments made with each instrument divided by the total number of monthly payments made with all instruments. Online bill payments made at a company's website, which account for about 2 percent of all payments, are not included. Also, money orders, which account for about 5 percent of all payments are included in the calculations, but they are not included in the table.

Because of weighting, rounding, and the exclusion of money orders, the rows will not sum to exactly 100, but they are close to 100.

**Table 3b: Use of Payment Instruments by Adopters (in percent share of all payments)**

		Cash	Checks	Credit Cards	Debit Cards	ACH	Bank Site Online Banking	SVC
<b>Total</b>		<b>27</b>	<b>38</b>	<b>12</b>	<b>23</b>	<b>16</b>	<b>18</b>	<b>6</b>
<b>Age</b>	<b>25-34</b>	24	24	8	29	19	20	7
	<b>35-44</b>	32	34	11	24	14	14	6
	<b>45-54</b>	26	42	13	23	14	20	8
	<b>55-64</b>	25	43	15	18	15	18	7
	<b>65 or Over</b>	26	49	16	14	20	20	5
<b>Education</b>	<b>HS or Less</b>	31	43	9	23	19	23	8
	<b>Some College</b>	26	37	10	23	16	17	6
	<b>College Degree</b>	22	32	16	26	15	19	5
	<b>Post-Graduate School</b>	23	32	20	20	12	14	4
<b>Income</b>	<b>&lt;25,000</b>	38	43	8	22	18	16	13
	<b>\$25,000-\$50,000</b>	26	40	12	23	16	14	7
	<b>\$50,000 - \$74,999</b>	23	32	11	23	18	20	5
	<b>75,000-100,000</b>	23	32	16	29	14	13	4
	<b>&gt;100,000</b>	18	29	15	23	14	20	5
<b>Marital Status</b>	<b>Married</b>	25	38	13	23	15	19	5
	<b>Divorced</b>	33	39	8	26	19	19	8
	<b>Widowed</b>	27	50	13	17	21	20	7
	<b>Single</b>	31	30	11	26	16	10	9
<b>Race</b>	<b>White</b>	28	37	9	21	20	25	16
	<b>Latino</b>	26	40	13	23	15	16	5
	<b>Black</b>	35	31	7	27	23	14	8
	<b>Asian</b>	34	29	24	13	8	13	2
	<b>American Indian</b>	35	24	7	33	13	11	7
	<b>Other</b>	26	34	11	25	19	22	8
<b>Gender</b>	<b>Male</b>	27	36	12	24	18	22	6
	<b>Female</b>	27	40	13	22	15	14	7

SOURCE: 2006 Survey of Consumer Payment Choice.

NOTES: Share is calculated as the number of monthly payments made with each instrument divided by the total number of monthly payments made with all instruments. Online bill payments made at a company's website, which account for about 2 percent of all payments, are not included. Also, money orders, which account for about 5 percent of all payments are included in the calculations, but it is not included in the table. The rows do not add to 100 because they are measuring share among adopters only.

**Table 4a: Average Absolute Ratings of Payment Characteristics**

Payment Method	Characteristic							Average
	Cost	Convenience	Safety	Privacy	Accuracy	Timing	Record Keeping	
Cash	8.0	7.5	6.1	8.2	8.0	7.1	5.3	7.2
Checks	7.3	8.0	7.6	6.7	8.7	7.6	8.9	7.8
Credit Cards	5.6	8.8	6.6	6.4	8.1	8.0	8.2	7.4
Debit Cards	7.4	9.1	7.3	7.1	8.5	8.6	7.8	8.0
ACH	8.5	9.1	8.3	7.9	8.9	8.9	8.5	8.6
SVC	7.9	8.2	7.7	8.3	8.2	8.3	6.0	7.8
Bank Site Online Banking	8.2	9.0	8.0	7.9	8.9	8.7	8.9	8.5
Average	7.6	8.5	7.4	7.5	8.5	8.2	7.7	7.9

SOURCE: 2006 Survey of Consumer Payment Choice.

NOTES: The characteristic ratings are on a 1-10 scale, where 10 is the best and 1 is the worst. The numbers are averages of these ratings across all respondents who have adopted the payment method.

**Table 4b: Logged Characteristic Ratings Relative to Checks**

Payment Method	Characteristic							Average
	Cost	Convenience	Safety	Privacy	Accuracy	Timing	Record Keeping	
Cash	8	-10	-39	26	-17	-16	-81	-18
Checks	0	0	0	0	0	0	0	0
Credit Cards	-38	14	-19	-7	-9	8	-12	-9
Debit Cards	6	25	2	16	-1	24	-16	8
ACH	19	21	13	23	3	24	-7	14
SVC	11	5	-1	35	-13	10	-59	-2
Bank Site Online Banking	26	41	22	34	6	31	3	23
Average	5	14	-3	18	-4	11	-25	2

SOURCE: 2006 Survey of Consumer Payment Choice.

NOTES: These numbers were obtained by a 4-step process. First we took a ratio of the individual characteristic rating relative to the respondent's rating of check. Then we took a log of this ratio. Then we took an average of these logged ratios across all respondents who have adopted the payment method. Finally, we multiplied by 100 to put the numbers in percentage terms.

**Table 5: Adoption Model Regressions (1st Stage of Heckman: Probit)**

Explanatory Variables	Cash	Checks	Credit Cards	Debit Cards	ACH	Bank Site Online Banking	SVC
<b>Age:</b>							
25-34	-.06	.06	.02	.18	.29 *	.46 ***	-.11
35-44							
45-54	-.22	-.12	.36 **	-.50 ***	-.22	-.35 **	.00
55-64	-.21	.37	.57 ***	-.40 **	-.29 *	-.46 ***	.22
>65	-.87 **	.30	.75 ***	-.92 ***	-.15	-.67 ***	.16
<b>Education:</b>							
Some High School	-.64	-.85 ***	-.22	-.28	-.22	-.41	-.09
High School	.19	-.24	-.04	-.08	-.05	-.44 ***	.02
Some College/Assoc. Degree	.33	.21	.01	.20	.12	.06	.03
College Degree							
At Least Some Post Grad.	.71 *	-.05	.19	-.08	.23	.15	.18
<b>Marital Status:</b>							
Divorced	.25	-.13	-.15	.25	.02	.13	-.25
Widowed	-.07	.02	.02	.28	.04	-.05	.19
Single	.84 *	-.39 *	.10	.05	-.22	-.25	.27
<b>Household Composition:</b>							
Size	-.05	-.06	.00	.00	-.06	-.04	.09
Children	.23	-.10	-.44 **	.00	.08	.14	-.03
<b>Race:</b>							
Latino	-.68 **	-.41	.47 *	.31	-.26	-.04	.03
Black	.30	-.74 ***	-.43 **	.18	-.04	.05	-.60 ***
Asian	4.91	-1.28 ***	.28	.22	-.14	-.41	-.61
American Indian	4.63	-.53	-.92 **	.76	.28	-.12	.28
Other	-.04	.38	-.62	-.30	-.61 *	.22	-.66
<b>Gender: Male</b>	-.13	-.28 *	-.30 **	-.05	-.10	-.02	-.39 ***
<b>Income:</b>							
<\$25,000	.05	-.68 ***	-1.33 ***	-.40 **	-.40 ***	-.71 ***	-.11
\$25,000-\$49,999	-.08	-.22	-.27 *	-.10	-.23 *	-.23	.24 *
\$50,000-\$74,999							
\$75,000-\$99,999	.77	.49	.20	-.07	.05	.07	.27
>\$100,000	-.28	.54	.59 **	.31 *	.31 **	.57 ***	.02
Retired	.09	.15	.21	.15	.24 *	.05	-.45 ***
Not Employed	-.53 *	-.45 **	-.11	-.16	-.12	-.29	-.21
<b>Financial Responsibility</b>	-.11	-.01	-.07	-.11 *	.02	.05	-.05
<b>Internet Use</b>	.08	.12 **	.23 ***	.17 ***	.12 ***		.11 ***
<b>Number of Observations</b>	663	922	914	848	986	1055	990
<b>Pseudo R-squared</b>	.19	.32	.30	.16	.09	.19	.09

SOURCE: 2006 Survey of Consumer Payment Choice.

NOTES: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

The dependent variable is set equal to 1 if the respondent has adopted the payment type. Otherwise, it equals zero. The Heckman 2-step procedure excludes respondents that have missing values in the second stage only if the dependent variable of the first stage is equal to 1, i.e. they had adopted the payment method.

Table 6: Use Model Regressions (2nd Stage of Heckman)

Explanatory Variables	Cash	Checks	Credit Cards	Debit Cards	ACH	Bank Site Online Banking	SVC
<b>Characteristics:</b>							
<b>Cost</b>	.00	.04 ***	.06 ***	-.01	.03 *	.03	.00
<b>Convenience</b>	.05 ***	.08 ***	.10 ***	-.02	.00	.07	.06 *
<b>Safety</b>	.01	.01	.02	.06 **	.01	.02	.00
<b>Privacy</b>	.00	.02	-.04 ***	.01	.01	.02	-.03
<b>Accuracy</b>	.03	.02	-.05 **	.02	.01	.00	-.05
<b>Timing</b>	.02	.01	.05 **	.08 *	.01	.01	.02
<b>Record Keeping</b>	.05 ***	.00	.02	.04	-.03	.02	.03 *
<b>Age:</b>							
<b>25-34</b>	-.02	-.06 **	-.04	.07 *	.00	.20	-.02
<b>35-44</b>							
<b>45-54</b>	-.01	.04	.00	-.05	.01	-.08	-.04
<b>55-64</b>	-.01	.02	.01	-.11 **	.03	-.12	-.02
<b>&gt;65</b>	.02	.02	.04	-.07	.04	-.23	.00
<b>Education:</b>							
<b>Some High School</b>	.08	-.01	-.02	.05	.05	-.04	.12 *
<b>High School</b>	.00	.01	-.03	.02	.01	-.10	-.01
<b>Some College/Assoc. Degree</b>	.00	.00	-.03 *	.00	-.02	.07	.02
<b>College Degree</b>							
<b>At Least Some Post Grad.</b>	.06 *	.01	.02	-.04	-.04	.04	-.01
<b>Marital Status:</b>							
<b>Divorced</b>	.02	-.04	-.02	-.03	.01	.05	.03
<b>Widowed</b>	-.01	-.04	.01	-.07	.04 *	-.05	.03
<b>Single</b>	-.02	-.03	.00	.02	.02	-.10	-.02
<b>Household Composition:</b>							
<b>Size</b>	.01	.01	-.01	.01	.00	-.04	.01
<b>Children</b>	-.02	.00	-.01	-.02	.00	.12	-.05
<b>Race:</b>							
<b>Latino</b>	-.03	.09 **	-.01	-.03	.08 **	-.01	.07
<b>Black</b>	-.04	.04	-.02	.01	.11 ***	.02	.07
<b>Asian</b>	.07	.06	-.02	-.15	.01	-.19	-.05
<b>American Indian</b>	.09	-.10	-.01	.08	-.05	-.04	-.06
<b>Other</b>	.00	-.13 *	.05	.01	.12	.22	.09
<b>Gender: Male</b>	.04 **	.00	.01	-.04	.02	.00	.00
<b>Income:</b>							
<b>&lt;\$25,000</b>	.08 **	.08 ***	-.02	-.06	.01	-.33	.03
<b>\$25,000-\$49,999</b>	.01	.05 **	-.02	-.03	.00	-.09	.00
<b>\$50,000-\$74,999</b>							
<b>\$75,000-\$99,999</b>	-.02	.01	.01	-.03	.00	.10	-.04
<b>&gt;\$100,000</b>	-.02	.00	.02	-.04	-.03	.26	.00
<b>Check Interest</b>	-.03	.00	-.02	.03	.00	.03	-.01
<b>Retired</b>	-.02	-.03	.02	.04	-.01	-.05	.02
<b>Not Employed</b>	.01	.01	.07 **	.02	.03	-.12	.07 *
<b>Financial Responsibility</b>	.01	-.01	.00	.02	.00	.03	.01
<b>Total Payment Methods</b>	.01 *	-.11 ***	.01 **	.04 ***	-.05 ***	-.05 ***	.00
<b>Inverse Mills Ratio</b>	-.12	-.15 *	-.01	.07	-.13 **	.61	-.05
<b>Number of Observations</b>	618	837	663	456	491	216	204
<b>R-squared</b>	.18	.45	.19	.17	.24	.36	.18
<b>Without CHAR</b>	.06	.41	.08	.12	.23	.31	.15
<b>Without CHAR and Total     Payment Methods</b>	.06	.11	.08	.09	.09	.18	.14

SOURCE: 2006 Survey of Consumer Payment Choice.

NOTES: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. Table entries are coefficient estimates from the second stage of the Heckman model in which adoption is the first stage. Results from the first stage are found in Table 5. For each column, the dependent variable is the share of total payments made with that payment type.

Table 7: Comparison of Heckman 2nd Stage Results and IV Regression Results for Checks

	Heckman Full Model	IV Full Model	Heckman Restricted	IV Restricted No Demog	IV Restricted with Demog
<b>Characteristics:</b>					
Cost	.04 ***	.10	.04 ***	.09	.10
Convenience	.08 ***	.12	.08 ***	.15	.17
Safety	.01	.17	.01	.26	.04
Privacy	.02	.05	.02	-.03	.06
Accuracy	.02	-.04	.02	-.12	-.05
Timing	.01	.14	.01	.16	.14
Record Keeping	.00	.23	.00	.18	.17
<b>Age:</b>					
25-34	-.06 **	-.01	-.07 **	.00	-.02
35-44					
45-54	.04	.08	.03	.08	.05
55-64	.02	-.03	.00	-.02	-.04
>65	.02	.00	.01	.01	-.02
<b>Education:</b>					
Some High School	-.01	.10			
High School	.01	.01			
Some College/Assoc. Degree	.00	.02			
College Degree					
At Least Some Post Grad.	.01	-.03			
<b>Marital Status:</b>					
Divorced	-.04	-.02	-.05 **	-.02	-.03
Widowed	-.04	-.06	-.05 *	-.07	-.07 *
Single	-.03	-.05	-.05 *	-.05	-.07 *
<b>Household Composition:</b>					
Size	.01	.00			
Children	.00	.01			
<b>Race:</b>					
Latino	.09 **	.12	.09 **	.11	.13 **
Black	.04	.08	.04	.06	.05
Asian	.06	.16	.07	.11	.12
American Indian	-.10	-.19 *	-.10	-.19 *	-.17 *
Other	-.13 *	-.15	-.13 *	-.18 *	-.18 *
<b>Gender: Male</b>					
	.00	.01			
<b>Income:</b>					
<\$25,000	.08 ***	.05	.09 ***	.03	.05
\$25,000-\$49,999	.05 **	.03	.05 **	.03	.03
\$50,000-\$74,999					
\$75,000-\$99,999	.01	.00	.01	-.02	.01
>\$100,000	.00	.01	.00	.00	.00
Check Interest	.00	-.01	.00	-.02	-.02
Retired	-.03	-.01	-.03	-.01	-.01
Not Employed	.01	.06	.01	.05	.04
Financial Responsibility	-.01	-.02	-.01	-.02	-.01
Total Payment Methods	-.11 ***	-.08 ***	-.11 ***	-.08 ***	-.09 ***
Inverse Mills Ratio	-.15 *	-.32 *	-.15 **	-.25 **	-.21 **
Number of Observations	837	754	837	754	754
R-squared	.45		.45		
Sargan p-value		.54		.60	.62
Basman p-value		.58		.64	.67

SOURCE: 2006 Survey of Consumer Payment Choice.

NOTES: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

The restricted model excludes education, household size, number of children, and gender from the regression.

These variables are used as instruments in column 5. They are not used as instruments in column 4. The IV regressions are two-stage least square regressions that include the inverse mills ratio obtained from the first stage of the Heckman model.

**Table 8: Change in Use Model Regressions (Ordered Logit)**

Explanatory Variables	Cash	Checks	Credit Cards	Debit Cards	ACH	Bank Site Online Banking	SVC
<b>Characteristics:</b>							
<b>Cost</b>	.88	.97	1.36 ***	1.43	1.61 *	2.70 **	1.27
<b>Convenience</b>	1.71 ***	2.96 ***	2.65 ***	.78	1.10	3.27 *	1.03
<b>Safety</b>	1.02	1.01	1.21	1.68 **	.76	1.09	1.06
<b>Privacy</b>	.88	1.41 **	.91	1.04	.96	.62	.66
<b>Accuracy</b>	1.02	.81	1.14	1.75	.92	.75	1.05
<b>Timing</b>	1.08	1.37 *	.92	3.20 ***	2.51 ***	2.20	.89
<b>Record Keeping</b>	1.59 ***	.69 **	1.24	.93	2.26 ***	2.21	1.39 **
<b>Age:</b>							
<b>25-34</b>	.71	1.27	.74	2.10 **	3.09 ***	.91	.55 *
<b>35-44</b>							
<b>45-54</b>	1.41	1.51 *	1.11	.66	1.11	.87	1.25
<b>55-64</b>	1.25	1.98 ***	.86	.88	1.00	2.80 *	1.19
<b>&gt;65</b>	1.10	2.08 **	.94	.91	1.04	3.77	1.77
<b>Education:</b>							
<b>Some High School</b>	3.31 **	1.92 *	.86	.51	.46	.41	1.06
<b>High School</b>	2.45 ***	2.04 ***	1.31	.43 ***	.77	2.41	.54 *
<b>Some College/Assoc. Degree</b>	1.34	1.18	.84	.57 *	1.12	.71	.69
<b>College Degree</b>							
<b>At Least Some Post Grad.</b>	1.08	.91	1.43	.49 **	1.07	1.29	.83
<b>Marital Status:</b>							
<b>Divorced</b>	1.94 **	.93	1.34	1.26	1.05	1.53	1.10
<b>Widowed</b>	2.07 **	1.19	1.53	.98	.80	1.27	1.03
<b>Single</b>	1.36	1.29	1.65 *	.92	.73	3.00 *	.95
<b>Household Composition:</b>							
<b>Size</b>	1.05	1.03	.96	1.19	.98	1.14	1.21 *
<b>Children</b>	1.58 *	1.56 *	1.11	.73	1.23	1.26	.55 *
<b>Race:</b>							
<b>Latino</b>	1.55	1.80 *	.81	.74	.57	3.20	.46
<b>Black</b>	1.16	1.11	.47 **	1.69	.72	1.17	.89
<b>Asian</b>	2.95	3.55 *	.72	.86	.50	.35	1.23
<b>American Indian</b>	1.10	.25 *	3.10	5.23	.36	2.92	8.31
<b>Other</b>	2.29	.49	3.91 *	.73	1.79	2.77	.05 **
<b>Gender: Male</b>	1.08	1.54 ***	1.09	.70 *	1.09	.69	.85
<b>Income:</b>							
<b>&lt;\$25,000</b>	1.44	1.34	.50 **	.52 *	1.06	.72	.72
<b>\$25,000-\$49,999</b>	1.18	1.09	.71	.96	1.21	.98	.73
<b>\$50,000-\$74,999</b>							
<b>\$75,000-\$99,999</b>	1.20	1.05	.86	.72	1.08	1.37	.90
<b>&gt;\$100,000</b>	1.31	.75	.97	.63	1.67 *	1.63	1.34
<b>Check Interest</b>	1.51 **	.94	.72 **	1.54 **	1.24	1.59	1.59 **
<b>Retired</b>	1.27	.71 *	1.65 **	.67	.85	.29 **	.56
<b>Not Employed</b>	.53 **	.52 **	1.54	.56	1.11	.88	1.86
<b>Financial Responsibility</b>	.89	.99	1.00	1.05	1.30 **	1.06	1.00
<b>Number of Observations</b>	633	863	713	495	533	216	391
<b>Pseudo R-squared</b>	.10	.09	.06	.13	.10	.13	.07
<b>Pseudo R-squared without characteristics (same sample)</b>	.06	.05	.03	.07	.05	.05	.06

SOURCE: 2006 Survey of Consumer Payment Choice.

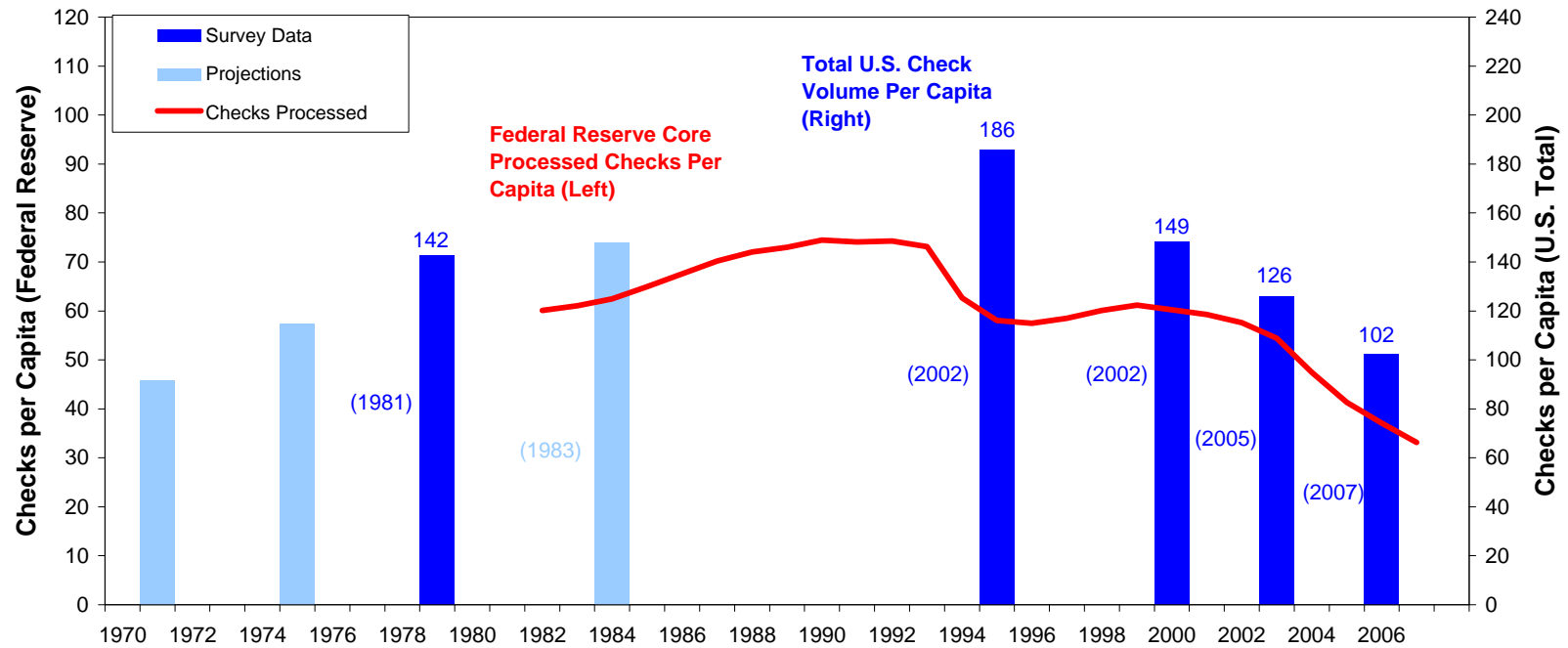
NOTES: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. Table entries are odds ratios.

For the dependent variables, 1 represents an increase in use, 0 represents no change, and -1 represents a decrease in use during the previous 3 years.

**Appendix**  
**Table 1: Instrumental Variable Definitions**

<b>Instrument</b>	<b>Definition</b>
AARP membership	Equals 1 if respondent or spouse is AARP member
Bill payment: car	Equals 1 if respondent makes car payments
Bill payment: college tuition	Equals 1 if respondent makes college tuition payments
Bill payment: mortgage	Equals 1 if respondent makes mortgage payments; 0 otherwise
Bill payment: student loan	Equals 1 if respondent makes student loan payments
Cash withdrawal: ATM	Equals 1 if respondent uses ATM to withdraw cash from their checking account
Cash withdrawal: bank branch	Equals 1 if respondent goes to a bank branch office to have a bank employee withdraw cash for them
Cash withdrawal: cash back from debit transaction	Equals 1 if respondent uses the cash back option from a debit card transaction to withdraw cash
Cash withdrawal: check	Equals 1 if respondent writes a check to withdraw cash
Check truncation	Equals 1 if respondent has ever had a cashier immediately hand their check back to them after a completed purchase
Internet access: home	Equals 1 if respondent has access to the Internet for personal use at home
Internet access: work	Equals 1 if respondent has access to the Internet for personal use at work
Internet access: other location	Equals 1 if respondent has access to the Internet for personal use at another location
Knowledge of check float	Equals 1 if respondent knows how many days it usually takes for the value of a check to be deducted from their checking account after they make a store purchase
Online financial experience	Level of experience conducting personal financial transactions online ranging from 1 (not at all experienced) to 5 (an expert).
Retirement Income	Equals 1 if respondent currently receives any form of retirement income such as Social Security, pensions, or any other type of retirement account
Returned checks: cancelled checks	Equals 1 if their bank returns their cancelled checks to them
Returned checks: electronic copies	Equals 1 if their bank returns electronic copies of their cancelled checks to them
Returned checks: paper copies	Equals 1 if their bank returns paper copies of their cancelled checks to them

Figure 1: U.S. Checks Per Capita

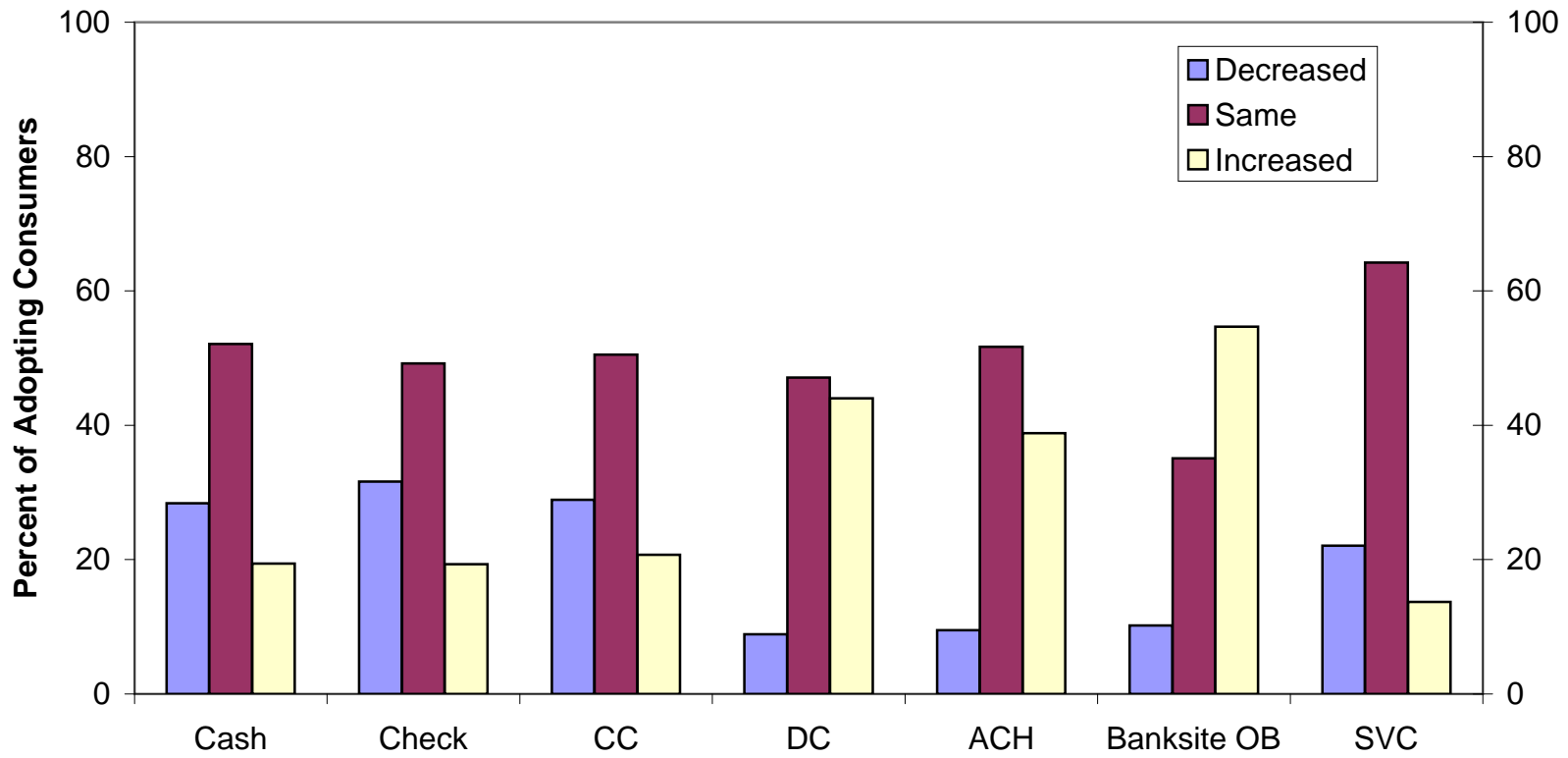


NOTES: Numbers in parentheses are the years when the data were published.

SOURCES: Federal Reserve System. See also Federal Reserve Bank of Atlanta (1981, 1983); Federal Reserve System (2002, 2004); Gerdes and Walton (2002); Gerdes, Liu, Parke, and Walton (2005); Gerdes (2008); Benton, Blair, Crowe, and Schuh (2007).

**Figure 2**

**Change in Consumer Payment Use, 2003-2006**

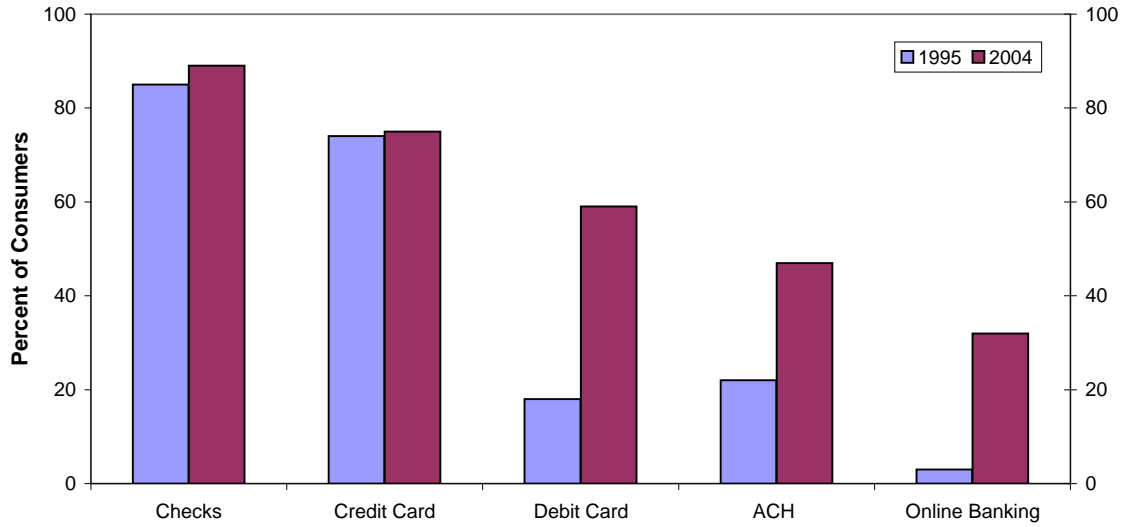


Source: 2006 Survey of Consumer Payment Choice

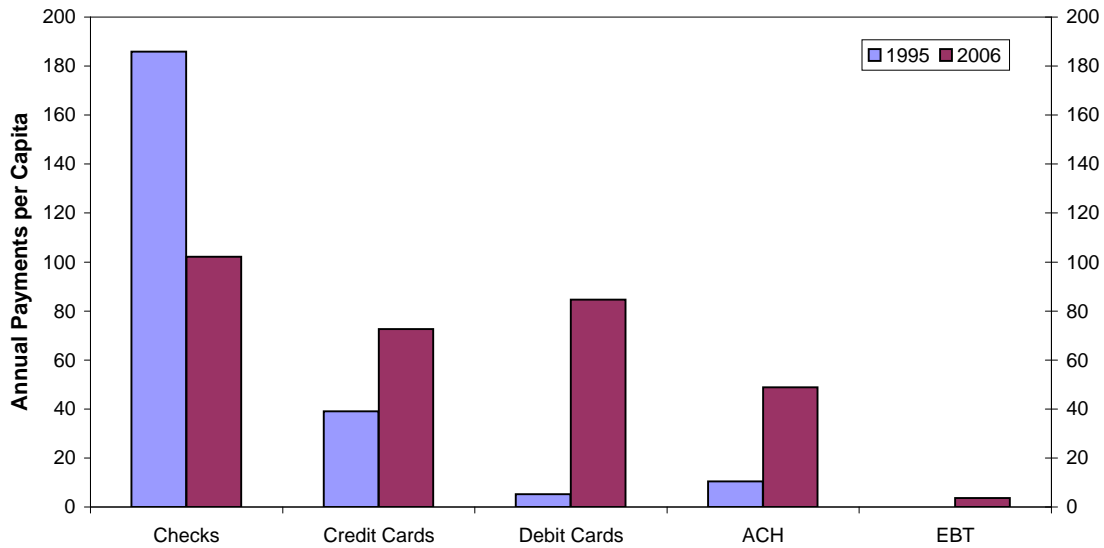
Note: The change in use question was only asked to respondents who had used the given payment type in the last five years. Adopters who had not used the payment type in the last five years were counted as "same." Non-adopters were excluded from the figure.

Figure 3

U.S. Payment Adoption Rates (Consumers Only)

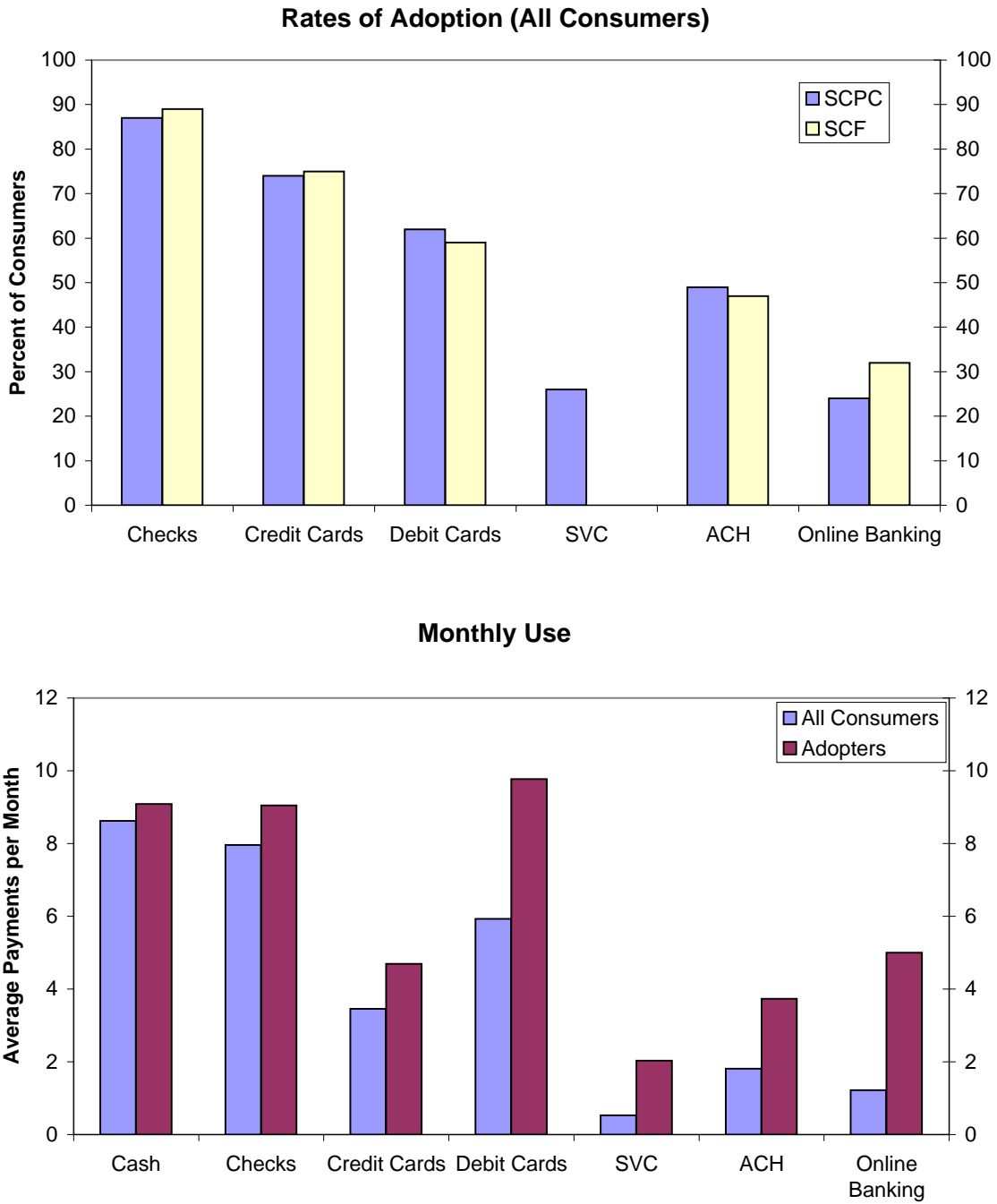


U.S. Payment Use (All Payments)



SOURCES: Top Panel: Survey of Consumer Finances (1995, 2004).  
Bottom Panel: Gerdes et al. (2002), Gerdes (2008).

**Figure 4**  
**Adoption and Use of Payment Instruments by U.S. Consumers**



SOURCES: Top Panel: Survey of Consumer Finance (2004), 2006 Survey of Consumer Payment Choice.  
 Bottom Panel: 2006 Survey of Consumer Payment Choice.  
 NOTES: SVC data not available from the SCF.