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**The Economics of a Cashless Society:
An Analysis of the Costs and Benefits of Payment Instruments**

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Executive Summary

Ever since Diners Club introduced the first general-purpose charge card in the early 1950s, pundits have been predicting the emergence of a “cashless society.” Fifty years later, we still use cash, but it is much less important than it once was. Today, there are a wide array of payment instruments, including cash, checks, several different types of payment cards, and electronic transfers. Moreover, there is a heated debate as to whether government should regulate various kinds of private payment systems, such as credit cards.

As a guide for examining policy questions, this paper provides an economic approach for assessing the relative costs and benefits of various payment methods. It is the first study to examine empirically the move toward a cashless society using cost-benefit analysis.

We present three case studies that illustrate the welfare implications of substituting one kind of payment method for another. We find that when all key parties to a transaction are considered and benefits are added, cash and checks are more costly than many earlier studies suggest. In general, the shift toward a cashless society appears to be a beneficial one.

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I. INTRODUCTION

Over the course of history, there have been many different forms of payment systems. Originally, barter was quite common. Eventually, various forms of money were introduced.¹ In the mid-twentieth century, charge cards debuted.² Ever since then, pundits have been predicting the demise of paper instruments and the emergence of a “cashless society.”³ Today, we still pay with cash and checks, but several other payment instruments, such as credit and debit cards, are widely used. The use of paper money is declining, but at a slow pace. In this paper, we analyze the costs and benefits of using different payment instruments that have affected the shift toward a cashless society.

As more payment systems have been introduced, researchers have begun to critically examine their costs from both a private and social perspective.⁴ From a private perspective, researchers have examined the incentives payers have for choosing a given type of payment instrument, the incentives retailers may have for accepting such instruments, and why various payment methods are used in different settings. From a social perspective, researchers have examined whether economic welfare would increase if certain payment instruments displaced others—such as, if electronic instruments displaced paper-based instruments. Our study is the first to examine empirically the move toward a cashless society using a framework that includes benefits as well as costs.

¹ For a history of the evolution of money see, e.g., Glyn Davis, *A History of Money: From Ancient Times to the Present Day*, Cardiff, U.K.: University of Wales Press, 2002.

² Diners Club, introduced in 1950, was the first general purpose (as opposed to store-specific) charge card. David Evans & Richard Schmalensee, *Paying With Plastic: The Digital Revolution in Buying and Borrowing*, Cambridge, MA: MIT Press (forthcoming, 2005).

³ As a 1958 U.S. News & World Report article on the then-new Diners Club credit card stated, “Before long, a man will be able to live or travel almost anywhere with only a few dollars in his pocket. Instead of paying cash as he goes, he will simply settle by check for just about everything at the end of the month.” “What You Now Can Do Without Cash,” *U.S. News & World Report*, October 24, 1958.

The interest in the economics of payment instruments has been more than academic. For example, two recent cases centered on whether payment cards are “overused” in a social welfare sense: the investigation of MasterCard by the Office of Fair Trading in the United Kingdom, and the Australian central bank investigation of MasterCard and Visa.⁵ In brief, the regulators claim that payment card systems charge “unjustifiably high” fees to merchants for payment cards while the banks issuing payment cards provide consumers with below-cost services and loyalty rewards.⁶ Thus, by not charging consumers the full marginal cost imposed by their card use, the regulators assert that payment card systems encourage consumers to overuse payment cards, which they can afford to do profitably because merchants shoulder the cost.

In the United States, the scrutiny has been no less intense, but has emphasized different pricing aspects of the payment card systems. In the widely publicized *Wal-Mart* case, for example, the plaintiffs argued that debit cards were illegally tied to credit cards—that is, merchants accepting credit cards also had to accept debit cards. They claimed that this tie enabled the payment card systems to charge “exorbitant” fees to merchants, although they did not argue that the end result was debit card overuse.⁷ At the other extreme in terms of policy implications, New York Attorney General Eliot Spitzer is considering opening an investigation on the commercial bank practice of charging consumers per-transaction fees for PIN debit

⁴ We define “private” costs and benefits as those faced by only one side of a transaction, such as a merchant payee or a consumer payer. “Social” costs and benefits are those incurred by the economy as a whole, including all parties to a transaction.

⁵ “MasterCard Interchange Fees: Preliminary Conclusions,” Office of Fair Trading (OFT634), February 2003, at 3. Reserve Bank of Australia, “Reform of Credit Card Schemes in Australia IV: Final Reforms and Regulation Impact Statement,” August 2002. The Australian central bank’s expert economist argued, “distortions in credit and charge card prices can lead to excessive card use.” Michael L. Katz, “Network Effects, Interchange Fees and No-Surcharge Rules in the Australian Credit and Charge Card Industry,” August 2001, at 2, ¶15. The ruling by the Reserve Bank of Australia, Australia’s central bank, forced Visa and MasterCard to cut their interchange fees by 40 percent. “Visa Throws in Towel on New Card Rules,” *New Zealand Herald*, October 30, 2003.

⁶ Merchants pay a fee, referred to as the “merchant discount,” to the banks that process their payment card transactions. Merchant’s banks must then pass on a portion of that fee, referred to as the “interchange fee,” to cardholders’ banks. Thus, merchants indirectly pay card issuing banks for each payment card transaction.

⁷ Second Amended Consolidated Class Action Complaint and Jury Demand, *In re Visa Check/MasterMoney Antitrust Litig.* (E.D.N.Y. 2000) (No. CV-96-5238). The case settled before the jury trial began. In the settlement, MasterCard and Visa agreed to pay several billion dollars in cash and to not require merchants to take their debit cards as a condition of taking their credit cards.

cards. While it is unclear what Spitzer's plans are, he appears to be concerned that consumers pay too much to use PIN debit payment cards.⁸

While all of these policy issues are worth examining, we would argue that most attempts at answering them have been incomplete because they do not adequately consider key parties in a transaction or economic benefits. This paper has two main objectives: first to develop a method for evaluating payment instruments and second to apply that method. Given the regulatory activity on this issue, a sensible cost-benefit approach is needed. The empirical applications we develop illustrate how cost-benefit analysis can be used. They also provide policy makers with insights on how moves toward a cashless society affect net economic welfare. In particular, we find that merchant cost studies suggesting that payment cards, especially credit cards, are very costly are misleading when used to argue that payment cards are costly for the economy as a whole. When other parties to a transaction are considered and benefits are included, payment cards appear competitive with other forms of payment available to consumers. Our results suggest that the slow but inevitable shift toward a cashless society is beneficial, providing certain groups with clear benefits while not costing more to process in the aggregate than traditional paper transactions.

The paper proceeds as follows. Section II offers guidelines for assessing the costs and benefits of payment instruments. In Section III, we evaluate the literature on payment instruments in light of these guidelines. A significant portion of the literature has focused solely on the costs of payment instruments. Some studies have counted elements of cost in an inconsistent manner and others have focused on the costs of payment instruments for just one party to a transaction, notably merchants. As a result, the literature provides only limited guidance on the desirability of substituting certain payment instruments for others. To better understand the economics of the transition from cash and checks to cards, we develop case studies in Section IV for three retail environments: grocery stores, discount stores, and electronics specialty stores. Our calculations focus on providing rough estimates of marginal costs and benefits for an additional transaction by an average consumer. The case studies

⁸ David Breitkopf, "What Are N.Y. PIN-Debit Fee Probers After?" *American Banker*, October 6, 2003.

present evidence on the incentives driving the move toward a cashless society. Section V presents our main conclusions.

II. THE COST-BENEFIT APPROACH

This section of the paper is intended as background for our later analysis. Readers with economics training will find it quite familiar. Our method is based on three fundamental principles. First, a payer tends to choose a payment system that maximizes her net benefits from a particular transaction. Her choice is constrained by available instruments, such as a previous decision to apply for a credit card, and by payees' decisions about what instruments to accept.⁹ Payees make choices by comparing the net benefits of accepting a particular instrument with those of not accepting it. Interestingly, much of the economic literature on payment systems focuses solely on payees' costs, even though this focus can be misleading for ranking the relative merits of payment systems from both an individual and a social perspective.

Second, all parties involved in a transaction should be included in a cost-benefit analysis. Focusing on the costs and benefits to a payer or payee can help explain why a payer uses or a payee accepts a particular instrument. But even when separately analyzing the incentives for use or acceptance it is appropriate to analyze both sides of a transaction. A payer's decision to carry a payment instrument will be affected by how many payees accept it, and a payee's decision to accept it will be affected by how many payers carry and use it.¹⁰ Focusing on the net benefits to all parties in a transaction is necessary when examining the

⁹ To clarify the concepts necessary for analyzing the costs and benefits of different payment methods, we initially assume that payers choose among available payment options. That is, the availability of payment instruments is assumed to be exogenous. An individual payer is largely responsible for determining the payment method, selecting an instrument from among those she has access to and that the payee accepts. Note that consumers initiate more than 90 percent of all transactions, so starting from a payer's choice of instruments and then factoring in acceptance constraints is a natural approach. Brian Mantel, "Why Don't Consumers Use Electronic Banking Products? Toward a Theory of Obstacles, Incentives, and Opportunities." Federal Reserve Bank of Chicago, Emerging Payments Occasional Paper Series EPS-2000-1, September 2000, at 8. This simplifying assumption is dropped later on when we address individual decisions by payees to accept a given method and by payers to carry a given method.

¹⁰ Payment instruments operate in a two-sided market. Payment instrument providers need to coordinate the demands of two (or more) distinct groups of customers, payers and payees. See the discussion in David S. Evans, "The Antitrust Economics of Multi-Sided Platform Markets," *Yale Journal on Regulation*, Vol. 20, 2003, at 357-58.

social net benefits from a transaction. In some cases, a payer's benefit may represent a cost to payees. Float is an example: the private costs and benefits tend to cancel out in a social net benefit calculation. It is also important to consider the externalities imposed on other parties by some payment instruments. For instance, because paper checks tend to take longer to process at the point of sale than other forms of payment, they impose relatively higher opportunity costs on anyone waiting in line behind a payer.¹¹

Third, all significant components of costs and benefits should be considered when comparing payment instruments. This includes both explicit costs (such as bank fees) and implicit costs (such as opportunity costs). Some costs are certain and unavoidable, such as envelope and postage costs for mailing a check to pay a bill. Others are not, such as the possible loss of cash if a person is robbed on the way to a store. Regardless of the underlying nature, all significant costs and benefits should be included in a reasonable assessment of net benefits.¹²

A. The Parties Involved

Consider a simple transaction in which a consumer wants to purchase a good at a store. There are always at least two parties to this transaction—the consumer and the store. Both participate directly, not only because the consumer purchases a good that the store supplies, but also because both choose a given payment instrument to consummate the transaction. The store chooses to accept a set of payment methods and the consumer chooses among them.

Even the simplest payment mechanisms involve numerous indirect parties, although some operate behind the scenes. For instance, cash has to be produced and distributed. In fact, in the late 1990s the American government spent roughly \$700 million a year to buy new notes and coins from the Bureau of Engraving and Printing and to process, store and distribute the

¹¹ The opportunity cost of time is the value of time in the best alternative use. For example, a worker paid \$10 an hour who needs to leave work to spend one hour at a doctor's appointment would face an opportunity cost of \$10. This represents the money he could have earned if he had not spent the time at the doctor.

¹² Ideally, one would want to identify and quantify all costs and benefits to the extent reasonable. Of course, the identification of significant costs and benefits is a matter of judgment. Moreover, the quantification of certain costs and benefits is difficult in practice, as we discuss in the case studies.

currency.¹³ In order to make a cash payment a consumer must first obtain cash, say from an ATM. This machine is maintained and serviced by a financial institution.¹⁴ These institutions play a role at the beginning of a transaction by distributing cash prior to a sale and at the end of the process by accepting cash deposits, say in a retailer's bank account.

Consider what happens if a consumer pays for goods with a check. She first must have a checking account at a financial institution and must obtain checks from a check-printing firm. Assuming the store accepts personal checks, it will deposit the consumer's check in its bank. If the consumer's and the store's accounts are in the same bank, then the check is called "on us" and stays within that bank.¹⁵ Otherwise, the physical check usually travels from the store's bank through a financial intermediary (a clearing house or a Federal Reserve Bank) to the paying consumer's bank. It is often then returned to the consumer at the end of the month along with a bank statement.¹⁶

The example highlights a simple, but fundamental, point: although the payer and payee are usually the two primary parties directly involved in a given transaction, many other parties are involved as well. Many of these parties charge payers and payees directly for their services, others incur costs that are not fully passed on (at least not directly). Including these other parties is essential for calculating social costs and benefits—a point illustrated by our case studies—but it also can be important for calculating private costs and benefits.

¹³ Paul W. Bauer, "Currency: Time for Change?," *Federal Reserve Bank of Cleveland Economic Commentary*, October 1998. Note that the dollar figures throughout this paper have not been adjusted to current dollars, and are reported as the original author(s) or study reported them.

¹⁴ On the development of the ATM system, see Donald I. Baker & Roland E. Brandel, *The Law of Electronic Fund Transfer Systems: Legal and Strategic Planning*, New York: Warren, Gorham & Lamont, 1998, at ch. 6.

¹⁵ On-us check transactions comprise approximately 33 percent of all checks processed. Joanna Stavins, "A Comparison of Social Costs and Benefits of Paper Check Presentment and ECP Truncation," *New England Economic Review*, July/August 1997, at 32.

¹⁶ Stavins, "Comparison of Social Costs," *supra* note 15; Joanna Stavins, "While More People Are Paying Electronically, Many of Us Still Cling to Checks," *Federal Reserve Bank of Boston Regional Review*, Vol. 11, 2002; and Stuart E. Weiner, "Electronic Payments in the U.S. Economy: An Overview," *Federal Reserve Bank of Kansas City Economic Review*, 1999. Due to recent check-imaging legislation (commonly referred to as the Check 21 Act), more consumers will receive a statement with an image of their cancelled checks as opposed to the physical checks themselves. Will Wade, "Gauging the Long-Term Opportunities in Check 21," *American Banker*, October 31, 2003.

B. Private Versus Social Net Benefits

While the distinction between private and social costs may seem obvious, some of the literature to date has not dealt with the distinction clearly.¹⁷ For our purposes, private net benefits accrue to each of the private parties (or groups) involved in a transaction, such as merchants or consumers.¹⁸ Social net benefits include payers and payees plus indirect parties.¹⁹ Understanding private net benefits is a key to understanding the incentives that payers have for using a particular payment instrument and that payees have for accepting it. Understanding social net benefits is critical for assessing the overall impact of a given instrument.

Consider again a consumer purchasing a good at a store, but now assume a debit card is used for payment. The benefits for the payer might include the decreased bulk of debit cards as compared to cash and a reduced need to obtain cash from an ATM. If the debit card receipt is signed for authorization (called signature debit) rather than authorized with a personal identification number (PIN debit), the consumer is guaranteed full reimbursement for any unauthorized debit charges to her account.²⁰ Furthermore, signature debit, unlike PIN debit,²¹ benefits the consumer with up to two days of float, as the money is not immediately deducted from her account. If, on the other hand, the transaction is processed as PIN debit, the consumer can get cash back from the store and save another trip to the ATM.²² On the cost side, the consumer will certainly have to wait at the store counter while the card transaction is processed, and the wait may be slightly longer than if she had paid with cash—although it is likely shorter than with checks.²³ She may also have to pay her bank a transaction fee for using PIN debit.²⁴

¹⁷ We discuss this in Section III.

¹⁸ Net benefits are defined as the difference between benefits and costs.

¹⁹ We focus on economic welfare and do not consider equity or distributional issues.

²⁰ Ann H. Spiotto, "Credit, Debit, or ACH: Consequences and Liabilities. A Comparison of the Differences in Consumer Liabilities," Federal Reserve Bank of Chicago, Emerging Payments Occasional Paper Series EPS-2001-3, 2001.

²¹ Most physical debit cards allow both PIN and signature debit transactions. How the card is read and authorized determines the kind of debit transaction. Signature debit transactions are processed by swiping the card through a traditional credit/charge card reader and requiring the consumer to sign the receipt; PIN debit transactions are processed by passing the card through a PIN pad and requiring the consumer to enter her PIN for authorization.

²² Ingenico, "Online Debit: A significant opportunity for retailers to reduce their cost of business while improving customer service," 2002 (visited March 25, 2003) <<http://www.ingenico-us.com/PDF/debitwp.pdf>>.

²³ One of the few U.S. studies that reports time spent at the point of sale is the Food Marketing Institute. See, e.g., Food Marketing Institute, "Benchmarking Comparative Payment Methods: Costs and Case Studies," 1994; Food

She likely considered these costs and benefits when she first decided to carry a debit card. The decision to carry a debit card is often trivial for consumers, however, since many banks automatically issue one when a customer opens an account. The more important decision for individuals is whether to use the card at stores that accept it.

When it first decides whether to accept debit cards, a store also considers the benefits and costs. Many customers carry and use debit cards so a store could decide to accept them as a convenience service or to increase the likelihood of a sale. For PIN debit transactions, stores typically receive payment the following business day; for signature debit, stores get paid within a couple of days.²⁵ Cash can be counterfeited or stolen from a store's register and checks can bounce, but theft and insufficient funds are less likely with debit cards. Processing debit card transactions may take slightly longer than cash, but is certainly faster than processing checks. More importantly, with debit cards a store does not have to spend resources in preparing cash or check deposits or in transporting paper instruments to a bank, which eliminates the deposit fee that merchants often have to pay for depositing cash or checks.²⁶ On the other hand, a store would have to pay a fixed per-transaction fee to a processor to clear debit card transactions.²⁷ With signature debit transactions it typically would have to pay an additional fee to a bank, one that is proportional to the transaction amount.²⁸ Finally, before accepting PIN debit, a store would have to install a PIN reader, a separate machine from the charge and credit card reader it probably already has.

Marketing Institute, "A Retailer's Guide to Electronic Payment Systems Costs," 1998; and Ingenico, *supra* note 22.

²⁴ See, e.g., David Breitkopf, "Pulse: Processing Tab Main Reason for Hike," *American Banker*, July 7, 2003; Lavonne Kuykendall, "Debit Cards Gain in Popularity, Not on Bottom Line," *American Banker*, June 13, 2002; and W.A. Lee, "Can Debit Cards' Popularity Support Reward Programs?," *American Banker*, September 18, 2002.

²⁵ Ingenico, *supra* note 22.

²⁶ Retailers report paying deposit fees in the following empirical studies: Food Marketing Institute, "Benchmarking Comparative Payment Methods," *supra* note 23; Food Marketing Institute, "A Retailer's Guide," *supra* note 23; and Coopers & Lybrand, "Survey of Retail Merchants to Determine Costs of Payment Acceptance," 1994.

²⁷ The banks that handle payment card processing for retailers are typically referred to as "acquirers" (as opposed to "issuers" that issue payment cards to consumers). Acquiring banks often sign on a merchant for a particular payment card brand, say MasterCard, and then sometimes outsource the actual card processing to a third party.

²⁸ Banks belonging to the MasterCard and Visa networks process signature debit cards. Evans & Schmalensee, *supra* note 2.

Debit card transactions at a store impose two types of costs on indirect parties—an important consideration for social net benefits. First, waiting for a debit transaction to be processed at the counter generates an opportunity cost of time for the payer as well as the people in line. As an externality, time waiting in line is not included in the private net benefit calculations for a payer, but should be included in calculations of social net benefits. Of course, *all* payment instruments generate analogous externalities at the point of sale. As such, retailers may account for them in the price of goods sold if the externalities necessitate hiring additional clerks, for instance. A key to determining social net benefits is assessing the relative magnitude of the externality for each payment method; that way, incremental social net benefits can be computed.²⁹

In addition, debit card transactions impose other costs on indirect parties that are passed through to consumers or stores. A bank processing a debit transaction incurs processing costs, but passes these on to the merchant through the so-called “merchant discount.”³⁰ While including processing costs in social net benefits of debit cards is important, note that the merchant discount is designed, at least in part, to cover these costs. Understanding the role that different fees play is essential in fully capturing social net costs while avoiding double counting.

C. Careful Accounting

While the importance of considering net benefits as opposed to costs or benefits in isolation seems apparent, in practice it is difficult to do. As a result, the debate over payment instruments has frequently only counted costs. But an analysis that examines only one side of

²⁹ This issue suggests the need to set a baseline for comparison. If all payment mechanisms impose externalities, such as waiting time in line, then each payment instrument could be compared to a given option, such as cash. In the case studies evaluated in Section IV, we compare the net costs of payment cards to the net costs of paper instruments.

³⁰ The merchant discount is the price a merchant pays to an acquirer for the service of payment card processing. For Visa and MasterCard transactions, the merchant discount includes the “interchange fee,” a transfer payment that acquiring banks make to issuing banks (that is, banks that issue cards to consumers). Issuers incur a greater proportion of costs of the system and the interchange fee serves to balance costs and demand between the issuing and acquiring sides. Closed systems, such as American Express do not have separate issuers and acquirers. See Richard Schmalensee, “Payment Systems and Interchange Fees,” *Journal of Industrial Economics*, Vol. 50, 2002.

the equation can be misleading for both private and social decision-making, a point our case studies clarify.

Consider the private perspective in the consumer purchase example. When a consumer decides whether to pay cash or write a check, it is clear that the relative costs of these instruments matter. Writing a check will likely impose a higher opportunity cost of time for the payer as well as for other people in line. But it is also clear that relative benefits matter. If, say, having proof of payment were important to a payer, then the fact that returned checks provide this benefit while cash does not will matter. The fact that we see checks heavily used in some venues but not in others suggests that proof-of-payment plays a key role only in certain circumstances. Paying with cash, on the other hand, can maintain a customer's anonymity and thus privacy. Without employing some other means of tracking, such as a customer loyalty card, retailers are unable to capture and analyze a consumer's cash purchases.

Now consider the social perspective. If we were trying to determine whether replacing checks with debit at the point of sale increased welfare, we would have to consider net benefits for the payer, net benefits for the store, and costs and benefits other parties incur from the use of one payment instrument versus the other. In this calculation, some items are a benefit for one party, but impose a cost on another participant. When a consumer writes a check at a store, she gets the benefit of float for a few days. The merchant, however, incurs a cost from float. Even though float tends to cancel out in social calculations, it is an important element of the calculation because it affects private choices.³¹

All benefits should be considered, even though some are difficult to quantify. The proof-of-payment component of checks, for example, may be trivial in some settings—say, convenience stores—but is undoubtedly important in many other circumstances, such as paying when utility bills. In fact, survey research shows that people are willing to pay to receive their cancelled checks from their banks.³²

³¹ To the extent that different interest rates are available to consumers as opposed to merchants, float may be valued differently by the various parties and therefore would not completely cancel out in a net social cost calculation. Also, if individuals expend resources to influence float (either to increase or decrease it), those expenditures will represent a cost to society.

³² Stavins, "Comparison of Social Costs and Benefits," *supra* note 15, at 38.

To the extent possible, implicit costs should be included in the cost-benefit analysis. For example, the time spent at the point of sale while a transaction is processed represents an opportunity cost for payers. Probabilistic costs can be important as well. For instance, there is some chance that cash will be stolen from a consumer on the way to a store or by employees once paid to a store. Although some costs are easier to estimate than others, seemingly second-order costs can matter when it comes to both private decision-making and economic welfare evaluations. One study found, for example, that the crime rate plays an important role in determining the intensity of cash use.³³ In fact, one important obstacle to developing the ATM system in the U.S. in the late 1980s and early 1990s was increased ATM-related crime.³⁴

D. How to Pay, How to Get Paid

Before deciding which instrument to use, a payer has to choose which instruments to carry. On the other side of the transaction, a payee has to choose whether to accept a payment instrument or not. This raises the issue of the difference between the acceptance decision and the usage decision, which is linked to the distinction between marginal and total costs and benefits.

Consider once again a consumer purchasing a good at a store. Assume that at the end of the month the store calculates the cost of accepting debit cards. The total cost for a payee to accept debit cards is comprised of some fixed and some variable components.³⁵ For example, in order to accept PIN debit cards, a store has to purchase PIN pads for customers to enter their PINs and it has to train its staff to use these machines properly. These costs are fixed—they have to be paid in order to accept PIN debit at all, but are paid only once. Each PIN debit card transaction also imposes a variable cost—merchants pay a per-transaction fee to the bank that processes its payment card transactions.

³³ David B. Humphrey, Lawrence B. Pulley, & Jukka M. Vesala, “Cash, Paper, and Electronic Payments: A Cross-Country Analysis,” *Journal of Money, Credit & Banking*, Vol. 28, 1996.

³⁴ Baker & Brandel, *supra* note 14, at 1-19ff. Bank customers sued banks seeking compensation for injuries from crimes related to ATM use, an interesting example of payers trying to pass through to third parties one portion of the cost of transacting in cash.

³⁵ Variable costs are components that vary with the number of transactions or with the size of a transaction.

How much does it cost a store to process an additional PIN debit transaction? In answering this question, fixed costs are irrelevant. The only components of cost that matter are the variable ones, in particular the fee paid by a merchant to its processor. Thus the marginal cost of debit is the relevant measure for questions of payment instrument use.

The distinction between marginal and total costs has implications for analyzing the net benefits of payment instruments. The private marginal cost of using a given payment instrument for a payee may be the lowest among all payment instruments. If, however, the fixed costs of initial acceptance are relatively large, payees may be reluctant to adopt this new payment method.³⁶ Questions of payment method acceptance thus require analyzing total, not just marginal, costs and benefits. Therefore, when we talk about costs and benefits it is worth clarifying whether fixed costs are included and whether a given cost is fixed or variable at the time of evaluation.

The availability decision can be more significant for one party versus another depending on the payment instrument. First, consider cash. Merchants have been accepting cash basically since cash came into being as a payment instrument, although not always at par.³⁷ Since cash is legal tender, American merchants have given little thought to the issue of accepting it. For present-day U.S. payers, however, deciding whether or not to carry cash, or deciding how much to carry, is far from trivial. They face a fixed cost of obtaining cash: explicit ATM fees, the opportunity cost of the trip to the ATM, and, prior to the expansion of the ATM system, the larger time cost of going to a bank to obtain cash. Now, consider payment cards. History shows that convincing merchants to accept various payment cards has been a far more substantial issue than convincing consumers to carry and use them. Merchants have had to make investments in card-processing technology and staff training, whereas consumers have often obtained cards for free from issuers and have even received rewards for using them.³⁸

³⁶ If some parties face higher costs or fewer benefits from switching than others, they can prevent the entire system from changing. Electronic check processing may suffer this fate. Stavins, "Comparison of Social Costs," *supra* note 15.

³⁷ That is, at various points in time certain currencies have traded at less than their face value.

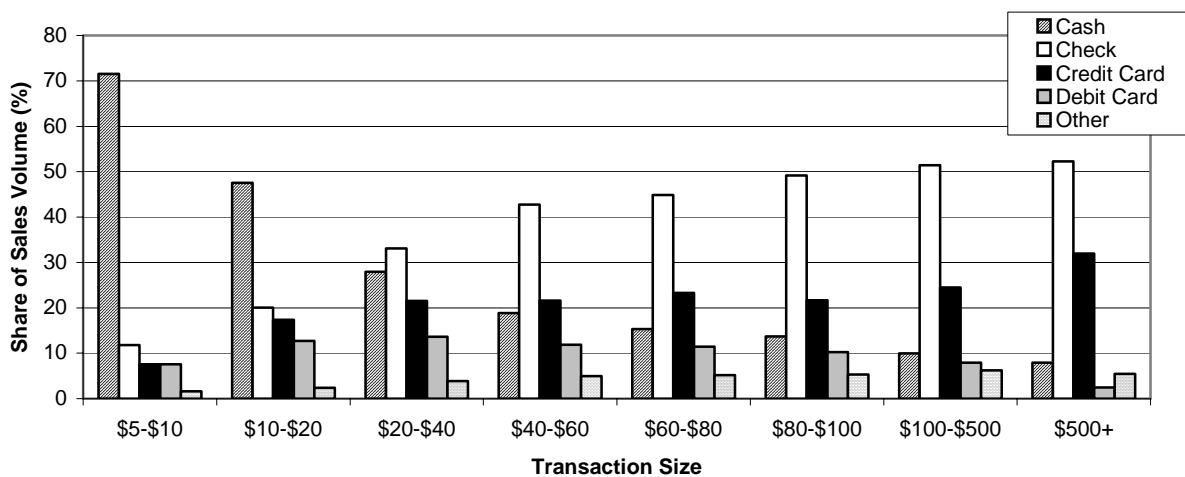
³⁸ This is not to say that the card availability decision has been totally costless for payers—some credit cards, for example, charge annual fees, clearly a fixed cost of paying with cards. And using debit cards instead of checks

In our case study analysis, we focus on marginal costs and benefits. That is, we examine the costs and benefits of an incremental transaction and do not include fixed costs.

E. Different Instruments Serve Different Needs

In examining payment instrument use across different transaction sizes and in different environments, it is clear that many different methods are used for very similar purchases. Figure 1 shows the percentage of 2001 sales volume for consumer-to-business transactions paid for by payment cards and paper instruments, broken out by transaction size.³⁹ As the chart illustrates, several different payment instruments are employed at each transaction size.

Figure 1. Transaction Shares of Various Payment Instruments, 2001



Source: Visa U.S.A., 2001 data.

has required consumers to relinquish some float. For more detail on the evolution of payment cards, see Evans & Schmalensee, *supra* note 2.

³⁹ The Visa U.S.A. survey data employed here tracks ownership and usage of payment cards and other payment mechanisms for households over time. Between 4,000 and 6,000 households are interviewed each quarter, and the results are representative of households with incomes over \$10,000 that also own at least one plastic card (store or general purpose). Households are surveyed once per quarter for their spending patterns and card ownership for the three months of the quarter. Thus, each household will have at most four units of observation each year (and some will have less than four, due to some respondents not providing survey information in a particular quarter). Publicly available data, such as statistics in *The Nilson Report*, do not provide the same level of detail (i.e., no figures by transaction size or by merchant). However, once aggregated, the Visa U.S.A. data are consistent with *The Nilson Report*.

A number of factors explain the diversity in consumer payment instrument use. For a given dollar amount, a wide range of transaction types exists depending on, among other things, who is making a payment to whom. For example, consumers pay landlords rent—a recurring, fixed amount charge; consumers purchase goods and services from businesses, either in person or remotely; and consumers pay utilities, another recurring charge, though typically not of a fixed amount. Differing levels of trust between payer and payee will influence the preferred payment method,⁴⁰ as will payee constraints on what is accepted. Moreover, consumers vary in income and wealth. Individuals who command higher labor incomes may have a higher opportunity cost of time.⁴¹ They may be willing to pay more for a transaction that is faster. Thus, variation in income can generate different valuations across consumers for various payment instruments.

Transactions themselves are also diverse. They may be small or large on average; they may be occasional or frequent; they may be in person or conducted remotely. Monthly rent, for instance, may be several hundred dollars while newspapers cost just a few dollars a week. Even at the same merchant, transaction size varies. At the supermarket, one could purchase eggs and milk for cash or use a check to buy a week's worth of groceries.

Heterogeneity among merchants plays a role in determining payment instrument acceptance. For example, a discount retailer with multiple checkout lanes will face different costs and benefits from accepting personal checks or online debit cards than a boutique retailer with only one payment register. Merchants also deal in goods with different prices. A retailer dealing in low-price items may look at the relative merits of PIN and signature debit very differently than a retailer dealing in higher-price items since merchants typically pay a fixed per-transaction fee for PIN debit and a percentage of the transaction value for signature debit.⁴² Merchants must also consider what payment instruments their clientele are most likely to want to use. As a result of all of these factors, for example, consumers may pay for \$10 worth of goods at a department store with cash or a credit card, but newsstands typically require cash.

⁴⁰ Jeffrey K. MacKie-Mason & Kimberly White, "Evaluating and Selecting Digital Payment Mechanisms," Working Paper, 1996.

⁴¹ Irrespective of labor income, people in a hurry to do something else will face a higher opportunity cost of time.

⁴² Evans & Schmalensee, *supra* note 2.

Even when consumers' choices are not constrained, payment methods can differ for the same purchase size because consumers view transaction types differently. For example, consumers are more likely to pay for \$100 worth of groceries with a check or debit card, but will often pay for \$100 worth of clothes with a credit card.⁴³ The fact that we observe several instruments used leads us to believe that payers with different personal characteristics have different assessments of costs and benefits. Some payers, for example, may place a high valuation on transaction speed whereas others may place a higher valuation on expense tracking and the possibility of getting cancelled checks back. Private net benefits of a given instrument vary across people and, therefore, private usage in a given environment and for a given transaction size vary too.

These points raise an interesting issue in regard to evaluating social net benefits, which requires combining costs and benefits of payment instruments as perceived by heterogeneous agents. This is a standard problem in cost-benefit analysis, one that is typically resolved by considering an average or representative value.⁴⁴ But heterogeneity implies that the average value may not be relevant for particular transactions, consumers, or merchants.⁴⁵ Likewise, it would be inappropriate to assess general merchant costs by focusing on, say, supermarkets. While we use an average agent approach, we address three elements of diversity in our analysis—retail venue, transaction size, and consumer heterogeneity.

F. What to Hold Constant

A final point to consider in analyzing the net benefits of a payment method is the underlying assumption that a given transaction will occur regardless of the payment method decision. The consumer purchase example above illustrates a “conditional” approach. The assumptions here are that the transaction will take place with certainty, that it will take place at a given size and that it will take place in a specific context. Under these assumptions a consumer is faced with choosing a payment instrument based on the net benefits of each accepted instrument.

⁴³ Evans & Schmalensee, *supra* note 2.

Imagine a slightly different situation, one that allows the transaction to vary, say by purchase size or place. This unconditional approach raises different issues, assessing whether the transaction would have taken place in the absence of certain payment instruments, evaluating potential changes in the characteristics of the transaction, and gauging the economic consequences.

The second approach is harder to implement, but it recognizes the possibility that different payment instruments can, in general, increase economic welfare by increasing the number and type of transactions that take place or by affecting transaction costs. Consider, for example, certain impulse purchases. In arguing the need for stored value “smart” cards,⁴⁶ the Chairman of Intuit, Scott Cook, recounted a tale of driving through Santa Cruz on a hot day looking for a soft drink.⁴⁷ He stopped at two separate stores but encountered long checkout lines and vending machines that took coins only (which he did not have) or rejected the bills he did have. He never did buy a drink.

A new transaction may not take place due to restrictions on payment methods that are accepted. Of course, a payment instrument’s impact on the transactions taking place has limits. If one store does not accept personal checks, a store down the street may. That the second store accepts checks does not raise the number of transactions taking place, it merely shifts the venue. Even here, though, economic welfare is affected because searching for a store that accepts the desired payment method involves transaction costs. Nor is there perfect substitution over time for consumption—Scott Cook searched unsuccessfully for his preferred payment method. This simple illustration highlights two possible complementary effects from broadening the payment methods available: first, more consumption may occur because

⁴⁴ One can also use weights to calculate an aggregate value. See, e.g., Daniel T. Slesnick, “Empirical Approaches to the Measurement of Welfare,” *Journal of Economic Literature*, Vol. XXXVI, 1998.

⁴⁵ We explore this issue below in considering the sensitivity of our results to changes in the wage rate.

⁴⁶ Stored value smart cards are essentially electronic wallets. Holders transfer money to the card, which can then be used instead of cash or change at vending machines, parking meters, and other places where small bills and coins are used. Stored value smart cards are already well established in Asia (Japan and Hong Kong in particular) and in public transit systems in the United States. “Octopus Reaches Out Beyond Hong Kong,” *Card Technology*, February 1, 2003; Donald Davis, “JCB’s Chip Card Growth Strategy,” *Card Technology*, February 1, 2003; and Burney Simpson, “Public Sector Takes the Lead in Adopting Chips,” *Card Marketing*, March 1, 2002.

transaction costs are lower; second, the distribution of transactions can differ with consumers benefiting from getting closer to their preferences.

The conditional perspective on costs and benefits can produce results that look very different from the unconditional approach. If a transaction is going to happen at a store with certainty, then the opportunity cost of time spent traveling to the store is irrelevant; the trip is made regardless of the payment instrument used. But once you consider the possibility of purchasing goods from home via the internet, say, time spent in getting to the store is no longer irrelevant in comparing marginal costs and benefits. If, thanks to the availability of certain instruments, some consumers make the transition from in-store purchase to internet purchase, they clearly benefit from the time saved by avoiding the trip. Instead, they now have to account for time spent consummating a transaction online and the inconvenience of waiting for goods to be delivered. In sum, evaluating net benefits of payment instruments changes considerably in a conditional versus an unconditional approach. In practice, the conditional approach is far easier (and thus is the one we focus on in our analysis), but the unconditional approach can illuminate key issues.

III. A SURVEY AND SYNTHESIS OF THE LITERATURE

Several scholars have attempted to evaluate the costs of various payment instruments. When considered in light of the approach outlined above, it becomes clear that few papers present a comprehensive analysis of the payment methods they review. Most ignore the benefits side of the equation altogether, and some do an incomplete job in examining costs.

Our review focuses on the United States. Given the historical and institutional differences across countries, it is difficult to translate cost and benefit studies from one country to another. Even payment instruments that look similar across countries on the surface may be quite different operationally and, therefore, in terms of their costs and benefits.⁴⁸ Nonetheless,

⁴⁷ He presents this anecdote in the foreword to *Smart Cards, Seizing Strategic Business Opportunities*, edited by Catherine Allen & William J. Barr, New York: McGraw-Hill, 1997, at xi.

⁴⁸ Consider check clearance in two seemingly similar countries, the United States and Canada. Canadian banks developed a system where checks are cleared on a same-day basis, but U.S. banks have no such system in place and paper checks generally take around 5 days to clear. Due to historical differences in banking laws, Canada's commercial bank industry is highly concentrated: in 1990 the six largest banks in Canada accounted for 90

studies from abroad can offer insights on how to approach payment instrument evaluation. We therefore review several non-U.S. papers that make points relevant to our analysis.

A. The Academic Literature

We begin our review of the academic literature with some of the early and influential studies that compare and contrast multiple payment instruments. These studies attempt broad cost evaluations, covering paper and electronic payment methods. None of them address benefits in a systematic way, although a few of them mention benefits in passing. From these studies, we move on to another group of papers that attempt broad cost comparisons across nations. The cross-country studies attempt to use variations in costs at the national level to help explain payment instrument use. As noted above, it is difficult to compare payment systems across nations due to legal and historical differences. Even so, comparing different rates of payment instrument use can illustrate how payers and payees react to varying incentive structures. As with the first group of papers, these studies also generally ignore benefits. We are aware of only one U.S. paper that considers both costs and benefits in a comprehensive manner. We conclude our academic review with that paper, as well as a few others that look solely at benefits and ignore costs.

1. Multiple Payment Instrument Comparisons

Humphrey and Berger (1990) present one of the earliest attempts to comprehensively estimate payment instrument costs.⁴⁹ Using 1987 data, the authors calculate private and social costs for nine separate payment instruments—cash, checks, credit cards, travelers checks, money orders, Automated Clearing House transfers (ACH), wire transfers, point of sale (POS)

percent of total banking assets and for more than 75 percent of payment volume, whereas this level of coverage in the U.S. would have required more than 3,000 institutions. The relative concentration in Canada allowed banks to negotiate same-day check clearance (achieved through post-dating), while U.S. checks take several days to clear and are handled, on average, by almost 4 separate banks. David B. Humphrey & Allen N. Berger, “Market Failure and Resource Use: Economic Incentives to Use Different Payment Instruments,” in *The U.S. Payment System: Efficiency, Risk and the Role of the Federal Reserve*, edited by David B. Humphrey, 1990, at 58.

⁴⁹ Humphrey and Berger, *supra* note 48. For an earlier attempt along the same lines, see David B. Humphrey, *The U.S. Payments System: Costs, Pricing, Competition, and Risk*, New York: Monograph Series in Finance and Economics, 1984.

bill payments, and ATM bill payments.⁵⁰ They find that from a social cost perspective cash is the cheapest payment instrument, followed by ACH, POS bill payment, and ATM bill payment. From a private perspective, however, checks emerge as the cheapest payment method, followed by cash, ACH and POS bill payment.⁵¹

According to Humphrey and Berger, float introduces a wedge between social and private cost. With cash, users make float payments to the government, the cash issuer; with checks, payees make float transfer payments to payers; with credit cards, payees receive their money quickly while the card system provides float to payers, who do not pay for their purchases until their monthly bill arrives. Since payers using credit cards and checks do not face the full cost of their instrument choice, Humphrey and Berger argue that payers tend to “overuse” these payment methods.⁵² That is, the authors maintain that float imposes an externality and thus introduces a market failure, which should be corrected through some means, possibly including government intervention.⁵³

The Humphrey-Berger analysis focuses exclusively on costs. Float is counted as a cost only; the benefits of float for consumers are not included. Although the authors acknowledge that “convenience and acceptability” may play a role in payment instrument choice, they do not include these benefits in their calculations. Their consideration of government intervention is premature given that they have not calculated the net benefits of payment instruments.⁵⁴

⁵⁰ Humphrey and Berger calculate private cost as the residual of social cost once float is removed. This definition differs from our definition of private cost.

⁵¹ Strictly speaking, Humphrey and Berger find that, from a private perspective, consumer checks are more costly than cash, ACH and POS, whereas business and government checks are less costly than cash.

⁵² This point does not necessarily follow, though, since payment card systems are two-sided markets. The asymmetric fee arrangement can help to get both of the crucial parties to the transaction to participate. For an overview of two-sided markets, see Evans, *supra* note 10. For a theoretical treatment of two-sided market issues, see Jean-Charles Rochet & Jean Tirole, “Platform Competition in Two-Sided Markets,” *Journal of the European Economic Association*, Vol. 1, 2003; and Geoffrey G. Parker & Marshall W. Van Alstyne, “Information Complements, Substitutes and Strategic Product Design,” Working Paper, November 8, 2000. Because the platform (the payment card system) needs to balance overall demand, the prices charged to any one side will not generally equal the marginal cost on that side, if indeed marginal costs can even be separated by sides. See Schmalensee, *supra* note 30.

⁵³ Humphrey & Berger, *supra* note 48, at 47.

⁵⁴ The authors note that “speed, security, availability, and acceptability” may be important determinants of choice, but do not count these features in their accounting because benefits of this type are difficult to quantify. Humphrey & Berger, *supra* note 48, at 52.

Humphrey and Berger also do not include some important cost elements. For example, a payer's cost of cash is excluded from their calculations; yet, this is likely one of the key factors driving individuals away from paper instruments and toward payment cards for point of sale transactions.⁵⁵ Nor do their calculations include a payer's opportunity cost of time for check writing, which could be one of the elements driving individuals away from checks toward payment cards and automatic bill payment. Finally, the paper does not include the payee's cost of handling and processing checks, which available evidence indicates is a significant cost for retailers.⁵⁶

Wells (1996) builds on the Humphrey-Berger study.⁵⁷ For checks and ACH payments, she updates the 1987 data to 1993 dollars and then presents her own calculations side-by-side.⁵⁸ She finds that between 1987 and 1993 the value of check float declined considerably, due to both a decline in interest rates and improvements in check processing. She points out that despite the fall in the value of float, check use did not decline, but instead total check use increased by 20 percent.⁵⁹ Wells thus questions the Humphrey-Berger hypothesis that float explains the use of checks.

Wells also includes an estimate of the payee cost of checks, omitted from the Humphrey-Berger analysis. This addition makes a significant difference in the final numbers. Her estimate of the social cost of checks, for example, is significantly higher than Humphrey and Berger's.⁶⁰

⁵⁵ Humphrey and Berger acknowledge that the payer cost of using cash should include the cost of lost cash and theft, along with the cost of obtaining cash from a bank, but the calculations do not do so. Humphrey & Berger, *supra* note 48, at Table 2-A2.

⁵⁶ See, e.g., Food Marketing Institute, "A Retailer's Guide," *supra* note 23.

⁵⁷ Kirstin E. Wells, "Are Checks Overused?," *Federal Reserve Bank of Minneapolis Quarterly Review*, Vol. 20, 1996.

⁵⁸ Wells points out that an important difference between her study and the Humphrey-Berger analysis is that she accounts for the payer cost of checks and ACH. Wells, *supra* note 57.

⁵⁹ As a fraction of all transactions, however, checks declined by 3 percent in that time. *Payment Systems in Eleven Developed Countries*, Bank for International Settlements: Central Banks of the Group of Ten Countries and Switzerland, May 1989; and *Statistics on Payment Systems in the Group of Ten Countries*, Bank for International Settlements: Committee on Payment and Settlement Systems, December 1996.

⁶⁰ Wells calculates the total social cost of checks is between \$2.78 and \$3.09, whereas the total private cost is between \$2.69 and \$3.00. In Humphrey-Berger's approach, as updated by Wells, the total social cost of checks is only \$1.00, and the total private cost is slightly negative.

Wells does not include benefits in her calculations, but she also acknowledges that they matter, particularly in her discussion of why checks are used more frequently than less costly alternatives. She suggests that users do not treat checks and electronic payment instruments as close substitutes for one another: “Checks may be used more...simply because users prefer them to other ways of making payments.”⁶¹ In particular, benefits may stem from the control that is associated with having a physical payment instrument.⁶²

In a paper that emphasizes the low cost of electronic payment instruments, Gresvik and Øwre (2002) study how much it costs Norwegian banks to process various payment instruments, including certain forms of paper and electronic giro,⁶³ checks, and payment cards used both at ATMs and at the point of sale.⁶⁴ They base their results on an activity-based costing analysis survey.⁶⁵ The survey contains data on direct costs that vary with the number of transactions—costs related to individual services provided by a bank such as the purchase of notes and coins, the purchase of card services, and inter-bank charges. It also covers indirect costs, including personnel costs, computer system operations, the cost of buildings, machines, office supplies, and marketing. Indirect costs are allocated across payment services based on a bank’s activities in supplying that service.

The authors conclude that in general paper-based payment methods are more costly than electronic methods. One exception holds, however—internet giro costs more than mail giro, probably because internet giro is relatively new in Norway and start-up costs are high. The authors identify payment cards, which are more akin to PIN debit cards in the United States, as

⁶¹ Wells, *supra* note 57, at 5.

⁶² Wells suggests that “the primary objection to ACH payments may be not that they are electronic, but rather that they are automatic.” Wells, *supra* note 57, at 5.

⁶³ Giro payments, very significant in several European countries, are essentially credit transfer payments equivalent to preauthorized bill payments in the United States. In Europe, postal savings institutions, commercial and savings banks, and credit cooperatives set up their own separate giro systems in the late 1800s and early 1900s. After a period of competition between these various systems, cooperative agreements between postal and bank giros were established. The clearing systems for credit transfer giro payments started making the transition to electronics in the early 1970s. David Humphrey, Setsuya Sato, Masyoshi Tsurumi, & Jukka Vesala, “The Evolution of Payments in Europe, Japan, and the United States: Lessons for Emerging Market Economies,” The World Bank, Policy Research Working Paper No. 1676, October 1996.

⁶⁴ Olaf Gresvik & Grete Øwre, “Banks’ Costs and Income in the Payment System in 2001,” *Norges Bank Economic Bulletin*, 2002.

⁶⁵ Activity-based cost accounting, frequently referred to as ABC, is a method of assigning costs to business processes and activities. It attempts to determine which activities “cause” which costs.

among the cheapest payment instruments. In Norway, cards may be used to make payments at store terminals and to withdraw cash at either store terminals or ATMs.⁶⁶ In fact, payment cards used at in-store terminals are the most popular payment instrument in the country as well as the cheapest. The average cost of in-store card use has declined considerably, the authors explain, due to economies of scale achieved through significant growth in the number of transactions. Payment cards used for cash withdrawals at ATMs cost considerably more since the transactions involve cash replenishment, maintenance and security costs. Using checks for cash withdrawals is even more expensive, however, costing around three times as much as payment card cash withdrawals at ATMs.

2. Cross Country Comparisons

Humphrey, Pulley, and Vesala (1996) analyze patterns in the use of cash and other paper and electronic payment instruments in 14 developed countries, including the U.S.⁶⁷ Using payment data for 1987-1993, the authors address what determines payment instrument usage. Treating payment instruments as if they were traditional goods, the authors construct measures of the costs (analogous to prices) of various payment methods in order to study whether differences in payment instrument use across countries and over time can be explained by differences in their relative prices.

The authors attempt to collect systematic information on the prices of five payment instruments—checks, paper giros, electronic giros,⁶⁸ credit cards and debit cards. They calculate the payer price of checks, for example, as the opportunity cost of holding a minimum balance in a checking account plus mailing costs minus the value of the float.⁶⁹ They calculate prices for other payment instruments along similar lines.

One interesting aspect of this paper is that the calculated prices of payment instruments fail to explain differences in instrument use across countries and over time.⁷⁰ The authors offer

⁶⁶ Similar to PIN debit cash-back within the United States.

⁶⁷ Humphrey, Pulley & Vesala, *supra* note 33.

⁶⁸ In the study, electronic giro payments include direct deposits, direct debits, and other automated clearing house payments.

⁶⁹ Humphrey, Pulley & Vesala, *supra* note 33, at 938.

⁷⁰ Humphrey, Pulley & Vesala, *supra* note 33, at 936.

various explanations for the lack of explanatory power, one of which is particularly appealing. Differences among the calculated prices are generally small and simple differences in the “convenience” of using a particular instrument—a factor that is not measured—may outweigh the price differences that users face.⁷¹ This is an acknowledgement that net benefits, not just costs, matter for determining usage.

The authors find that what they call “institutional variables”—in particular the violent crime rate—explain some non-trivial portion of the observed differences in usage across countries.⁷² Crime could be interpreted as an element of cost, such as the expected cost of using cash. Unlike payment cards and checks, which bear the owner’s name and therefore require a degree of sophistication to use without authorization, stolen cash is perfectly transferable. The authors’ finding confirms the importance of considering probabilistic costs, an issue raised above.

In another study comparing costs across nations, De Grauwe, Buyst and Rinaldi (2000) study the costs of cash and payment cards in Iceland and Belgium.⁷³ The authors select these two countries because they provide a clear contrast. Among the developed countries, Iceland has one of the lowest rates of cash use while Belgium is at the other extreme.

The authors focus on social cost, defined as the resource cost to the economy of operating a cash-based system and a card-based system. They measure social cost by identifying all the participants in each system and counting their costs net of revenues. For the card-based system, they examine the card companies, commercial and savings banks, cardholders, merchants, and clearing and settlement institutions (where they exist). For the cash-based system, they study the role of the central bank, commercial banks, consumers and merchants. For the cash payment system in Iceland, for example, the authors estimate the cash production and distribution costs incurred by the central bank and then subtract the revenues that this institution collects through interest foregone on cash in circulation. They then add the costs incurred by commercial banks, merchants and consumers.

⁷¹ Humphrey, Pulley & Vesala, *supra* note 33, at 932-33.

⁷² Humphrey, Pulley & Vesala, *supra* note 33, at 934, 936.

⁷³ Paul De Grauwe, Erik Buyst & Laura Rinaldi, “The Costs of Cash and Cards Compared: The Cases of Iceland and Belgium,” mimeo, February 2000.

From a social perspective, the authors conclude a card-based system is considerably more efficient than a cash-based system. For Iceland, the per-transaction cost of cash is about 5 times higher than for cards. In Belgium, the per-transaction cost of cash and cards is similar, but cash is about 5 times more expensive than cards if cost is expressed as a percentage of transaction value.

As payment card use increases relative to cash for a given amount of economic activity, the authors argue that the average cost of cash increases relative to cards for two reasons. First, diseconomies of scale in the supply of cash rise as cards displace cash, while economies of scale improve for cards. Second, the displacement relegates cash to smaller transactions. Because smaller transactions must cover the fixed costs of the cash system, the cost of cash expressed as a percentage of transaction size rises.

The authors find that distribution of costs and revenues change dramatically as an economy shifts from a cash-based system to a card-based system. The central bank is the biggest loser in the process since it foregoes an important source of revenue. Consumers are the primary winners because the transition to a card-based system lowers the resource cost of the payment system. This has the same effect as any reduction in the cost of inputs in the production system—it can lower the price of goods and services for consumers.

Surprisingly, the authors find that cards are significantly less costly than cash even when only merchants are considered. They explain that this contradicts the perception that many merchants have because merchants often fail to include the resources they spend in handling and transporting cash.

Further supporting the cost savings involved in moving to a non-paper payment system, Humphrey, Willeson, Lindblom, and Bergendahl, survey the payment cost accounting literature, including many of the papers reviewed above (and below).⁷⁴ The authors discuss the limited data on payment method costs in various countries and conclude that electronic payment instruments, such as electronic giro, ACH, and debit cards, cost nations between one-third and one-half as much as paper-based instruments, such as cash and checks. They suggest

that a country may save 1 percent of its GDP annually by shifting from a fully paper-based to a fully electronic-based system.⁷⁵

In addition to the startling cost savings suggested from moving to a cashless economy, this survey makes a couple of other interesting points. First, scale economies have a dramatic impact on the costs of operation. Since the level of use varies across countries for a given payment instrument, so do the costs. For example, bank check processing costs are over ten times higher in Norway than in Spain. The authors posit that processing economies of scale are to blame, as only 0.3 percent of all payments in Norway are made by check. Second, some paper-based methods appear to be less costly to process than electronic methods. For instance, in Germany checks cost retailers less than debit cards or electronic giro. The authors note that this finding is somewhat misleading, though, since check processing in Germany is entirely electronic. In essence, a check in that country is a paper initiated electronic instrument.

The Humphrey, et al. survey does have some limitations. The costs presented are not calculated for a given transaction size, but instead each cost is specific to the average transaction size of a given payment instrument within a given country. Nor are all parties to a transaction included: missing from many of the comparisons are government and consumer costs. Furthermore, retailer costs representing U.S. merchants come from the Food Marketing Institute's study of supermarket and grocer costs.⁷⁶ Given the unique characteristics of grocers,⁷⁷ it seems unlikely that grocer payment processing costs are indicative of other retailers. Finally, because the many studies reviewed in the paper do not count benefits, the survey does not include benefits in its calculations.

⁷⁴ David Humphrey, Magnus Willeson, Ted Lindblom, & Göran Bergendahl, "What does it Cost to Make a Payment?," *Review of Network Economics*, Vol. 2, June 2003.

⁷⁵ A later paper by the same authors confirms this finding in an empirical analysis based on data from 12 European countries. See David Humphrey, Magnus Willeson, Göran Bergendahl, and Ted Lindblom, "Cost Savings from Electronic Payments and ATMs in Europe," working paper, August 2003.

⁷⁶ This study is discussed in detail below.

⁷⁷ See the first case study below.

3. Comparisons Including Benefits

A paper by Stavins (1997)⁷⁸ addresses different ways of processing one payment instrument—the transition from traditional check clearing to electronic check “presentment and truncation.”⁷⁹ The analysis systematically accounts for both costs and benefits to all parties involved in check processing. As the author observes concerning benefits, “even though one payment instrument may be cheaper than another, it is more efficient only if its net social benefits are higher than those of the alternatives. To determine whether that is the case, benefits must also be taken into account.”⁸⁰

Stavins examines costs and benefits arising from electronic check presentment and truncation for the depositing customer (the check recipient), the bank of first deposit, an intermediary (such as the Federal Reserve), the paying bank, and the paying customer. If the bank of first deposit truncates the check, for example, the check writer faces two additional costs. First, she loses float because truncation expedites check processing. Second, she loses whatever value she places on receiving the canceled check. To estimate the latter cost, Stavins relies on market surveys finding that consumers are willing to pay for their canceled checks.⁸¹ The author concludes that electronic check processing would raise net social benefits by a substantial amount.⁸² Despite the savings, however, several obstacles stand in the way of easy adoption. Transition costs, network externalities, and an uneven distribution of the savings are some of the key factors that might prevent or slow electronic check processing.

Carow and Staten (2000) do not evaluate costs at all and instead focus on benefits. The authors examine why consumers might choose to pay with general-purpose payment cards.⁸³

⁷⁸ Stavins, “Comparison of Social Costs,” *supra* note 15.

⁷⁹ With electronic check truncation, the physical transfer of the original paper check to the paying bank is stopped at some point, such as at the bank of first deposit. Instead, the check is sent through the processing route electronically, presented to the paying bank (and all the other processors in between) via an electronic image of the check.

⁸⁰ Stavins, “Comparison of Social Costs,” *supra* note 15, at 28.

⁸¹ Stavins, “Comparison of Social Costs,” *supra* note 15, at 38-42.

⁸² She assumes that all on-us checks would be kept by the paying bank while all others would be truncated either by the bank of first deposit or by an intermediary. Under these assumptions, electronic check processing increases net social benefits by 2.39 cents per check, or \$1.4 billion per year. Stavins, “Comparison of Social Costs,” *supra* note 15, at 37.

⁸³ Kenneth A. Carow & Michael E. Staten, “Plastic Choices: Consumer Usage of Bank Cards vs. Proprietary Credit Cards,” Working Paper, April 2000.

Using survey data from retail and gasoline cardholders, the authors consider the substitution of general-purpose (bank) cards for proprietary retailer cards. They find that the convenience of using a single payment card and the potential to earn rebates are among the primary reasons for using a bankcard. They also find that consumers use proprietary gasoline cards to keep purchase records and use proprietary retail cards to obtain better service.

Mantel (2000) summarizes the literature on consumer payment decision-making, also focusing on payer benefits.⁸⁴ He proposes a framework in which three factors explain the private use of electronic banking: consumer wealth; personal preferences, including convenience, control, budgeting, privacy, security, and personal involvement; and transaction-specific factors, such as transaction size and fixed-amount vs. variable-amount bills.

Also examining payment instrument decisions, MacKie-Mason and White (1996) summarize the properties of 10 electronic payment mechanisms according to 30 criteria.⁸⁵ They show how a decision maker may follow a systematic approach to selecting a payment mechanism. According to the authors, certain characteristics of payment methods may be so important that they play a fundamental role in the selection process. For example, mechanisms with low overhead costs are ideal for small transactions that occur frequently.

B. Retail Industry Studies

Another set of studies explore retailer costs of processing various payment instruments. While industry groups conducted or sponsored these studies, at least one of them is frequently cited in the academic literature. As noted above, the Humphrey, Willeson, Lindblom, and Bergendahl analysis relies on the Food Marketing Institute's study of grocery stores and supermarkets to represent merchant costs for all American retailers.

The reliance on industry studies is not surprising given the dearth of merchant cost information. Government data sources, used for many payment instrument costs, do not cover merchants' costs. In fact, it appears that retailers themselves often do not track their costs at the

⁸⁴ Mantel, *supra* note 9.

⁸⁵ MacKie-Mason & White, *supra* note 40.

level of detail needed to evaluate one payment instrument against another.⁸⁶ As a result, the few industry studies that focus exclusively on specific kinds of merchants and on processing costs for point of sale transactions are an important source for academic studies. That said, it is difficult to determine whether these studies accurately portray merchant costs. Surveys may not reach the proper decision makers within the company, or even if they do, if retailers are not accurately tracking costs then survey responses may be little more than the merchant's best guess. Even if individual merchants' responses are accurate, it is difficult to know whether the respondents are representative of their industry. More fundamentally, since so few industries are covered it is doubtful that the available studies represent the full range of retailer costs.

1. Grocery Store Costs

In 1994, the Food Marketing Institute (FMI) conducted a study on the cost to U.S. grocers to accept various payment instruments.⁸⁷ The numbers were updated in 1998 following the same research method and again in 2000, although the 2000 method does not match that of the earlier two studies.⁸⁸ All three reports are based on surveys of FMI members, each with a limited sample size. The reports do not provide enough information to determine whether the samples are representative of grocers nationwide.⁸⁹

⁸⁶ The 2000 Food Marketing Institute study, as well as the 1994 Coopers & Lybrand study report, both complain of this. See Food Marketing Institute, "It All Adds Up: An Activity Based Cost Study of Retail Payments," 2000, at Section 2.1; and Coopers & Lybrand, *supra* note 26.

⁸⁷ Food Marketing Institute, "Benchmarking Comparative Payment Methods," *supra* note 23. In particular, FMI conducted a survey of member companies.

⁸⁸ Food Marketing Institute, "A Retailer's Guide," *supra* note 23; and Food Marketing Institute, "It All Adds Up," *supra* note 86. Note that at the time of both the 1998 and the 2000 studies, the FMI was a plaintiff in a lawsuit filed against Visa and MasterCard regarding the payment card associations' "honor-all-cards" rules. See Second Amended Consolidated Class Action Complaint and Jury Demand, *In re Visa Check/MasterMoney Antitrust Litig.* (E.D.N.Y. 2000) (No. CV-96-5238).

⁸⁹ Surveys were sent to all FMI member companies. In 1994, FMI received 42 responses, in 1998 they received 48 responses, and in 2000 estimates they received 36 responses. The 1998 responses "account for 27 percent of the [food retailer] industry sales." Food Marketing Institute, "A Retailer's Guide," *supra* note 23, at 1. We do not have sufficient information to determine whether the responding grocers are representative of the industry as a whole. We were unable to audit the report's findings as we do not have access to individual survey responses. Note that the surveys were sent to FMI's "key contact" at the member company, who may or may not have been someone familiar with payment systems and their costs. See Defendants' Memorandum in Support of Motion in Limine to Exclude from Trial Plaintiff Food Marketing Institute's Reports of Surveys on Payment Costs, Redacted Version, *In re Visa Check/MasterMoney Antitrust Litig.* (E.D.N.Y. 2003) (No. CV-96-5238), at 7.

The FMI studies focus on the “direct” costs to grocers of accepting cash, non-verified and verified checks, food stamps, credit or charge cards, debit cards, EBT, and WIC.⁹⁰ Consistent with the focus on processing costs, allocations of corporate overhead and equipment costs are excluded from the analysis. Surprisingly, float costs are excluded, despite the significant role they appear to play in the academic literature. Included are the costs of processing transactions at the checkout counter (“tender time”), the costs of preparing and transporting bank deposits (“deposit preparation time”), the costs of financial institution services (“bank charges”), and costs specific to certain payment instruments (“other direct costs”).⁹¹

The FMI studies calculate costs both for an average transaction size, which differs across payment instruments, and scaled to \$100 of sales.⁹² The report does not clarify whether transaction sizes include cash back to customers for PIN debit and checks.⁹³ If included, the reported costs could be considerably distorted. Consider a typical \$40 PIN debit grocery sale with reported merchant processing costs of 29 cents.⁹⁴ Scaled to \$100 of sales, PIN debit processing costs are 70 cents. If, however, \$20 of the \$40 was cash given back to the consumer, which has no processing cost and does not represent a sale or any profit for the merchant, then the true purchase size is only \$20. Scaling the same 29 cents of processing costs to \$100 of sales, but starting from a \$20 average purchase implies \$1.45 in PIN debit processing cost. Thus, processing cost per dollar of sales is dramatically understated if cash back is erroneously

⁹⁰ EBT is the electronic transfer of government benefit funds (e.g., food stamps). Recipients access benefits through plastic cards at retail point of sale or ATM terminals. See Food Marketing Institute, “Benchmarking Comparative Payment Methods,” *supra* note 23, at 117. WIC is the Supplemental Food Program for Women, Infants, and Children. It provides government assistance to low-income, pregnant and post-partum women and their infants. Benefits are delivered either by paper voucher or EBT. See Food Marketing Institute, “A Retailer’s Guide,” *supra* note 23, at 28.

⁹¹ Food Marketing Institute, “Benchmarking Comparative Payment Methods,” *supra* note 23, at 1.

⁹² This measure simply scales up the cost per average transaction. One hundred dollars worth of sales can be comprised of a single \$100 transaction, two \$50 transactions, ten \$10 transactions, or any other combination. Generally, the number of transactions making up \$100 worth of sales will vary depending on the payment type. Cash purchases are typically smaller than credit card purchases, for example, so \$100 worth of cash sales is likely to include more transactions than \$100 worth of credit card sales.

⁹³ PIN debit cards allow for ATM-like withdrawals at retail point of sale. The transaction, referred to as “cash back”, is dependent on a sale but is frequently free of charge. Many groceries also allow customers with checking privileges to write checks in excess of the purchase in order to receive cash back. The FMI survey question (the full survey is included as Appendix B in the 1998 report) is ambiguous in regards to including cash-back in the purchase.

included. Unfortunately, it is unclear whether or not cash back amounts are counted in the purchase size.

With these caveats in mind, the 1998 study⁹⁵ finds that on an average transaction basis cash is the cheapest payment instrument for the grocery industry, followed (in ascending cost order) by PIN debit cards, ACH debit,⁹⁶ and verified checks. Credit is found to be the most costly for grocery retailers to accept. The ordering changes when costs are scaled to \$100 of sales: PIN debit is the cheapest payment instrument for grocers, followed by verified checks, ACH debit, and non-verified checks, with WIC by far the most costly.⁹⁷ In addition to mean processing costs, FMI reports high and low costs based on survey responses. The variation is substantial, even considering that the study covers only one retail segment. For instance, the highest cost for processing cash transactions is twice the mean and almost ten times the lowest cost.⁹⁸

2. Selected U.S. Retailer Costs

Similar to FMI, Coopers & Lybrand conducted a study using 1994 data to determine the cost U.S. merchants face in accepting various payment instruments: cash, checks, store cards, Visa credit, MasterCard credit, Discover and American Express credit or charge cards.⁹⁹ Unlike the FMI study, the Coopers & Lybrand project covers four merchant segments: department

⁹⁴ These are, in fact, the numbers reported by FMI. Food Marketing Institute, “A Retailer’s Guide,” *supra* note 23.

⁹⁵ Our analysis is primarily based on the 1998 study. The 2000 study appears to omit cost categories that are clearly important in the 1994 and 1998 studies. It also combines payment categories, reporting all checks together (as opposed to splitting verified and non-verified) and reporting credit cards combined with signature debit cards. Moreover, the costs reported in the 2000 study are dramatically different from those in the 1998 study, even though the 2000 study collected cost data from the 1998-1999 timeframe, just one to two years after data collection for the 1998 study. For example, the “other direct costs” category for cash transactions was just under 14 cents in the 1998 study, but falls to 0.1 cent in 2000; bank charges for check deposits were 5 cents a check in the 1998 study and \$0 in the 2000 one. (See FMI, *It All Adds Up*, *supra* note 88.) These discrepancies, along with sparse details and backup information in the 2000 report—which prevent a careful comparison of the studies—led us to report findings from the 1998 study instead.

⁹⁶ ACH debit involves supermarket loyalty cards linked to a customer’s bank account; the cards act as automated clearing house debit cards. (See “A Retailer’s Guide,” *supra* note 23, p. 13.)

⁹⁷ See Food Marketing Institute, “A Retailer’s Guide,” *supra* note 88, p. 3.

⁹⁸ We explore this variation further in the first case study.

⁹⁹ Coopers & Lybrand, *supra* note 26. Note that the Coopers & Lybrand study was prepared for Visa U.S.A. Visa was a defendant in the *Wal-Mart* case, revolving around “Honor-all-card” rules imposed by payment card systems. Second Amended Consolidated Class Action Complaint and Jury Demand, *In re Visa Check/MasterMoney Antitrust Litig.* (E.D.N.Y. 2000) (No. CV-96-5238).

stores, apparel stores, discount stores, and specialty electronics stores. It excludes fixed costs from the calculations, relies on one “representative” merchant from each segment,¹⁰⁰ and estimates payment instrument costs both for the average transaction size (which varies by payment instrument) and scaled to \$100 of sales.¹⁰¹ Float is included among the variable cost measures.

Echoing the FMI findings, the Coopers study finds that cash is the cheapest payment instrument for each of the merchant segments, for an average-sized transaction. For \$100 worth of sales, cash is again the cheapest in all but one merchant segment—checks are cheaper for the department store. Checks are the second cheapest instrument in both types of calculations in all segments but one—the Discover card is second cheapest for the apparel store.

The Coopers & Lybrand analysis highlights the importance of two elements of cost. First, average transaction size affects the relative cost rankings of the various payment instruments. Second, the study illustrates that relative payee costs vary depending on the merchant segment considered. For \$100 worth of sales at the department store, for example, American Express was about 1.73 times as expensive as cash, while it was 6.93 times as expensive at the discount store.¹⁰² The Coopers and FMI studies tend to agree that cash is the cheapest instrument for merchants to accept as payment while credit cards are the most expensive.

3. Overseas Retailer Costs

A Dutch retail trade association, Hoofdbedrijfshchap Detailhandel (HBD), published a report a few years ago on the costs of various payment instruments to retailers. The study found that the cost of an average cash transaction was half as much as a typical debit card payment. The HBD commissioned a second study to further analyze the results of the first report. The

¹⁰⁰ The same caveat that applied to the FMI study certainly applies here. The Coopers & Lybrand calculations are based on just one retailer survey in each category. They state that the chosen retailers are “representative” of the industry, but it is unlikely that any one retailer could accurately represent an entire retail segment.

¹⁰¹ As with the FMI study, the Coopers study multiplies the cost for the average transaction size by the constant necessary to reach \$100 of sales. Thus, costs are assumed to increase linearly.

¹⁰² Coopers & Lybrand, *supra* note 26, at 32.

second report, which adopted a more comprehensive approach to analyze payment instrument costs, was published in March 2001, with the main results summarized by Van Hove.¹⁰³

According to Van Hove, the study authors do not concentrate on the cost of an average transaction—rather they estimate how the costs incurred by retailers vary as a function of transaction size. Van Hove notes that cash is cheaper than debit for retailers for transaction amounts up to NLG 67 (around US \$37).¹⁰⁴ Debit, however, is cheaper for higher amounts. His main explanation is that the fixed costs associated with debit card payments are substantial.

Van Hove then discusses the estimates of the social costs involved, defined as the private costs to both merchants and consumers plus the costs incurred by commercial banks and the central bank (to the extent that these costs are not paid for by merchants and/or consumers). He reports that the social cost of cash is larger than its private cost, but the private and social costs of debit are essentially the same since the prices charged by the Dutch electronic funds transfer operator cover costs. The bottom line: for amounts between NLG 29 and NLG 67 (around \$16 to \$37 US), cash payments may be cheaper for retailers but are more expensive for the economy as a whole. For amounts greater than NLG 67, debit is cheaper than cash both privately and socially.

C. Lessons Learned From The Literature

As the above review illustrates, the literature has approached payment instrument evaluation from several different angles. The variety of methods and differing degrees of completeness provide several important lessons. First, the benefits that individuals obtain when using payment instruments are at least as important as the costs when it comes to choosing an instrument. Second, some of these benefits are rather difficult to measure directly. Third,

¹⁰³ See Leo Van Hove, “The Price of Cash Revisited,” *Epsa Newsletter*, (July 2001) (visited Mar. 23, 2003) <<http://epso.jrc.es/newsletter/vol08/8.html>>; and Leo Van Hove, “Electronic Money and Cost-Based Pricing,” *Wirtschaftspolitische Blätter*, Vol. 49(2) (April 2002).

¹⁰⁴ The Dutch Guilder (NLG) used to be the official currency of The Netherlands. On January 1, 1999 eleven of the countries of the European Economic and Monetary Union, including The Netherlands, decided to give up their own currencies and adopt the Euro. The NLG ceased to be legal tender on February 28, 2002. At the time of this writing, the conversion of NLG to Euros took place at the rate of $(\text{NLG}/2.20371) = 1 \text{ EUR}$. The exchange rate between U.S. dollars (USD) and Dutch Guilders (NLG) at the time of the HBD analysis was about $1.00 \text{ USD} = 2.06296 \text{ NLG}$. See XE.com Universal Currency Converter (visited August 24, 2004) <<http://www.xe.com/ucc/>>.

different parties to a transaction may assess benefits and costs very differently. Fourth, the same party may evaluate benefits and costs differently depending on the transaction type or size. Finally, the fact that a payment instrument is cheaper for one party (such as retailers) does not mean that it is cheaper for all parties.

Consider first the industry studies, each of which limits its analysis to the cost of accepting various payment instruments at the point of sale. They do not consider payers' costs or costs imposed on other parties to the transaction. The studies do not even mention the benefits that both payers and payees receive from using various payment instruments. Narrowly focusing on one side of the transaction, however, can offer an in-depth accounting of the direct cost to merchants in accepting various payment instruments, and thus their private incentives for accepting certain payment methods while discouraging or rejecting others. The disadvantage of this approach is its potential for conveying the misleading impression that what is more costly for one side of the transaction is necessarily more costly for the parties as a whole. Moreover, merchants themselves must consider more than cost because in practice many do accept payment cards. By revealed preference, many retailers find that the benefits of accepting payment cards outweigh the costs.¹⁰⁵

Another misleading aspect of the merchant studies lies in their assumptions about transaction size. The cost comparisons presented in retailer studies, while meaningful for merchants, can be deceptive for policy makers. In particular, the costs are calculated for the average transaction size specific to a given instrument. Each instrument has a different average transaction size so each cost is calculated for a different base. Asking what it costs to process the average purchase is a relevant retailer question, but social questions of optimal use imply changes in behavior. If we consider, say, whether payment cards are overused relative to cash, we want to know what it costs to process these two instruments at the *same* transaction size. That way, we can determine if moving more transactions (of all sizes) from one payment method to another saves resources. Some components of processing cost vary nonlinearly by

¹⁰⁵ Some merchants may accept credit cards because they feel they must—once competitors accept plastic, it may be a necessary service to maintain customers. Other merchants, however, may accept cards because of perceived benefits. For instance, some fast food chains that began accepting credit cards within the last few years maintain

transaction size—bank charges, for example—while others do not vary at all, so simply scaling to \$100 of sales does not solve the comparison problem. To make an “apples-to-apples” comparison needed for policy, costs need to be reconstructed from their elements, varying only those components that are sensitive to transaction size.

Despite their deficiencies in understanding private or social choices, the industry studies do identify important components of processing costs for different payment instruments. For example, the FMI data imply that three items of cost combined (tender time, deposit preparation time, and other direct costs) represent the bulk of payee cost for paper-based instruments—about 98 percent for cash, 91 percent for non-verified checks, and 71 percent for verified checks. Bank charges, which are the fourth cost item and include the merchant discount fee in the case of credit, charge and debit cards, represent between 45 and 55 percent of payee cost for PIN debit cards and ACH debit, respectively. In contrast, the FMI data indicate that bank charges dominate the payee cost of accepting credit, charge and signature debit cards, ranging from 78 to 81 percent. The differences in the relative importance of cost items underscore the importance of careful accounting. If bank charges were omitted from the FMI study, the payment instrument ordering the study reports would no longer hold. Instead credit and charge cards would appear cheaper for grocers than the cheapest paper instrument (cash).¹⁰⁶

From a social perspective, bank charges represent a cost to merchants but provide revenues to acquiring and issuing banks and help to pay for benefits, including low to zero annual fees for consumers and fraud prevention and dispute resolution systems for both merchants and consumers. If electronic payment instruments are cheaper for merchants when bank charges are excluded, then an important question is whether bank charges provide benefits for other parties to the transaction such that, when all parties’ costs and benefits are taken into account, net social benefits are positive.

that the average purchase amount is larger for credit card customers than for cash customers. See Bruce Horowitz, McDonald's Joins Pay-With-Plastic Trend, *USA Today* July 23, 2004.

¹⁰⁶ Without counting bank charges, credit (\$0.2005) is slightly more expensive than signature debit (\$0.1783), PIN debit (\$0.1592) and ACH debit (\$0.1592), but still cheaper than cash (\$0.2119), which is in turn cheaper than verified checks (\$0.3165) and non-verified checks (\$0.5319). See Food Marketing Institute, “A Retailer’s Guide,” *supra* note 23, at 3.

The majority of the studies—including the academic ones—focus either exclusively or mainly on costs. This is likely due to the difficulty in defining and measuring the benefits various payment instruments provide. While some studies hint that benefits such as convenience matter, they do not develop the implications of this insight. Stavins is the only U.S. study, to our knowledge, that makes a systematic attempt to measure costs and benefits for all parties involved. Regarding the dangers of looking only at costs and disregarding benefits, Stavins observes: “...even though bicycles are cheaper than cars, one would not recommend that bicycles be substituted for cars without evaluating the relative benefits of each mode of transportation.”¹⁰⁷ We concur that cost considerations are necessary but not sufficient for making sound policy recommendations. The challenge is to produce a study on the costs and benefits of various payment methods taking as many costs and benefits as possible into account for all parties involved—a task we attempt in the next section.

IV. COST-BENEFIT CASE STUDIES

To demonstrate the importance of moving beyond a narrow focus on costs, we develop three case studies based on existing cost analyses, but expanded according to our guidelines. To fully understand how one payment instrument compares to another, it is necessary to delve into the details. We therefore conduct a careful cost-benefit assessment, including as many individual costs and benefits as can be quantified. We focus our analysis on the shift from using paper instruments toward greater use of payment cards. This payment transition is occurring throughout the retail sector. While the three case studies do not cover the entire sector, they do shed light on the move to a cashless economy and underscore the lessons we discuss above.

Over the last decade, payment cards such as credit and debit have tended to replace cash and checks in a wide variety of transactions, both large and small. Table 1 illustrates this shift by calculating the percentage point change from 1994 to 2001 in the consumer-to-business sales volume paid for using several different payment methods.¹⁰⁸ As the table shows, the use of cash in all but one transaction size category (\$500 and over) fell substantially. The use of

¹⁰⁷ Stavins, “Comparison of Social Costs and Benefits,” *supra* note 15, at 28.

¹⁰⁸ 1994 and 2001 represent the endpoints of our dataset. The decline in cash and check use is fairly steady throughout the time period, as is the rise in credit and debit card use.

checks fell substantially in all categories. In contrast, the use of credit, charge and debit cards increased in all categories.

Table 1. The Percentage Point Change in Transaction Shares by Transaction Size: 1994-2001

| | \$5-10 | \$10-20 | \$20-40 | \$40-60 | \$60-80 | \$80-100 | \$100-500 | \$500+ |
|--------------------|---------------|----------------|----------------|----------------|----------------|-----------------|------------------|---------------|
| Credit/Charge | 3 | 5 | 8 | 6 | 7 | 5 | 4 | 5 |
| Debit | 7 | 12 | 12 | 11 | 10 | 9 | 7 | 2 |
| Card Total | 10 | 17 | 21 | 17 | 17 | 14 | 11 | 8 |
| Cash | -6 | -9 | -7 | -6 | -6 | -4 | -2 | 1 |
| Checks | -5 | -7 | -13 | -11 | -12 | -11 | -9 | -5 |
| Paper Total | -10 | -17 | -21 | -17 | -17 | -15 | -12 | -4 |

Notes: Debit combines signature and PIN debit transactions. Due to rounding, card and paper totals may not sum exactly. ACH, EFT, and other miscellaneous payment methods are excluded, and thus the card total and paper totals do not net to zero.

Source: Visa U.S.A., 1994-2001.

Given the ubiquitous shift away from paper (both cash and checks), we examine whether the increased use of payment cards has generated welfare gains. In particular, we examine the net benefit of replacing one additional consumer paper currency transaction with a payment card transaction. We therefore analyze marginal use among consumers who already have payment cards at merchant locations that already accept them. Since upwards of 73 percent of all U.S. households currently have a general purpose credit or charge card,¹⁰⁹ the marginal cost of one more card transaction is quite relevant.

By revealed preference, the fact that consumers are choosing to pay more often with payment cards when they could continue to pay with checks or cash implies that they are better off—increased use of payment cards must make consumers better off or they would not alter their behavior. The question is whether there are net gains to the economy as a whole, including the merchants receiving those payments and the banks processing them. If consumers do not

¹⁰⁹ Survey of Consumer Finances, 2001; and Evans & Schmalensee, *supra* note 2.

pay the full price of using a payment card, an argument made by several scholars,¹¹⁰ then what is good for consumers does not necessarily imply net social benefits.¹¹¹

We attempt to answer the question of net social benefits on a per transaction basis relying on the guidelines developed in Section II. In particular, because the location of a transaction influences the cost and benefit calculations, we analyze three specific venues: grocery stores, discount stores, and specialty electronics stores. These three venues cover a range of goods and average prices, allowing us to explore how the context of a transaction can influence the costs and benefits of using a particular payment instrument. We begin with the merchant cost estimates presented in the two U.S. industry cost studies reviewed above. Then we expand on those studies by fixing transaction size, broadening the analysis to include all parties to a transaction, and adding in benefits where possible. We highlight the dramatic changes that these modifications bring. Those instruments that appear expensive to merchants are not expensive for the economy as a whole. In general, the steady shift toward a cashless society appears to be a beneficial one.

As a cautionary note, remember that calculations like the ones presented below can convey a false sense of precision. In order to highlight the often small differences in costs and benefits across payment instruments, the figures in the tables below are reported at the nearest cent. Most of these numbers are rough estimates. All of the numbers should be interpreted as suggestive but not definitive. Nonetheless, our assumptions are reasonable and supported by the available evidence and, as such, the calculations resting on them are informative. While they do not provide precise differences in costs and benefits among various payment methods, they do

¹¹⁰ Determining whether payment card use is actually subsidized is complicated by the fact that cards are used in two-sided markets (see footnote 10). What some scholars call a subsidy may in fact be a pricing mechanism intended to balance the two sides of the market. Moreover, removing the cash/check to payment card “subsidy” may not improve social welfare. In a recent paper, Rochet and Tirole examine card pricing and social welfare in a theoretical model where consumers may pay with either a card or cash. The authors examine the effects of lifting the no-surcharge ban, which prevents merchants from charging cardholders a higher price than customers paying in cash. Rochet and Tirole find that merchants would raise the price for cardholders and lower it for cash users, but the social welfare implications are “ambiguous.” In other words, forcing card using consumers to pay a higher price for goods than cash using consumers does not necessarily raise social welfare and in fact could reduce it. Jean-Charles Rochet and Jean Tirole, “Cooperation Among Competitors: Some Economics of Payment Card Associations,” *Rand Journal of Economics*, Vol. 33, Winter 2002.

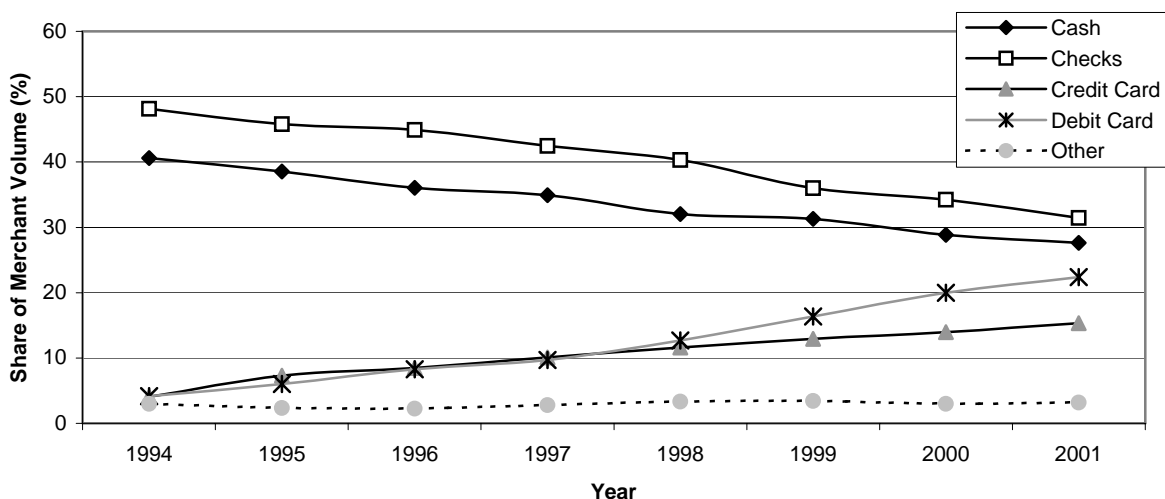
¹¹¹ In fact, this point was made clear by the Dutch retailer study reviewed earlier, which found that what was best for merchants was not best for the economy as a whole.

reveal relationships and patterns. Thus, the analysis presented here is useful in examining general welfare issues and goes considerably beyond the existing literature.

A. Replacing Cash and Checks at the Grocery Counter

Our first case study examines payment instrument use in grocery stores.¹¹² The same pattern we observe in Table 1 for consumer-to-business transactions as a whole is apparent in supermarket transactions: payment cards are replacing cash and checks. Figure 2 reports the share of grocery store purchases allocated to different payment methods from 1994 through 2001. While checks fall from around 50 percent to near 30 percent and cash declines from 40 percent to below 30 percent, debit rises from under four percent to over 20 percent and credit/charge increases from around 5 percent to almost 15 percent of grocery purchases.

Figure 2. Share of Sales Volume by Payment Method at Grocery Stores: 1994–2001



Source: Visa U.S.A., 1994-2001.

We start with the Food Marketing Institute (FMI) cost study of 1998 (see Table 2 below), which reports the costs that grocers face in accepting various payment instruments.¹¹³

¹¹² See the Appendix for full details on the calculations presented below.

¹¹³ Food Marketing Institute, “A Retailer’s Guide,” *supra* note 23, at 3. As explained earlier, the FMI 2000 study did not include as much detail as the 1998 study nor were as many payment categories included. As a result, we rely on the 1998 figures with the exception of the 2000 time observations, as explained below. Given the paucity of retailer cost data estimates, we feel the publicly available FMI data are our best option.

Costs vary considerably among grocers due to size, geographic location, age and sophistication of the equipment used, among other things. We employ FMI's average cost figures in the bulk of our calculations, but examine the high and low figures later in sensitivity analysis. The variable "tender time" captures the cost of the time that register attendants must spend to process payment for a transaction, not counting the time to ring up individual items. "Deposit preparation" measures the labor costs of preparing a typical paper bank deposit for a merchant's bank account, such as counting cash and reconciling the register drawer. Electronic payment methods are cleared online at the point of sale and therefore do not involve any deposit preparation. "Bank charges" are explicit fees, such as a deposit fee for cash and checks or bank processing fees for payment cards. "Other direct costs" capture miscellaneous costs associated with each type of payment, such as check losses and collection fees, credit card losses,¹¹⁴ and armored car costs for transporting cash to a bank. Finally, the cost per \$100 of sales translates the reported costs, which apply to the average transaction size for that payment type, to \$100 worth of sales.

¹¹⁴ This category covers "charge backs" for merchants. Merchants are only responsible for these refused charges under certain circumstances. When a card issuer or consumer questions a transaction because of a stolen card, dispute over receipt of goods or cashier error, retailers have to gather documentation from stores as proof of purchase. If they do not deliver this evidence within a set timeframe the disputed amount is charged back to the retailer.

**Table 2. Per Transaction Processing Costs for Various Payment Instruments
Grocery Store Merchants (\$)**

| | Cash | Non- Verified Check ¹ | Verified Check | Credit/ Charge | Signature Debit | PIN Debit |
|--------------------------------------|-------------|--|-------------------|-------------------|--------------------|-------------|
| Tender Time | 0.11 | 0.26 | 0.24 | 0.18 | 0.18 | 0.17 |
| Deposit Preparation | 0.004 | 0.03 | 0.03 | 0 | 0 | 0 |
| Bank Charges | 0.004 | 0.06 | 0.16 | 0.94 | 0.56 | 0.41 |
| Other Direct Costs | 0.16 | 0.27 | 0.03 | 0.02 | 0 | 0 |
| Per Transaction Total Cost | 0.27 | 0.63 | 0.46 | 1.14 | 0.75 | 0.57 |
| Average Purchase for Payment Type | 11.52 | 54.24 | 54.24 | 44.50 | 33.00 | 41.05 |
| Cost Scaled to \$100 of Sales | 2.35 | 1.16 | 0.85 | 2.56 | 2.26 | 1.39 |

Notes: Numbers may not add due to rounding.

¹Non-verified checks are manually authorized at the checkout counter. Verified checks are electronically authorized to have sufficient funds in the account to cover the purchase.

Source: Food Marketing Institute, “A Retailer’s Guide to Electronic Payment Systems Costs,” 1998, updated by authors as detailed in the Appendix.

In order to provide accurate and current numbers, most of the figures in the above table are modified from the original FMI report.¹¹⁵ First, the 1998 “tender time” cost FMI reported was based on time observations taken in 1994. Because processing time for payment card transactions has fallen considerably since then, we use the tender times (in seconds) reported by FMI in 2000. We then adjust the tender time and deposit preparation costs for all payment types to reflect wage changes since 1997, the year FMI calculated the cost figures. We also update the bank charges for cash and checks to reflect inflation and for payment cards to reflect increases in processing fees.¹¹⁶ Finally, we update other direct costs for cash (which includes armored car transport) to reflect inflation.

A couple of items in Table 2 should be highlighted. First, following FMI, the figures in each column of the table are calculated for a different transaction size—the typical size for each payment instrument. For example, the average cash transaction was \$11.52 and the average for

¹¹⁵ See the Appendix for a replication of the 1998 FMI table.

¹¹⁶ Note that PIN debit bank processing fees have been escalating over time. The 1998 FMI study reports average PIN debit transaction fees of 13 cents while the 2000 study reports 20 cents. Several PIN networks recently

checks was \$54.24.¹¹⁷ Certain costs, such as some bank fees, are sensitive to the purchase amount, so costs presented this way are difficult to compare, as discussed earlier. Second, the relative costs of the various payment instruments change considerably when the costs are translated to \$100 of sales. When costs are scaled-up in this fashion, a credit card transaction is only around 9 percent more expensive than a cash transaction for grocers.¹¹⁸

The costs reported in Table 2 say nothing about whether the economy benefits when payment cards replace cash and checks for grocery purchases. In keeping with our cost-benefit approach, three adjustments are needed to analyze welfare. First, to facilitate comparisons we need to recalculate costs at some fixed transaction size. We choose the typical cash transaction size and the typical check transaction size because these are the transactions that are being replaced by payment cards. Moreover, for grocery purchases these two transaction sizes represent the lowest and highest average purchase sizes. Second, we need to consider other parties involved in the transaction. Finally, where possible, we need to calculate the benefits accruing to the parties involved. We present the results of the first step, setting the transaction size, in Table 3.

1. Setting the Transaction Size

To make comparisons across payment instruments meaningful, we calculate costs for two fixed transaction sizes.¹¹⁹ Several of the cost categories collected by FMI vary with transaction size. Bank charges for cash, credit, charge and signature debit cards are dependent on purchase size, for instance. And check and credit card losses are reported as a percentage of

raised their rates (including NYCE, Visa's Interlink, and MasterCard's MoneyLink). (See David Breitkopf, "Study: PIN Fees Are Up But Won't Become Norm," *American Banker*, Monday August 19, 2002.)

¹¹⁷ This problem is especially acute at the grocery store, where buying a gallon of milk and a loaf of bread is quite a different transaction than shopping for an entire cart full of groceries. Supermarkets, in fact, sometimes devote a separate checkout lane to purchases of 15 items or less.

¹¹⁸ Even this comparison is not accurate, however, since not all costs increase with transaction size, thus scaling can misrepresent actual cost.

¹¹⁹ The fact that the average transaction size for cash differs from that for checks (and payments cards, as well) indicates that consumer preferences for payment mechanisms vary by transaction size. William Whitesell develops a model that explains some of the preference differences (see William C. Whitesell, "The Demand for Currency versus Debitable Accounts," *Journal of Money, Credit, and Banking*, Vol. 21, No. 2 (May 1989)). See also Anthony M. Santomero and John J. Seater, "Alternative Monies and the Demand for Media of Exchange," *Journal of Money, Credit, and Banking*, Vol. 28, No. 4 (November 1996, Part 2).

the sales value.¹²⁰ Table 3 presents the results of fixing the transaction size across payment instruments, employing both the average cash size and the average check size.

**Table 3. Per Transaction Processing Costs for Various Payment Instruments
Grocery Store Merchants, Fixed Transaction Size (\$)**

| | Cash | Non- Verified Check | Verified Check | Credit/ Charge | Signature Debit | PIN Debit |
|--|------|---------------------------|-------------------|-------------------|--------------------|-----------|
| Merchant Cost, Avg. Transaction Size (Repeated from Table 2) | 0.27 | 0.63 | 0.46 | 1.14 | 0.75 | 0.57 |
| Merchant Cost, Cash Transaction Size \$11.52 | 0.27 | 0.41 | 0.44 | 0.61 | 0.68 | 0.57 |
| Merchant Cost, Check Transaction Size \$54.24 | 0.28 | 0.63 | 0.46 | 1.21 | 0.81 | 0.57 |

Source: Authors' calculations as detailed in the Appendix.

Choosing a fixed transaction size induces a dramatic change in terms of relative costs, even before considering all parties involved in a transaction. Taking the typical cash transaction size in the second row, the costs of credit cards and non-verified checks fall considerably as compared to row one. Examining the typical check transaction size in the last row, on the other hand, credit and charge cards are twice as expensive for merchants as checks are. Cash remains the cheapest payment method for grocers at each transaction size.

2. Adding Other Parties to the Transaction

Next we add other key parties to the transaction. In particular, we add the costs of using or processing each payment instrument for consumers, the central bank, and commercial banks. Table 4a adds these costs based on the average cash transaction size of \$11.52, while Table 4b uses the average transaction size for checks of \$54.24.

¹²⁰ Food Marketing Institute, "A Retailer's Guide," *supra* note 23, at 20.

**Table 4a. Per Transaction Processing Costs for Various Payment Instruments
Grocery Store Cash Transaction \$11.52 (\$)**

| | Cash | Non- Verified Check | Verified Check | Credit/ Charge | Signature Debit | PIN Debit |
|--|--------------|---------------------------|-------------------|-------------------|--------------------|-------------|
| Merchant | | | | | | |
| Theft/Counterfeit | 0.03 | 0 | 0 | 0 | 0 | 0 |
| Float | 0.001 | 0.002 | 0.002 | 0.002 | 0.002 | 0.001 |
| Costs From Table 3 | <u>0.27</u> | <u>0.41</u> | <u>0.44</u> | <u>0.61</u> | <u>0.68</u> | <u>0.57</u> |
| a) Merchant Marginal Cost | 0.30 | 0.42 | 0.44 | 0.61 | 0.68 | 0.57 |
| Consumers | | | | | | |
| Processing Time | 0.14 | 0.33 | 0.31 | 0.23 | 0.23 | 0.21 |
| Queue Time | 0.14 | 0.33 | 0.31 | 0.23 | 0.23 | 0.21 |
| Explicit Price | 0.03 | 0.04 | 0.04 | 0 | 0 | 0.13 |
| Implicit Price | 0.28 | 0 | 0 | 0 | 0 | 0 |
| Seigniorage | <u>0.07</u> | <u>0</u> | <u>0</u> | <u>0</u> | <u>0</u> | <u>0</u> |
| b) Consumer Marginal Cost | 0.65 | 0.70 | 0.65 | 0.46 | 0.46 | 0.55 |
| Central Bank | | | | | | |
| Production | 0.001 | 0 | 0 | 0 | 0 | 0 |
| Processing | <u>0.002</u> | <u>0.03</u> | <u>0.03</u> | <u>0</u> | <u>0</u> | <u>0</u> |
| c) Central Bank Marginal Cost | 0.004 | 0.03 | 0.03 | 0 | 0 | 0 |
| Commercial Banks | | | | | | |
| ATM Maintenance | 0.06 | 0 | 0 | 0 | 0 | 0 |
| Production | 0 | 0 | 0 | 0.01 | 0.01 | 0.01 |
| Processing | 0.004 | 0.12 | 0.12 | 0.29 | 0.26 | 0.26 |
| Card Rewards | <u>0</u> | <u>0</u> | <u>0</u> | <u>0.01</u> | <u>0</u> | <u>0</u> |
| d) Commercial Bank Marginal Cost | 0.07 | 0.12 | 0.12 | 0.32 | 0.28 | 0.28 |
| e) Sum of Marginal Costs (double count) | 1.02 | 1.27 | 1.24 | 1.39 | 1.42 | 1.40 |
| f) Social Marginal Cost (no double count) | 1.01 | 1.18 | 1.05 | 0.96 | 0.92 | 1.00 |

Notes: Numbers may not add due to rounding. Sum of MC, e), is equal to a + b + c + d. Due to transfers across parties (such as merchant payments to banks), this figure double counts some cost elements. Social Marginal Cost, f), eliminates any transfers that give rise to double counting.

Source: Authors' calculations as detailed in the Appendix.

Table 4a adds several elements to the analysis. For merchants, the FMI study omits at least two components of the marginal cost of payment instruments: theft/counterfeit loss for

cash and float loss for each instrument.¹²¹ Card issuers bear the brunt of any payment card float cost. They pay acquirers for any purchases within one to two days of the transaction and acquirers then pass those payments on to merchants. The cardholder does not pay the card issuer until the monthly bill arrives, meaning the issuing bank funds credit and charge card float for an average of 25 days.¹²² An issuer's float cost is included, however, in the interchange fee that issuers charge acquiring banks, and that acquirers then pass on to merchants in the form of the merchant discount. As a result, card issuer float costs are already counted in the bank fees in Table 2. The merchant still faces a one- to two-day wait for credit and charge card reimbursements, however. We include this cost in Tables 4a and b. For checks and signature debit cards, the merchant typically waits two days before receiving funds from the customer's bank; with PIN debit the delay is typically one day.¹²³ We also assume merchants take a day on average to deposit cash receipts.

The above calculations also include other parties to the transaction, starting with payers. The opportunity cost of the time that consumers spend at the register while a transaction is processed is captured by "Consumers: Processing Time." Consumers waiting in line also face an opportunity cost for their time while the current payer's transaction is being conducted, which is captured by "Queue Time." Both of the time costs likely will vary with payers' wage rates; our calculations rely on typical earnings.¹²⁴ Next we include the explicit price that consumers pay for an instrument. For cash, we include the average within network ("on us") ATM fee for cash withdrawals, scaled by the percentage of people facing such charges. To the extent that consumers access off-network ATMs, we are understating the explicit price for cash

¹²¹ Recall that check loss and credit card charge-backs are already included in FMI's estimate for Other Direct Costs. Thus, adding the marginal cost of cash theft and counterfeit loss here provides a more even treatment of payment instruments and makes the costs more comparable.

¹²² "Survey of Credit Card Plans," Federal Reserve Board (credit terms as of July 31, 2003) (visited Nov. 10, 2003) <<http://www.federalreserve.gov/pubs/shop/tablwb.pdf>>.

¹²³ For checks, see Stavins, "Comparison of Social Costs," *supra* note 15. For debit cards, see Ingenico *supra* note 22. For credit cards, see "Survey of Credit Card Plans," *supra* note 122.

¹²⁴ There is some debate within the economic literature on whether wage rates accurately reflect the opportunity cost of time. (See, for instance, W. Douglass Shaw, "Searching for the Opportunity Cost of an Individual's Time," *Land Economics*, Vol. 68, February 1992.) In particular, this calculation assumes that work and non-work hours can be substituted at will, which is not always the case. As a result, wage rates may overstate or understate the opportunity cost of time. Recognizing this, we conduct sensitivity analysis on the wage measure used to calculate time costs.

faced by consumers.¹²⁵ In the case of checks, this is the price consumers pay for each paper check. Because credit and charge cards typically only charge an annual fee for rewards cards (where the rewards will offset the fee to some extent), and finance charges only apply to credit services and not transaction services, the explicit marginal cost to consumers of using these cards for another purchase is zero.¹²⁶ Many issuers do, however, charge per transaction fees for PIN debit.¹²⁷ We scale the average PIN fee by the percentage of institutions assessing a fee.

As the last cost item for consumers we add the implicit cost of obtaining cash.¹²⁸ The first component of this cost is comprised of the time that consumers spend in making a trip to an ATM.¹²⁹ Seigniorage is the second implicit cost for cash. Seigniorage can be defined in many ways, but the definition most closely matching our cost-benefit exercise is fiscal

¹²⁵ In 2001, only 10 percent of banks charged a fee for own-customer ATM access. However, over 78 percent of banks charged a fee for withdrawals out-of-network and that fee averaged \$1.17. Over 88 percent of the operators of the “foreign” network tacked on an additional fee, which averaged \$1.32. Thus the typical charge for getting cash from an off-network ATM was around \$2.50 in 2001. Timothy H. Hannan, Retail Fees of Depository Institutions, 1997-2001, *Federal Reserve Bulletin*, September 2002. The rise in ATM fees appears to be one of the factors driving the popularity of debit cards. See Joanna Stavins, “Effect of Consumer Characteristics on the Use of Payment Instruments,” *New England Economic Review*, Issue Number 3, 2001, p. 21.

¹²⁶ Only 15 percent of the 410 million bankcard accounts in 2002 had an annual fee. (See James J. Daly, “Issuers Shed Some Profitability,” *Credit Card Management*, May 2003 Vol. 16 No. 2, p. 36.) Moreover, annual fees represent fixed, not marginal costs. Using a credit card for transactions implies that the balance is paid in full when the bill arrives. We consider credit purchases below when we add benefits for each payment method.

¹²⁷ According to a recent survey conducted by Dove Consulting Group Inc., 26 percent of financial institutions charge their debit cardholders a per-use fee, with fees ranging from 25 cents to one dollar. Joan Goldwasser, “Check Card Changes Ahead,” *Kiplinger's Personal Finance*, Oct. 20, 2003.

¹²⁸ For non-cash payment methods, the POS time factor (already captured in processing time) represents the bulk of any implicit costs. Checks involve carrying identification and cumbersome checkbooks—which do not fit into the average wallet. Thus women, who usually carry purses, write a greater proportion of checks than men. Jackie Spinner, “The Check’s Last Writes,” *Washington Post*, Feb. 9, 2003; Gregory Richards, “Check Use Continues to Decline as People Favor Credit, Debit Cards,” *Florida Times-Union*, Mar. 31, 2003. We were unable to quantify these implicit costs, however.

¹²⁹ Some consumers at some times will not need to make a special trip to the ATM, but will instead obtain cash while taking care of other errands. At other times, consumers may need to go considerably out of their way to visit an ATM. Note that only 20 percent of supermarkets contain an in-house cash machine (Food Marketing Institute, “2003 Security and Loss Prevention Issues Survey,” 2003, at 2). Moreover, non-banks (called “ISOs”) operate at least thirty percent of all ATMs located outside of banks (e.g., in groceries and airports, for instance). (David Gosnell, “ATM portfolios grow through acquisition,” *ATM&Debit News*, 25 June 2002.) ISOs charge for each and every withdrawal. Even if a bank were operating the ATM in a particular grocery, many of the grocery’s customers would have accounts at different banks and thus would be subject to off-network ATM fees. Since the typical off-network charge is \$2.50 per extraction, obtaining cash at the grocery store would save the time cost of driving to an ATM but would cost most consumers significantly more in fees. On the whole, our ATM time assumptions seem reasonable for the implicit cost of obtaining cash, especially considering that we assume no waiting time to use an ATM (i.e., no line) and do not count gasoline costs for driving to an ATM.

seigniorage—the profit from printing currency, net of expenses, that the central bank actually has available for budgeting purposes.¹³⁰ Cash users pay seigniorage to the Federal Reserve as an implicit transfer. We therefore list this item as a cost for consumers.¹³¹

The central bank is the second party added to the calculations.¹³² The Federal Reserve Bank incurs processing costs for handling currency and removing unfit bills. The central bank subsidizes the use of cash in coordinating cash supplies for banks and maintaining a high level of cash quality without charge to consumers or banks.¹³³ The Federal Reserve also acts as an intermediary in check processing for the majority of checks that cross commercial banking networks, although it passes these costs on to commercial banks.¹³⁴ Finally, the central bank incurs production costs for cash. Unlike metal coins, paper currency has a short lifespan. With each transaction, a bill becomes more soiled and worn. The Federal Reserve typically destroys

¹³⁰ For technical definitions of fiscal and other kinds of seigniorage, see Manfred J.M. Neumann, “Seigniorage in the United States: How Much Does the U.S. Government Make from Money Production?,” *Review – Federal Reserve Bank of St. Louis*, Mar/Apr 1992. Note that the central bank operates on a non-profit basis, turning all of its profits over to the Treasury department.

¹³¹ It is listed again in later tables as a revenue (benefit) to the central bank. Seigniorage therefore cancels out at the social level, although it affects private estimates.

¹³² Some economists might object to including the central bank in a cost-benefit calculus, on the grounds that it is not an individual. Any costs incurred by the government, or even quasi-government entities like the Federal Reserve, are ultimately borne by tax paying individuals. (See, for example, Steven E. Landsburg, *The Armchair Economist: Economics and Everyday Life*, New York: Free Press (1993), at chapter 10.) We agree, in principle. In practice, however, it is impossible to trace these costs to their final destination. We choose instead to consider costs at their first instance.

¹³³ See Jeffrey M. Lacker, “Should We Subsidize the Use of Currency?,” *Federal Reserve Bank of Richmond Economic Quarterly*, Vol. 79/1 Winter 1993. As we noted earlier, the question of subsidization has been raised for several different payment instruments. Humphrey and Berger (1990) argue that checks and credit cards are both subsidized (by commercial banks in the case of checks and indirectly by merchants in the case of credit cards). It appears that commercial banks subsidize PIN debit, as well. To provide merchants with an incentive to lease and install special PIN pad equipment, bank associations initially set the PIN debit price structure with relatively low interchange fees as compared to signature debit and credit cards. Signature debit transactions, on the other hand, are processed using credit card equipment already in place at most merchants. Now, however, after many merchants have already installed PIN pad equipment, debit-processing banks appear concerned they are not covering costs. (The number of PIN pads installed increased from 53,000 in 1990 to 529,000 in 1995 to more than 4 million in 2002. Faulkner & Gray, *1996 Debit Card Directory*, at 28; *The Nilson Report*, No. 785, April 2003.) For example, Corus Bank in Chicago reportedly loses around 2.5 cents on every PIN debit transaction its customers make. (See David Breitkopf, “PIN Debit Fees Becoming A Math Problem For Banks,” *American Banker*, July 23, 2003.) The issue of subsidies is clearly an important one when considering the net social benefits of shifting to a cashless society. This issue, and its policy ramifications, is an interesting topic for future research.

¹³⁴ By law, the Federal Reserve charges its cost plus an adjustment factor intended to simulate a normal economic profit. “Monetary Control Act of 1980,” at §11A (available at <<http://www.federalreserve.gov/paymentsystems/pricing/pricingpol.htm>>).

the most frequently used 5-dollar bills after just 15 months in circulation.¹³⁵ We therefore interpret cash production costs as a marginal cost for each transaction.¹³⁶

Commercial banks are the third and final party added to the calculations. Just as with paper currency, the magnetic stripe on plastic cards wears out over time and must be replaced. Only about a tenth of the magnetic stripes on credit, charge and debit cards fail within two years, but most banks replace their plastic cards within this time period to preempt any problems.¹³⁷ Commercial banks must also maintain ATM machines and refill them with cash periodically.¹³⁸ We allocate the monthly maintenance costs for ATMs across monthly grocery transactions to obtain a per transaction cost. Commercial banks also expend resources in processing checks.¹³⁹ In addition to in-house processing costs, commercial banks must pay the Federal Reserve (and any other intermediary) for any checks it processes as an intermediary. Commercial banks expend resources to process, sort, and handle paper currency as well.

Banks incur processing costs for payment cards as well. For example, issuers fund consumer credit card float for an average of 25 days and signature debit float for around 2 days. Acquirers facilitate transaction clearing between card issuers and merchants.

Finally, card issuers expend resources to provide consumers with rewards, such as airline miles or Discover's "cash back" promise. Around twelve percent of credit or charge cardholders have cards that provide rewards of some kind, counting American Express,

¹³⁵ The average lifespan of both \$1 and \$10 bills is only 18 months. "Dollars and Cents, The Circulation of Money," Federal Reserve Bank of Atlanta, (visited February 9, 2004) <http://www.frbatlanta.org/invoke_brochure.cfm?objectid=83FD41E6-9AF0-11D5-898400508BB89A83&method=display_body>.

¹³⁶ For paper checks, the marginal cost nature of production is obvious: each check is used only once.

¹³⁷ Rebecca Cox, "Cost-Conscious Banks Seek Ways to Prolong Life of Plastic Cards," *American Banker*, May 3, 1989. *The Nilson Report*, No. 759 (March 2002); *The Nilson Report*, No. 760 (March 2002); *The Nilson Report*, No. 784 (March 2003); *The Nilson Report*, No. 785 (April 2003).

¹³⁸ This is the regular upkeep cost of the machine, not the initial installation cost, which is considered overhead and not a per transaction cost. Maintenance includes cash replenishment, servicing, telephone costs, rent, and so on. See 2003 American Bankers Association ATM Fact Sheet, available online, <http://www.aba.com/NR/rdonlyres/00007096hamqwzpkfrfzgvm/ATMFactSheet5.pdf>.

¹³⁹ See Stavins, "Comparison of Social Costs," *supra* note 15 for a description of the tortuous path that the typical personal check travels before satisfying its payment function. The high cost of check processing is one reason behind bank support of debit cards. As one bank executive observed, "Our philosophy around PIN debit is that, even without making money off of it, it saves us money because it's one less check that we need to process." (As quoted in David Breitkopf, "Study: PIN Fees Are Up But Won't Become Norm," *American Banker*, August 19, 2002.)

Discover, MasterCard, and Visa. We estimate the cost of providing loyalty rewards, scaled by the percentage of cardholders with cards of this type.

We present two summary cost calculations at the bottom of Table 4a. The first simply sums the four private parties. Because several elements represent transfer payments, such as commercial bank payments to the Federal Reserve for check processing and merchant payments to commercial banks for payment card processing, this sum double counts certain costs. In order to obtain social marginal cost, transfer payments must be subtracted, which is done in the last line of the table. The social marginal costs in Table 4a are relatively close to one another. In Table 2, the spread between the most and least expensive instruments was 87 cents; in Table 4a that spread is only around 26 cents. Moreover, the cheapest instrument for merchants (cash) is not the cheapest instrument for the economy. Counting all parties, signature debit cards are cheapest, followed closely by PIN debit and credit cards. Paper instruments, cash plus verified and non-verified checks, emerge as the most costly forms of payment. Thus adding in the other parties to the transaction has changed the relative cost situation considerably—at least for small transactions. We turn next to a larger transaction size, the average check purchase.

**Table 4b. Per Transaction Processing Costs for Various Payment Instruments
Grocery Store Check Transaction \$54.24 (\$)**

| | Cash | Non- Verified Check | Verified Check | Credit/ Charge | Signature Debit | PIN Debit |
|--|-------------|---------------------------|-------------------|-------------------|--------------------|-------------|
| Merchant | | | | | | |
| Theft/Counterfeit | 0.14 | 0 | 0 | 0 | 0 | 0 |
| Float | 0.004 | 0.01 | 0.01 | 0.01 | 0.01 | 0.004 |
| Costs From Table 3 | 0.28 | 0.63 | 0.46 | 1.21 | 0.81 | 0.57 |
| a) Merchant Marginal Cost | 0.43 | 0.64 | 0.47 | 1.22 | 0.82 | 0.57 |
| Consumers | | | | | | |
| Processing Time | 0.14 | 0.33 | 0.31 | 0.23 | 0.23 | 0.21 |
| Queue Time | 0.14 | 0.33 | 0.31 | 0.23 | 0.23 | 0.21 |
| Explicit Price | 0.03 | 0.04 | 0.04 | 0 | 0 | 0.13 |
| Implicit Price | 1.29 | 0 | 0 | 0 | 0 | 0 |
| Seigniorage | 0.33 | 0 | 0 | 0 | 0 | 0 |
| b) Consumer Marginal Cost | 1.92 | 0.70 | 0.65 | 0.46 | 0.46 | 0.55 |
| Central Bank | | | | | | |
| Production | 0.01 | 0 | 0 | 0 | 0 | 0 |
| Processing | 0.002 | 0.03 | 0.03 | 0 | 0 | 0 |
| c) Central Bank Marginal Cost | 0.01 | 0.03 | 0.03 | 0 | 0 | 0 |
| Commercial Banks | | | | | | |
| ATM Maintenance | 0.30 | 0 | 0 | 0 | 0 | 0 |
| Production | 0 | 0 | 0 | 0.01 | 0.01 | 0.01 |
| Processing | 0.02 | 0.012 | 0.12 | 0.49 | 0.35 | 0.34 |
| Card Rewards | 0 | 0 | 0 | 0.05 | 0 | 0 |
| d) Commercial Bank Marginal Cost | 0.31 | 0.12 | 0.12 | 0.55 | 0.36 | 0.36 |
| e) Sum of Marginal Costs (double counts) | 2.67 | 1.49 | 1.27 | 2.23 | 1.64 | 1.48 |
| f) Social Marginal Cost (no double count) | 2.66 | 1.40 | 1.08 | 1.22 | 1.01 | 1.08 |

Notes: Numbers may not sum due to rounding. Sum of MC, e, is equal to a + b + c + d. Due to transfers across parties (such as merchant payments to banks), this figure double counts some cost elements. Social Marginal Cost, f, eliminates any transfers that give rise to double counting.

Source: Authors' calculations as detailed in the Appendix.

Table 4b is analogous to 4a, but highlights how transaction size matters. For instance, compared to Table 4a, ATM maintenance fees are higher since the costs are spread over fewer

higher dollar transactions (\$54.24 versus \$11.52).¹⁴⁰ Commercial bank payment card processing costs rise as well, since the cost of funds for the grace period increases with the transaction size. The implicit cost of cash increases dramatically as well. At the average ATM cash extraction of \$60, consumers can make only one grocery purchase of \$54.24. While consumers might adjust their cash withdrawal amount to reflect the higher expected purchase, consumers would have to bear the inconvenience of carrying bulky cash and the increased value of potential losses or theft. Recall from Figure 1 that consumers use cash to pay for purchases in the \$40-\$60 range only one-quarter as often as they do to pay for purchases costing \$5-\$10. Clearly consumers perceive either a significant cost to using cash for relatively large purchases or significant benefits to using other methods like checks and credit cards. We were unable to estimate these carrying and use costs directly, so as an alternative we assume that consumers do not adjust ATM withdrawal amounts and thus face a relatively high time cost when using cash for higher priced purchases.

As with the cash purchase size, adding other parties to the transaction changes the relative-cost picture significantly as compared to Table 3 at the average check purchase size. Once other parties are considered, payment cards do not look nearly as expensive vis-à-vis cash and checks as indicated by merchant costs alone. Signature debit is again the least costly; PIN debit and verified checks follow. Cash and non-verified checks are the most expensive instruments.

3. Quantifying Benefits

We now turn to our third adjustment: quantifying the benefits of payment cards relative to cash and checks. Tables 5a and 5b present the results.

¹⁴⁰ Recall that this cost element is estimated by allocating maintenance costs among potential grocery transactions generated from the cash dispensed at the ATM. If each grocery transaction costs more, maintenance costs will be allocated among fewer transactions.

**Table 5a. Adding Selected Benefits
Grocery Store Cash Transaction \$11.52 (\$)**

| | Cash | Non- Verified Check | Verified Check | Credit/ Charge | Signature Debit | PIN Debit |
|---|-------------|---------------------------|-------------------|-------------------|--------------------|-------------|
| Consumers | | | | | | |
| Float | 0 | 0.002 | 0.002 | 0.02 | 0.002 | 0.001 |
| Credit Option | 0 | 0 | 0 | 0.06 | 0 | 0 |
| Record Keeping | 0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0.15 | 0.15 | 0 | 0 | 0.13 |
| Signature Debit | 0 | 0 | 0 | 0 | 0.13 | 0 |
| Reward Cards | 0 | 0 | 0 | 0.01 | 0 | 0 |
| Discover Cards | 0 | 0 | 0 | 0.004 | 0 | 0 |
| Privacy | 0.12 | 0 | 0 | 0 | 0 | 0 |
| Consumer Marginal Benefits | 0.12 | 0.19 | 0.19 | 0.13 | 0.16 | 0.16 |
| Central Bank | | | | | | |
| Processing Revenue | 0.002 | 0.03 | 0.03 | 0 | 0 | 0 |
| Seigniorage | 0.07 | 0 | 0 | 0 | 0 | 0 |
| Central Bank Marginal Benefits | 0.07 | 0.03 | 0.03 | 0 | 0 | 0 |
| Commercial Bank | | | | | | |
| Processing Revenue | 0.003 | 0.06 | 0.16 | 0.42 | 0.50 | 0.41 |
| Sum of Marginal Benefits | 0.19 | 0.28 | 0.38 | 0.55 | 0.66 | 0.57 |
| Sum of Marginal Costs (Table 4a) | 1.02 | 1.27 | 1.24 | 1.39 | 1.42 | 1.40 |
| Net Social Marginal Cost | 0.83 | 0.99 | 0.87 | 0.84 | 0.76 | 0.83 |

Notes: Numbers may not add due to rounding. Net Social Marginal Cost equals the Sum of Marginal Costs minus the Sum of Marginal Benefits, which removes cross-party transfers.

Source: Authors' calculations as detailed in the Appendix.

Table 5a adds estimates of per-transaction benefits associated with each of the payment instruments at the grocery cash transaction size. Even more than the cost estimates, these figures are approximations given the difficult nature of quantifying benefits. Unfortunately, we do not have estimates for merchant-specific benefits aside from relative cost savings across payment instruments, something captured in the cost estimates already.

Consumer benefits are listed first. All non-cash payment instruments provide consumers with some level of float.¹⁴¹ Even PIN debit cards, which withdraw payments directly from a consumer's bank account, take a day to process on average. Credit and charge cards provide consumers with the greatest amount of float. On average, consumers have 25 days from the date of purchase to the date their card bill is due.¹⁴² Card issuers fund this float, recovering the cost of doing so in the interchange fee.¹⁴³

Credit cards also give consumers the option to borrow.¹⁴⁴ Uncertainty over income or expenses can lead a consumer to rely on credit cards for payment, even if she intends at the time of purchase to pay the charge in full when her bill arrives. This benefit is difficult to measure because it varies with personal finances and available credit options. For instance, consumers who own their home and have accumulated some equity may qualify for a home equity loan through their bank. This is a relatively low-cost credit option, but involves transaction costs to set up and is unavailable to renters. All secured loans involve this constraint—for many consumers these loans are not available. Credit cards, on the other hand, offer a convenient source of unsecured credit to a broad cross section of consumers.¹⁴⁵ Another unsecured credit alternative is the payday loan, but this is far more costly than credit card

¹⁴¹ Note that check float has declined considerably over the last ten years as check processing has improved. According to our review of the literature, however, “the limit to mechanical processing of checks has effectively been reached. While reader/sorter speeds could be increased, it would just rip the checks and jam the machines.” (David Humphrey et al., “What does it Cost to Make a Payment?,” *Review of Network Economics*, Vol. 2, Issue 2, June 2003, at 170 n28.) Faster check processing will likely require moving beyond traditional paper checks, to point of sale check imaging or truncation/electronic presentment, for instance. The recently passed Check 21 Act aims at just this sort of advance in check processing. See *supra* note 21.

¹⁴² “Survey of Credit Card Plans,” *supra* note 122.

¹⁴³ Thus, as discussed above, the merchant bank charge costs plus merchant float costs will generally offset the float benefit received by consumers. In effect, float is a transfer payment.

¹⁴⁴ Here we consider only the option value of obtaining credit, not the benefit of the credit itself net of the cost of funds. As Brito and Hartley observe, credit cards “[provide] insurance against unanticipated shocks to expenditure or income.” Dagobert L. Brito and Peter R. Hartley, “Consumer Rationality and Credit Cards,” *Journal of Political Economy*, 1995, vol. 103, no. 2, at 402.

¹⁴⁵ See, e.g., Joseph Nocera, *A Piece of the Action: How the Middle Class Joined the Money Class*, New York: Simon & Schuster, 1994, at 93-94; Scott B. MacDonald & Albert L. Gastmann, *A History of Credit & Power in the Western World*, New Brunswick, NJ: Transaction Publishers, 2001, at chapter 11; Glenn B. Canner & Charles A. Lockett, “Developments in the Pricing of Credit Card Services,” *Federal Reserve Bulletin*, September 1992, at 653.

debt.¹⁴⁶ An alternative relatively similar to credit cards is a personal line of unsecured bank credit. These credit lines typically have a minimum amount of several thousand dollars,¹⁴⁷ but the interest rate terms are similar to credit cards.¹⁴⁸ Once an unsecured line of credit is established, consumers must pay an annual fee to maintain it. This fee can be thought of as the option price of borrowing for the year. We therefore use the typical unsecured loan annual fee spread over the minimum loan amount and multiplied by the transaction size as a rough estimate of the per-transaction value of having the option to place a transaction on credit. While not all consumers exercise the option for credit, at the time of purchase it is likely to have some value for the majority of consumers.¹⁴⁹

All payment methods except for cash provide consumers with a record keeping mechanism useful for budgeting, planning, and income tax preparation.¹⁵⁰ Rather than having to keep track of each purchase's paper receipt, checks and payment cards provide itemized monthly statements. Most payment cards also have online statements accessible anytime.

Using checks and debit cards for grocery purchases can save consumers time outside of the checkout lane. Grocers commonly offer a cash back option that is free of charge for these payment instruments. As a result, consumers can reduce their need to make a separate trip to an

¹⁴⁶ A typical payday loan charges \$17.50 on every \$100 increment borrowed for each 15-day period. Thus a person borrowing \$200 for one month would pay \$70 in fees, which translates into an APR of 457 percent. PIRG and CFA report for 2000, see <http://www.pirg.org/reports/consumer/payday/>.

¹⁴⁷ Brito and Hartley quote a bank officer observing that the costs to the bank of processing a loan are so high that the bank could not afford to make a loan of less than \$3,000 for 1 year, except at interest rates that exceed those charged on credit cards. Brito & Hartley, *supra* note 144, at 402. Thus, credit cards appear to be the lowest cost means for borrowing small amounts without security.

¹⁴⁸ Wells Fargo Loans & Lines of Credit—Product Comparison, (visited August 7, 2003) <http://www.wellsfargo.com/per/loans_credit/chart.jhtml>; Wells Fargo Loans & Lines of Credit—Products (visited August 8, 2003) <http://www.wellsfargo.com/per/loans_credit/products.jhtml>; Wells Fargo Loans & Lines of Credit—Rate Calculator, (visited August 8, 2003) http://www.wellsfargo.com/per/loans_credit/rates/index.jhtml?_requestid=17336.

¹⁴⁹ Just as with stock options, a credit option need not be exercised in order to have value at the time of purchase. We suspect the majority of credit card users value this option.

¹⁵⁰ Many consumers value cancelled checks as payment receipts. (See ATM & Debit News, “Star Survey Finds Even Debit Card Users Still Write Checks At The Point Of Sale,” March 6, 2003.) However, the recently passed Check 21 Act makes it legal for banks to provide only digital images of processed checks, allowing them to refuse to return the physical checks to customers or to charge those customers that request returned checks. (See Lauri Giesen, “The Enduring Check,” *Credit Card Management*, Nov. 2002; Lynn Koller, “Making a Clear Case for Online Digital check Imaging,” *Bank Technology News*, Apr. 2002. The text of the Check Clearing for the 21st Century Act (P.L. 108-100), or Check 21, is available at *Thomas: Legislative Information on the Internet*

ATM in order to obtain cash for other purchases. We assume this benefit is equal to the implicit cost of obtaining cash from an ATM, scaled by the average cash-back amount and the percentage of debit transactions involving cash-back.¹⁵¹

According to survey results, around 30 percent of debit cardholders prefer signature to PIN; another 30 to 40 percent prefer PIN to signature.¹⁵² Like all debit cards, signature cards offer enforced budgeting. Unlike PIN, signature debit also offers familiar use patterned after credit cards, dispute resolution procedures, and more extensive merchant acceptance.¹⁵³ Survey results indicate that those consumers preferring signature to PIN debit place a significant dollar value on that preference (from 25 cents a transaction up to 50% of the transaction value).¹⁵⁴ However, the survey methodology was distinctively different from the accounting based estimates we employ for other payment instrument benefits.¹⁵⁵ We therefore chose to treat signature and PIN debit symmetrically and estimate signature-specific benefits at the PIN-specific cash-back benefit amount.¹⁵⁶

The benefit to consumers from reward cards is calculated analogously to its cost for issuers. Again, this benefit is scaled by the percent of cardholders with a reward card.

<<http://thomas.loc.gov/>>.) As more banks take this cost saving route, the value of checks as record keeping instruments will likely decline.

¹⁵¹ Consumers could prefer other payment mechanisms (cash, credit) for the majority of their transactions and use PIN or checks for cash-back only when they need to replenish their cash supplies.

¹⁵² “Debit Card Study,” BAI Global: 4316, June 2, 1999, submitted as Expert Report of David W. Stewart, *In re Visa Check/MasterMoney Antitrust Litig.* (E.D.N.Y. 2000) (No. CV-96-5238).

¹⁵³ Signature debit is by far the more prevalent of the two debit forms. By number of transactions signature debit is used over twice as often as PIN and by sales volume use is nearly three times as large as PIN. *The Nilson Report*, No 784 (March 2003); *The Nilson Report*, No. 785 (April 2003).

¹⁵⁴ If signature debit benefit estimates based on the survey instrument are used in the calculations above, signature debit emerges as significantly less costly than all other forms of payment.

¹⁵⁵ The survey calculates the value of a consumer’s entire preference for signature over PIN debit, as opposed to estimating the value of the individual attributes a consumer may like about signature debit. Preference values for those consumers preferring PIN to signature debit were not included in the survey.

¹⁵⁶ Preferences for one debit card may be stronger than those for the other, but showing this would require comparable data for both payment instruments. Lacking that data, we opt for symmetric treatment. Consumers evidently perceive a number of differences between signature and PIN debit, most notably over the value of cash back and the actual level of security provided. Some debit users appear to believe that PIN debit is more secure than signature, since merchants rarely check signatures and would-be thieves do not know their PINs. Others, however, believe that signature is more secure because individual signatures are difficult to forge while a PIN can be observed as the card owner enters it on a PIN pad. See, for example, David Breitkopf, “Customers Get Savvier in Debit Debate,” *American Banker*, May 6, 2003. The realities of payment card security are not relevant in this decision process—to a very large extent consumers select payment instruments to use and thus their beliefs are what matters.

The last item listed for consumers is privacy. Some consumers worry that their purchases will be tracked if they pay with a check or plastic card that displays personal information. This can be a particular concern at grocery stores, where loyalty cards help merchants capture customers' buying habits and influence stocking decisions. Cash offers consumers an anonymous method of paying. We estimate this benefit using loyalty card discounts. At least in some retail venues, supermarkets included, shunning a loyalty card means forgoing product discounts. We can view these discounts, then, as the implicit benefit of providing personal information. Consumers paying with cash (and not providing a loyalty card) must value their privacy at least as much as the discount forgone.

Two items are listed for the central bank. First, it earns a profit on the currency it produces (seigniorage). Second, it recoups its expenses in processing checks. Both of these revenues must be included in the social calculation to obtain net marginal costs. For the same reason, commercial bank processing revenues are included as well.

Note that the sum of marginal costs, as opposed to social marginal costs, is used in Table 5a. This is necessary so as not to double count transfer payments as revenues.¹⁵⁷

¹⁵⁷ The Appendix describes this issue in greater detail.

**Table 5b. Adding Selected Benefits
Grocery Store Check Transaction \$54.24 (\$)**

| | Cash | Non- Verified Check | Verified Check | Credit/ Charge | Signature Debit | PIN Debit |
|---|-------------|---------------------------|-------------------|-------------------|--------------------|-------------|
| Consumers | | | | | | |
| Float | 0 | 0.01 | 0.01 | 0.10 | 0.01 | 0.004 |
| Credit Option | 0 | 0 | 0 | 0.27 | 0 | 0 |
| Record Keeping | 0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0.15 | 0.15 | 0 | 0 | 0.13 |
| Signature Debit | 0 | 0 | 0 | 0 | 0.13 | 0 |
| Reward Cards | 0 | 0 | 0 | 0.06 | 0 | 0 |
| Discover Cards | 0 | 0 | 0 | 0.02 | 0 | 0 |
| Privacy | 0.54 | 0 | 0 | 0 | 0 | 0 |
| Consumer Marginal Benefits | 0.54 | 0.19 | 0.19 | 0.48 | 0.17 | 0.16 |
| Central Bank | | | | | | |
| Processing Revenue | 0.002 | 0.03 | 0.03 | 0 | 0 | 0 |
| Seigniorage | 0.33 | 0 | 0 | 0 | 0 | 0 |
| Central Bank Marginal Benefits | 0.33 | 0.03 | 0.03 | 0 | 0 | 0 |
| Commercial Bank | | | | | | |
| Processing Revenue | 0.02 | 0.06 | 0.16 | 1.01 | 0.63 | 0.41 |
| Sum of Marginal Benefits | 0.89 | 0.28 | 0.38 | 1.49 | 0.80 | 0.57 |
| Sum of Marginal Costs (Table 4b) | 2.67 | 1.49 | 1.27 | 2.23 | 1.64 | 1.48 |
| Net Social Marginal Cost | 1.79 | 1.21 | 0.89 | 0.74 | 0.85 | 0.92 |

Notes: Numbers may not add due to rounding. Net Social Marginal Cost equals the Sum of Marginal Costs minus the Sum of Marginal Benefits, which eliminates cross-party transfers.

Source: Authors' calculations as detailed in the Appendix.

Table 5b is analogous to 5a, presenting estimates for the various benefits at the typical check-size grocery purchase. Record keeping and cash-back, as calculated here, do not depend on purchase size.¹⁵⁸

¹⁵⁸ It is possible that the amount of cash-back varies with transaction size but we do not have sufficiently detailed information on this benefit to make purchase-size-specific calculations.

Taking all of the above benefit estimates into account, the position of payment cards relative to cash and checks improves considerably, as Tables 5a and 5b illustrate. For either the average cash or check transaction size, a payment card is the cheapest instrument. Cash and non-verified checks are among the most costly instruments.

Compared to the above estimates, merchant cost studies do indeed present a misleading picture for policy makers: the ordering of payment instrument costs reversed entirely after multiple parties were added and benefits included. Table 6 illustrates how the relative rankings shift as other parties to a transaction are included and as benefits enter into the calculations. Cash falls from the cheapest instrument (rank = 1) to last place. Credit cards, in contrast, move from the most expensive (rank = 6) to the least. Signature debit cards drop from fifth place to second.

**Table 6. Payment Instrument Cost Rankings
Grocery Store Check Transaction \$54.24**

| | Cash | Non-Verified Check | Verified Check | Credit/ Charge | Signature Debit | PIN Debit |
|---------------------------|------|-----------------------|-------------------|-------------------|--------------------|--------------|
| Grocer Marginal Costs | 1 | 4 | 2 | 6 | 5 | 3 |
| Social Marginal Costs | 6 | 5 | 3 | 4 | 1 | 2 |
| Net Social Marginal Costs | 6 | 5 | 3 | 1 | 2 | 4 |

Source: Rows indicate the relative cost rankings in Tables 3, 4b, and 5b, respectively.

Note that the preceding calculations disregard the value of many other benefits that are difficult to quantify. First, merchants are not included in the benefits calculations. While many of the relative benefits of one payment instrument versus another are captured in labor cost savings (reduced POS labor) or in lower processing fees already captured in these calculations, it is likely that some direct benefits to merchants are ignored here. For example, if the reduction in transaction costs for consumers due to a better match between preferred and accepted payment methods discussed at the beginning of this paper translates into increased consumption, then payment cards could result in somewhat higher sales for merchants (although the amount might be insignificant for low price purchases like groceries). We were unable to estimate any direct merchant benefits.

Many of the instruments offer benefits that are difficult to value. For instance, payment cards offer the option of consolidating payments—everything can be charged on one card with one bill to pay at the end of the month. For both consumers and merchants, checks and payment cards provide improved theft and loss prevention as compared to cash, as well as easier dispute resolution in the event of problems.¹⁵⁹ Credit, charge and signature debit cards provide added protection on this front because the card systems take an active role in dispute resolution.¹⁶⁰ PIN debit does not provide this benefit as the money is immediately withdrawn from the consumer's bank account and any dispute resolution is left to the consumer and the merchant, just as with a cash purchase.¹⁶¹ All of these benefits are important and help to explain the pattern of observed payment instrument use. The difficult nature of estimating their value implies that we cannot explicitly account for them in Tables 5a and 5b. Despite the many items omitted from the calculations—and the rough nature of the estimates that are included—our calculations track observed payment instrument use at grocery stores fairly well. Payment cards are increasingly used to make grocery purchases and these are the instruments offering consumers the lowest net cost. While the numbers are only indicial, the relative rankings appear to be in line with behavior.

B. The Decline of Cash and Checks at Discount Stores

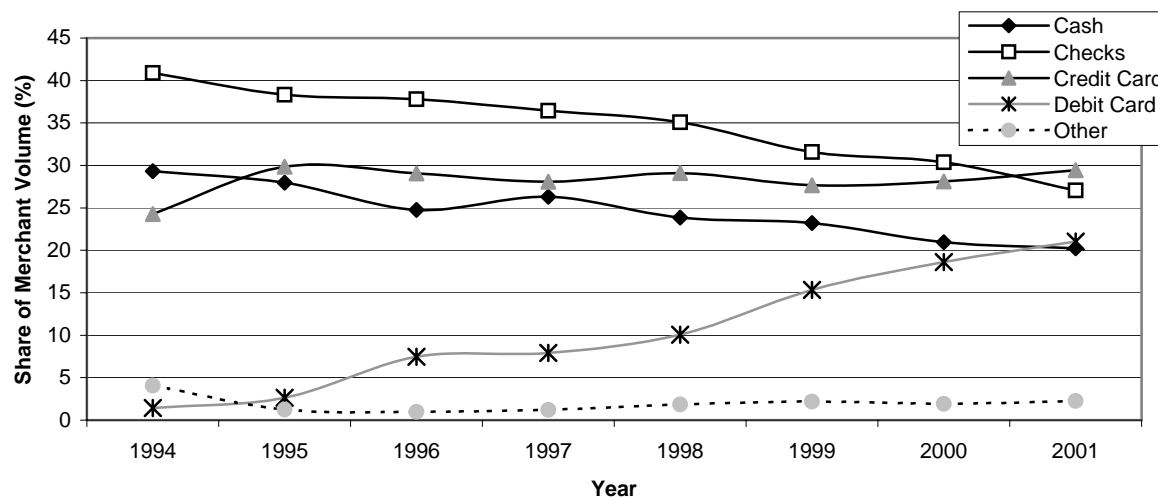
For our second case study, we examine discount stores. Just as with grocery stores, although less dramatically, discount stores have seen a shift in customer payment methods over time. Figure 3 presents the share of sales volume for credit, debit, cash, and checks from 1994 through 2001. The proportion of sales paid for with credit cards is mostly unchanged, remaining between 25 and 30 percent for most of the period. Debit cards, however, rise from essentially zero to over 20 percent—while cash and checks each decline by at least 10 percent.

¹⁵⁹ As one author states “...the decision to use a check or credit card versus other payment options can be viewed as the purchase of a low cost insurance contract, which limits future potential payment problems at the cost of some marginal inconvenience and expense [as compared to other electronic methods of paying].” Mantel, *supra* note 9, at 26.

¹⁶⁰ With signature debit, however, the money is often deducted before the consumer is aware of the fraud, making the resolution process somewhat more time consuming because reimbursements can be involved.

¹⁶¹ For a discussion of consumer dispute resolution concerns, see Mantel, *supra* note 9.

Figure 3. Share of Sales Volume by Payment Method at Discount Stores: 1994–2001



Source: Visa U.S.A., 1994-2001. Credit volume includes charge cards.

To evaluate discount store payment processing costs and benefits, we start with the merchant costs reported by Coopers & Lybrand (1995), discussed above in Section III. Recall that the Coopers study relied on cost data for only one “representative” merchant. We present this case study as a point of comparison to the grocer study. Discount stores are similar to grocery stores in several ways. Average transaction sizes are quite close, often within a few dollars for a given payment type (as Table 7 below demonstrates). The point of sale structure is similar as well—both typically have multiple checkout lanes positioned near the store exit. Thus, we would expect discount store payment processing costs to be similar to grocery costs. The cost estimates presented here can therefore be used as a check on the sensibility of the FMI numbers. The methods used to calculate non-merchant costs are identical to the grocer case, varying only because of slight differences in transaction sizes and reported differences in point of sale time. As a result, we present only the initial merchant cost table and the final net marginal social cost table, which incorporates benefits.¹⁶² Table 7 presents discount merchant store costs, based on Coopers & Lybrand.¹⁶³

¹⁶² The original costs reported in the Coopers’ study, as well as the intermediate cost tables we calculate, are all presented in the Appendix.

¹⁶³ The numbers reported are updated using the same approach as the grocery case study.

**Table 7. Per Transaction Processing Costs for Various Payment Instruments
Discount Store Merchants (\$)**

| | Cash | Check | MC/Visa Credit | Discover | American Express | Signature Debit* | PIN Debit* |
|---------------------------------------|-------------|-------------|-------------------|-------------|---------------------|---------------------|-------------|
| POS Time | 0.04 | 0.12 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| Drawer/Office | 0.01 | 0.11 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Bank Charges | 0.01 | 0.09 | 0.80 | 0.54 | 1.25 | 0.75 | 0.44 |
| Losses | 0.003 | 0.16 | 0.01 | 0.01 | 0.01 | 0.01 | 0 |
| Float | 0.001 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.003 |
| Other Costs | 0.02 | 0.001 | 0 | 0 | 0 | 0 | 0 |
| Per Transaction Total Cost | 0.08 | 0.49 | 0.90 | 0.64 | 1.35 | 0.85 | 0.52 |
| Average Receipt for Payment Type | 15.49 | 43.93 | 41.21 | 37.60 | 48.43 | 41.92 | 41.07 |
| Cost Scaled to \$100 of Sales | 0.49 | 1.11 | 2.18 | 1.70 | 2.79 | 2.03 | 1.26 |

Notes: Numbers may not add due to rounding.

* PIN and signature debit are imputed as described in the text and the Appendix.

Source: Coopers (1995), updated by authors as detailed in the Appendix.

The Coopers & Lybrand study includes a slightly different set of marginal processing costs. “POS Time” is equivalent to grocery tender time. “Drawer/Office,” however, includes the marginal cost portion of back office cashier/drawer balancing, which FMI excludes from its numbers. The Coopers study also includes merchant float costs and losses for cash, not just for checks and payment cards as with FMI.¹⁶⁴

The Coopers study provides greater detail on payment cards than FMI did for grocery stores. While FMI reported processing fees for the different payment card systems in one of the backup tables,¹⁶⁵ grocery store costs were not reported separately by card system. The FMI study groups all credit and charge cards together, obscuring the processing cost differences apparent in Table 7. According to the Coopers’ data, American Express costs discount merchants twice as much as Discover and fifty percent more than Visa/MasterCard.

¹⁶⁴ Recall that we add float costs and cash loss/theft to grocery store processing costs in Table 4a.

¹⁶⁵ Food Marketing Institute, “A Retailer’s Guide,” *supra* note 23, at 20.

Because the Coopers study collected data from 1994, debit use was reported as zero by the discount store that was surveyed. As Figure 3 illustrates, this is a key payment instrument with increasing use at discount stores, so we impute the costs for signature and PIN debit based on reported costs for Visa and MasterCard credit cards, debit merchant discount fees, and information about the relationship of debit to credit in the FMI study.¹⁶⁶ Float is calculated directly in the same manner as for grocery stores.

While some of the individual cost elements are different, discount store processing costs are quite similar to grocery store costs. Cash is the one instrument with a significantly different processing cost overall: 30 cents for grocery stores versus 8 cents for discount stores. Two marginal cost elements appear to drive the difference. First, time costs at the point of sale are far lower for discount stores as compared to grocery stores. Grocery tender time for a cash transaction costs around 11 cents; for a discount store merchant that cost is roughly 4 cents. Second, other direct costs are lower for discount than for grocery stores, costing discount store merchants around 2 cents but costing grocery merchants almost 16 cents. In terms of payment instrument rankings, though, the two retail venues are in agreement: cash is the cheapest instrument to accept, checks come next, and credit cards are among the most costly.

Table 8a below moves beyond discount store merchants by including costs and benefits to key parties to the transaction. It also fixes the transaction size at the cash average.

¹⁶⁶ The vast majority of debit cards are Visa Check cards, a signature debit card. *The Nilson Report*, No. 784 (March 2003); and *The Nilson Report*, No. 785 (April 2003).

**Table 8a. Adding Selected Benefits
Discount Store Cash Transactions, \$15.49 (\$)**

| | Cash | Check | MC/Visa Credit | Discover | American Express | Signature Debit | PIN Debit |
|--------------------------------------|-------------|-------------|-------------------|-------------|---------------------|--------------------|-------------|
| Consumers | | | | | | | |
| Float | 0 | 0.002 | 0.03 | 0.03 | 0.03 | 0.03 | 0.001 |
| Credit Option | 0 | 0 | 0.08 | 0.08 | 0.08 | 0 | 0 |
| Record Keeping | 0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 |
| Signature Debit | 0 | 0 | 0 | 0 | 0 | 0.13 | 0 |
| Reward Cards | 0 | 0 | 0.02 | 0.01 | 0.002 | 0 | 0 |
| Privacy | 0.16 | 0 | 0 | 0 | 0 | 0 | 0 |
| Consumer Marginal Benefit | 0.16 | 0.04 | 0.16 | 0.15 | 0.14 | 0.19 | 0.16 |
| Central Bank | | | | | | | |
| Processing Revenue | 0.002 | 0.03 | 0 | 0 | 0 | 0 | 0 |
| Seigniorage | 0.09 | 0 | 0 | 0 | 0 | 0 | 0 |
| Central Bank Marginal Benefit | 0.10 | 0.03 | 0 | 0 | 0 | 0 | 0 |
| Comm. Bank | | | | | | | |
| Processing Revenue | 0.01 | 0.09 | 0.30 | 0.22 | 0.40 | 0.43 | 0.44 |
| Sum of Marginal Benefits | 0.26 | 0.16 | 0.46 | 0.37 | 0.54 | 0.62 | 0.60 |
| Social Marginal Cost | | | | | | | |
| Social Marginal Cost | 0.82 | 1.00 | 0.75 | 0.75 | 0.75 | 0.71 | 0.80 |
| Sum of Marginal Costs | 0.83 | 1.12 | 1.05 | 0.97 | 1.15 | 1.14 | 1.23 |
| Net Social Marginal Cost | 0.57 | 0.96 | 0.60 | 0.60 | 0.61 | 0.52 | 0.64 |

Notes: Numbers may not add due to rounding. Net Social Marginal Cost equals the Sum of Marginal Costs minus the Sum of Marginal Benefits, which eliminates cross-party transfers. Social Marginal Cost is included for reference.

Source: Authors' calculations as detailed in the Appendix.

Following the same pattern as grocery stores, the relative ranking for discount store payment processing costs changes considerably when parties other than the merchant are considered and when some benefits are included in the calculation. Signature debit is once again the cheapest instrument at the cash transaction size; cash, credit cards and PIN debit come next and are all quite close in net cost. Checks have the highest social cost.

**Table 8b. Adding Selected Benefits
Discount Store Check Transactions, \$43.93 (\$)**

| | Cash | Check | MC/Visa Credit | Discover | American Express | Signature Debit | PIN Debit |
|--------------------------------------|-------------|-------------|-------------------|-------------|---------------------|--------------------|-------------|
| Consumers | | | | | | | |
| Float | 0 | 0.01 | 0.08 | 0.08 | 0.08 | 0.08 | 0.003 |
| Credit Option | 0 | 0 | 0.22 | 0.22 | 0.22 | 0 | 0 |
| Record Keeping | 0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 |
| Signature Debit | 0 | 0 | 0 | 0 | 0 | 0.13 | 0 |
| Reward Cards | 0 | 0 | 0.04 | 0.02 | 0.005 | 0 | 0 |
| Privacy | 0.44 | 0 | 0 | 0 | 0 | 0 | 0 |
| Consumer Marginal Benefit | 0.44 | 0.04 | 0.38 | 0.35 | 0.34 | 0.24 | 0.16 |
| Central Bank | | | | | | | |
| Processing Revenue | 0.002 | 0.03 | 0 | 0 | 0 | 0 | 0 |
| Seigniorage | 0.26 | 0 | 0 | 0 | 0 | 0 | 0 |
| Central Bank Marginal Benefit | 0.27 | 0.03 | 0 | 0 | 0 | 0 | 0 |
| Commercial Bank | | | | | | | |
| Processing Revenue | 0.01 | 0.09 | 0.85 | 0.63 | 1.13 | 0.77 | 0.44 |
| Sum of Marginal Benefits | 0.71 | 0.16 | 1.23 | 0.98 | 1.47 | 1.01 | 0.60 |
| Social Marginal Cost | | | | | | | |
| Social Marginal Cost | 2.25 | 1.10 | 0.90 | 0.90 | 0.89 | 0.77 | 0.85 |
| Sum of Marginal Costs | 2.26 | 1.22 | 1.75 | 1.53 | 2.02 | 1.54 | 1.29 |
| Net Social Marginal Cost | 1.55 | 1.06 | 0.53 | 0.55 | 0.55 | 0.53 | 0.69 |

Notes: Numbers may not add due to rounding. Net Social Marginal Cost equals the Sum of Marginal Costs minus the Sum of Marginal Benefits, which eliminates cross-party transfers. Social Marginal Cost is included for reference.

Source: Authors' calculations.

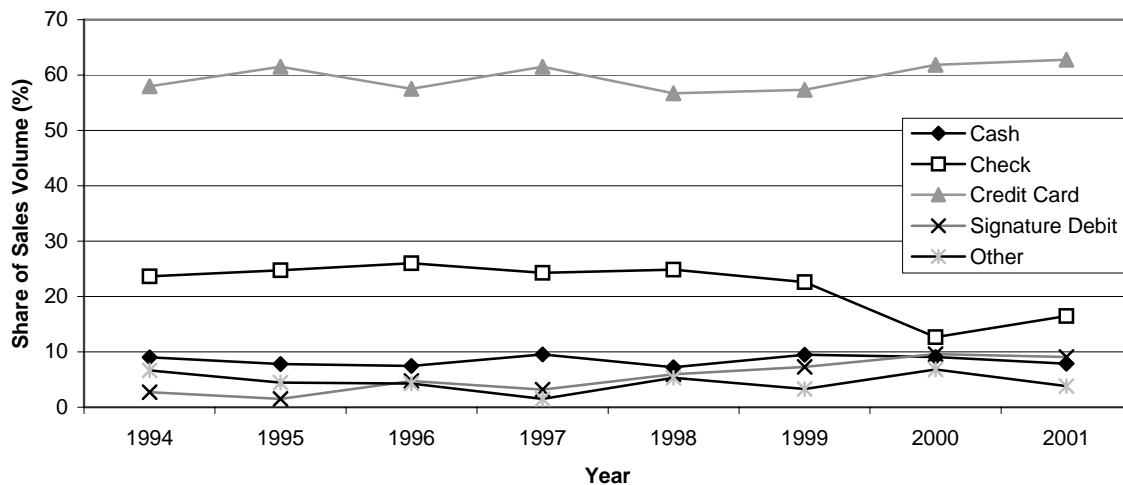
At the typical discount store check transaction size, payment cards are considerably less costly than paper currency, following the same pattern seen for grocery stores.

C. The Rise of Debit Cards at Electronics Specialty Stores

In our third and final case study, we consider electronics specialty stores. As with grocery and discount stores, consumers shopping at electronics stores have shifted their

payment behavior over time. Figure 4 presents the share of sales volume from 1994 through 2001 at electronics stores. Credit has a far higher share of electronics stores' sales volume than of either grocery or discount store sales volume; it is roughly 60 percent over the period. Debit cards rise from near zero to 10 percent and checks decline to less than 20 percent. Cash is generally flat over the period at 10 percent. As was suggested by Figure 1, paper instruments play less of a role in payments for relatively high priced items such as electronics. Clearly, consumers find that cash is either more costly to use for more expensive purchases or provides fewer benefits as compared to other payment mechanisms, such as credit cards.

**Figure 4. Share of Sales Volume by Payment Method
Electronics Specialty Stores, 1994–2001**



Source: Visa U.S.A., 1994-2001.

As a contrast to grocery and discount stores, the estimates presented in the electronics store case study illustrate the effect that retail venue can have on payment instrument cost and benefit analysis. First, average transaction sizes are far higher in electronics stores (as Table 9 below illustrates). Second, the point of sale structure is often quite different. The typical electronics store does not have multiple checkout lanes positioned near the store exit, although the large chainstores like Best Buy and Circuit City do. Moreover, most electronics stores do not accept PIN debit, as they require separate card readers.¹⁶⁷ Thus, we would expect

¹⁶⁷ Even Best Buy, however, processes PIN debit transactions in only a handful of its stores.

electronics store payment processing costs to be very different from discount and grocery store costs.

As with discount stores, we start with the merchant costs reported by Coopers & Lybrand for one “representative” electronics specialty merchant. Also as before, the methods used to calculate non-merchant costs are identical to the discount and grocer cases. We again present only the initial merchant cost table and the final net social marginal cost table, which incorporates benefits.¹⁶⁸ Table 9 presents electronics merchant costs, as reported by Coopers & Lybrand, updated as with the other case studies.

Many cost elements are dramatically different than those for grocery store merchants,¹⁶⁹ some higher and some lower. POS time costs are well below those for grocery stores—for example, the time cost for checks are lower by a factor of eight. Drawer/office costs are considerably higher for cash, but nearly identical for checks. Due to back office marginal costs, payment cards have non-zero drawer costs here. Bank charges are significantly higher as well, largely driven by the high average transaction sizes. Grocers reported an average cash purchase of around \$11.50, but cash purchases at electronics stores are six times as high. Unlike grocery stores where checks were used for the largest average transactions, credit and charge cards have the highest averages here at roughly \$150. In contrast to discount store costs, cash is the only payment instrument with an overall cost similar to grocery stores. Checks are around three times as costly in electronics stores; signature debit cards are over twice as costly. That said, cash is still the cheapest instrument for electronics stores to accept and checks are second.

¹⁶⁸ The original 1995 costs reported by Coopers as well as the intermediate tables we calculate are all presented in the Appendix.

¹⁶⁹ We could easily compare electronics store costs to discount stores as well, but we would gain few additional insights.

**Table 9. Per Transaction Processing Costs for Various Payment Instruments
Electronics Store Merchants (\$)**

| | Cash | Check | MC/Visa Credit | Discover | American Express | Signature Debit* |
|---------------------------------------|-------------|-------------|-------------------|-------------|---------------------|---------------------|
| POS Time | 0.06 | 0.15 | 0.12 | 0.11 | 0.11 | 0.12 |
| Drawer/Office | 0.05 | 0.03 | 0.06 | 0.06 | 0.06 | 0.06 |
| Bank Charges | 0.05 | 1.38 | 2.94 | 1.71 | 3.44 | 1.86 |
| Losses | 0.08 | 0.07 | 0.03 | 0.04 | 0.04 | 0.03 |
| Float | 0.005 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 |
| Other Direct Costs | 0.07 | 0.02 | 0 | 0 | 0 | 0 |
| Per Transaction Total Cost | 0.32 | 1.67 | 3.16 | 1.95 | 3.67 | 2.08 |
| Average Receipt for Payment Type | 64.98 | 124.66 | 150.39 | 149.87 | 148.15 | 99.30 |
| Cost Scaled to \$100 of Sales | 0.49 | 1.34 | 2.10 | 1.30 | 2.48 | 2.09 |

Notes: Numbers may not add due to rounding.

*Signature debit is imputed as described in the text and the Appendix.

Source: Coopers (1995), updated by authors as detailed in the Appendix.

Net social marginal costs for electronics store transactions are presented below in Tables 10a and 10b. Electronics store merchants may have a benefit that is not applicable to the other case studies. Before credit cards, merchants selling relatively high-priced items often provided in-store installment credit plans. Appliances in particular were often bought on a time plan.¹⁷⁰ By accepting credit cards, electronics stores do not have to bear the expense of providing in-store credit. We do not include the marginal elements of this benefit in our calculations, as we do not have a reasonable means of estimating it. If included, it would lower the relative cost of credit cards.

¹⁷⁰ See, e.g., Martha L. Olney, "Avoiding Default: The Role of Credit in the Consumption Collapse of 1930," *Quarterly Journal of Economics*, pp. 319-335, Feb. 1999, at 323; and Lendol Calder, *Financing the American Dream: A Cultural History of Consumer Credit* (Princeton University Press, 1999), at 199-201.

**Table 10a. Adding Selected Benefits
Electronics Store Cash Transactions, \$64.98 (\$)**

| | Cash | Check | MC/Visa Credit | Discover | American Express | Signature Debit |
|--------------------------------------|-------------|-------------|-------------------|-------------|---------------------|--------------------|
| Consumers | | | | | | |
| Float | 0 | 0.01 | 0.12 | 0.12 | 0.12 | 0.01 |
| Credit Option | 0 | 0 | 0.33 | 0.33 | 0.33 | 0 |
| Record Keeping | 0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0 | 0 | 0 | 0 | 0 |
| Signature Debit | 0 | 0 | 0 | 0 | 0 | 0.13 |
| Reward Cards | 0 | 0 | 0.06 | 0.02 | 0.01 | 0 |
| Privacy | 0.65 | 0 | 0 | 0 | 0 | 0 |
| Consumer Marginal Benefit: | 0.65 | 0.04 | 0.54 | 0.50 | 0.48 | 0.17 |
| Central Bank | | | | | | |
| Processing Revenue | 0.002 | 0.03 | 0 | 0 | 0 | 0 |
| Seigniorage | 0.39 | 0 | 0 | 0 | 0 | 0 |
| Central Bank Marginal Benefit | 0.39 | 0.03 | 0 | 0 | 0 | 0 |
| Commercial Bank | | | | | | |
| Processing Revenue | 0.05 | 1.38 | 1.27 | 0.74 | 1.51 | 1.31 |
| Sum of Marginal Benefits | 1.10 | 1.45 | 1.81 | 1.24 | 1.99 | 1.48 |
| Social Marginal Cost | 2.78 | 0.69 | 1.30 | 1.29 | 1.27 | 1.11 |
| Sum of Marginal Costs | 2.84 | 2.09 | 2.57 | 2.04 | 2.78 | 2.42 |
| Net Social Marginal Cost | 1.74 | 0.64 | 0.76 | 0.79 | 0.79 | 0.95 |

Notes: Numbers may not add due to rounding. Net Social Marginal Cost equals the Sum of Marginal Costs minus the Sum of Marginal Benefits, which eliminates cross-party transfers. Social Marginal Cost is included for reference.

Source: Authors' calculations as detailed in the Appendix.

Despite the differences in many of the individual cost and benefit elements, Table 10a presents a relative net social marginal cost comparison qualitatively similar to the other two case studies. Payment cards are about half as costly as cash at the typical electronics store cash purchase size. One surprising result is the relative standing of checks. Unlike grocery or discount store transactions, here checks emerge as cheaper than either cash or cards. That checks are cheaper than payment cards is a reversal in standing compared to the other two case

studies. It is driven by the high bank charge assessed merchants for check deposits as compared to the bank processing cost, charges that are netted out in the net social marginal cost calculations. It is unlikely that commercial banks are truly profiting more from checks used at electronics stores. Rather, it could be that banks charge a higher fee to electronics stores because the higher purchase amounts imply a greater fraud or non-sufficient fund risk for the bank, costs not captured in our processing cost estimates. Again, our numbers are not meant to be absolute, but only relative. Table 10b, below, for the average check purchase size reveals a similar pattern, although check and credit card net social marginal costs are roughly identical.

**Table 10b. Adding Selected Benefits
Electronics Store Check Transactions, \$124.66 (\$)**

| | Cash | Check | MC/Visa Credit | Discover | American Express | Signature Debit |
|--------------------------------------|-------------|-------------|-------------------|-------------|---------------------|--------------------|
| Consumers | | | | | | |
| Float | 0 | 0.02 | 0.22 | 0.22 | 0.22 | 0.02 |
| Credit Option | 0 | 0 | 0.62 | 0.62 | 0.62 | 0 |
| Record Keeping | 0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0 | 0 | 0 | 0 | 0 |
| Signature Debit | 0 | 0 | 0 | 0 | 0 | 0.13 |
| Reward Cards | 0 | 0 | 0.12 | 0.04 | 0.01 | 0 |
| Privacy | 1.25 | 0 | 0 | 0 | 0 | 0 |
| Consumer Marginal Benefit: | 1.25 | 0.05 | 1.00 | 0.93 | 0.90 | 0.18 |
| Central Bank | | | | | | |
| Processing Revenue | 0.002 | 0.03 | 0 | 0 | 0 | 0 |
| Seigniorage | 0.75 | 0 | 0 | 0 | 0 | 0 |
| Central Bank Marginal Benefit | 0.75 | 0.03 | 0 | 0 | 0 | 0 |
| Commercial Bank | | | | | | |
| Processing Revenue | 0.05 | 1.38 | 2.43 | 1.43 | 2.89 | 2.26 |
| Sum of Marginal Benefits | 2.05 | 1.46 | 3.44 | 2.35 | 3.79 | 2.44 |
| Social Marginal Cost | 3.55 | 0.71 | 1.62 | 1.61 | 1.57 | 1.24 |
| Sum of Marginal Costs | 3.61 | 2.12 | 4.05 | 3.03 | 4.47 | 3.50 |
| Net Social Marginal Cost | 1.56 | 0.66 | 0.61 | 0.68 | 0.68 | 1.06 |

Notes: Numbers may not add due to rounding. Net Social Marginal Cost equals the Sum of Marginal Costs minus the Sum of Marginal Benefits, which eliminates cross-party transfers. Social Marginal Cost is included for reference.

Source: Authors' calculations as detailed in the Appendix.

Thus, for all three case studies, once other parties to the transaction are considered and some of the benefits for various payment instruments are counted, cash no longer appears as attractive as was the case when merchants alone were considered. Our calculations do not reveal the precise marginal costs and benefits for each payment instrument, but they do suggest that economic welfare has increased as consumers have increased their use of payment cards at grocery stores, discount stores, and electronics stores.

D. Sensitivity Analysis

In this section, we consider the variation and the uncertainty in the estimates by presenting alternative values for key parameters. Even merchants within a single industry can face different payment processing costs due to size, sophistication, and a host of other factors. On the consumer side there is considerable heterogeneity in preferences and perceived costs. In addition to this kind of inherent variation, there is also uncertainty in several of the cost estimates. While many of the individual cost and benefit components have wide ranges, our conclusions above appear to be robust to changes in the specific cost and benefit elements.

Given that we do not have information on the joint distribution of costs and benefits, we focus here on those individual elements that show significant variation or that rely on uncertain assumptions. We present alternative calculations for grocery store transactions only. The Food Marketing Institute reports a range of costs (high, low, and average) that we use as the basis for our analysis. Nonetheless, the sensitivity discussion below likely applies to all three retail environments.

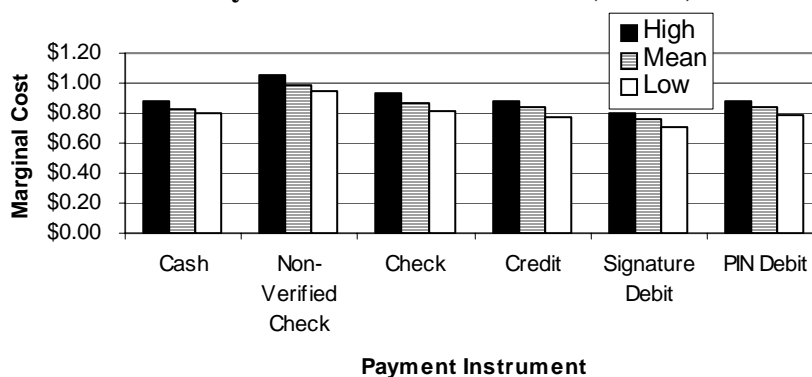
We consider four categories of alternatives. First, we examine the sensitivity of our calculations to variations and assumptions regarding the opportunity cost of time—an element that affects three cost components. Second, we briefly discuss the natural variation in the processing fees that commercial banks charge merchants. Third, we explore the role that consumer heterogeneity plays in determining which payment instruments are used. Finally, we investigate the affect of altering the conditional nature of the transaction—the assumption that it takes place in a given venue for a given dollar amount.

1. Opportunity Cost of Time

As Table 2 shows, time spent at the point of sale counter differs considerably across payment instruments.¹⁷¹ Our analysis could be sensitive to the use of average POS times, to our assumptions about point of sale queues, and to our use of average hourly wages in computing the cost of time. We explore how net social marginal costs vary with changes in these three costs.

To investigate the first effect, we recalculate the net social marginal cost estimates presented in Tables 5a and 5b using FMI high and low point of sale times. The results are presented in Figure 5 below. Since point of sale time does not vary by transaction size, we present the cash transaction calculations only. As can be seen from the chart, time at the checkout counter does affect the overall cost estimates, but even if we were to compare the highest times reported for payment cards with the lowest times for paper instruments, we would still conclude that payment cards generally are not more costly than paper currency.

**Figure 5. Net Social Marginal Cost Estimates, Varying POS Time
Grocery Store Cash Transaction (\$11.52)**



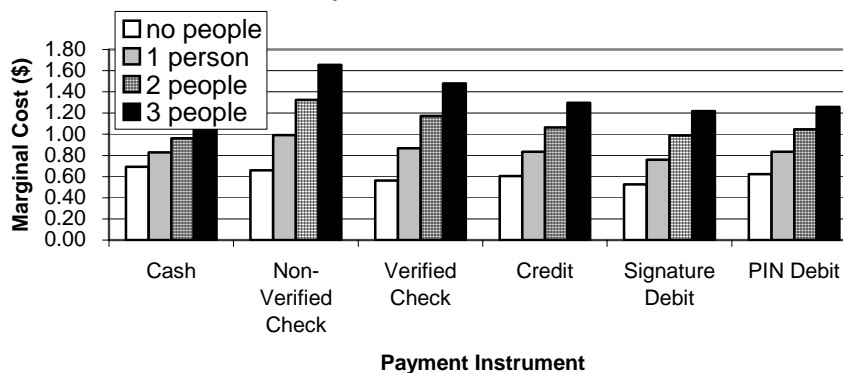
Source: Authors' calculations as detailed in the Appendix, based on FMI reported high, mean, and low POS time costs.

To test the second component of the opportunity cost of time, we alter our assumption about the number of people waiting in line behind a payer. Recall that in the calculations above, we assume one person waits in line for each grocery transaction, imposing an externality cost. While we were unable to find data on this issue, anecdotal evidence indicates that different kinds of stores are likely to have differences in the average number of people in line. We expect that queue size varies by store type. For example, discount stores are likely to have longer lines on average than electronics specialty stores. Supermarkets are likely to have longer lines than smaller, typically higher priced specialty grocers or local mom-and-pop grocers. Given the uncertainty in line length, we explore the sensitivity of our results to our queue assumption.

¹⁷¹ POS time varied considerably across the three case studies as well.

Figure 6 portrays a range of assumptions on queue size for grocery store cash size transactions. Queue assumptions clearly affect the net social marginal cost, especially for a payment instrument that takes more time to process at the point of sale, such as checks. With no one in line, credit cards are somewhat more costly than checks, but still less expensive than cash. Signature debit remains the cheapest of the payment instruments. With three people in line, all payment cards are less costly than checks, but cash is cheaper than either credit/charge or debit. While taking the highest queue length for payment cards and the lowest queue for paper instruments would change the standings considerably there is little reason to think that the number of people standing in line depends on the payment instrument used by one payer. Grocery stores do sometimes have cash only lanes—but these may have longer lines than the full service lanes as they typically restrict the number of items purchased as well.¹⁷² Moreover, cash-only lanes are evidently becoming more rare, as grocers move to self-checkout lanes instead.¹⁷³

**Figure 6. The Impact of Queue Size on Marginal Cost Estimates
Grocery Cash Transaction (\$11.52)**



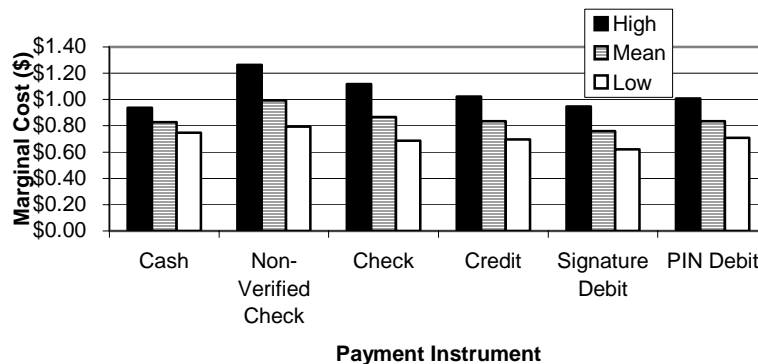
Source: Authors' calculations as detailed in the Appendix.

¹⁷² Remember that our queue comparison only counts the time spent in processing payments, not the overall time in line, which would also include the time for the cashier to scan the grocery items.

¹⁷³ By 2002, about 20 percent of supermarket chains had self-checkout lanes. Peter Lucas, "Self Service at the Point of Sale," *Credit Card Management*, March 2002. A recent survey conducted by the FMI of 40 major supermarket companies owning more than 6,000 stores found that over half of them are either planning or already have installed self-checkout centers. At self-checkout stations, about 50 percent of the transactions are with cash, 40 percent are with plastic cards, and about 10 percent are with checks. David Gosnell, "Going Automatic with Cash-Back," *Credit Card Management*, August 2003.

As a final test on the sensitivity of our results to opportunity costs, we calculate the combined consumer time elements (processing time plus queue time) for different consumer wage levels. Figure 7 reports net social marginal costs for grocery cash transactions, measuring the cost of time at the tenth wage percentile for U.S. workers, the average wage, and the ninetieth wage percentile. The average wage repeats the cost of time assumed in the case studies.

Figure 7. Net Social Marginal Cost, Varying Payer Wage, Grocery Cash Transaction (\$11.52)



Source: Authors' calculations as detailed in the Appendix.

Ideally, we would want to examine payment instrument use by income percentile, but this information is unavailable. Even with our simple approach though, we can interpret Figure 7 as indicating that consumers with higher wages face a higher level of cost for those instruments with relatively longer point of sale times, such as non-verified checks. While all net social marginal costs rise with wages, those with longer processing times do so more dramatically.

2. Bank Charges

Referring back to Table 2, bank charges are another obvious candidate for sensitivity analysis.¹⁷⁴ The merchant discount assessed on payment card purchases plays a pivotal role in

¹⁷⁴ There is little variation in deposit preparation costs. While other direct costs do vary by payment instrument, much of this variation is driven by: 1. FMI's exclusion of cash theft, counterfeiting and float costs, and 2. the catchall nature of the category (for example, armored car costs are not applicable to payment cards). For these reasons, we do not consider variation in these two remaining categories.

the expense of these cards for retailers. Further, merchant discounts exhibit considerable natural variation depending on the store type and size as well as on the payment card system.

Table 11 below presents FMI’s reported high, mean, and low bank charges. The marginal cost tables above are based on the mean charges. One factor behind payment card bank fee variation is FMI’s decision to report all card systems together. Processing charges vary substantially across systems, with American Express generally regarded as the most expensive and Discover generally considered the least.¹⁷⁵ A different proportion of sales attributed to each card system will result in different average bank costs for different merchants. The table illustrates that bank charges vary considerably among grocery stores for payment cards as well as verified checks.

Table 11. Bank Fee Variation, Grocery Store Transactions (1998 \$)

| | Cash (Per \$1000) | Non-Verified Check | Verified Check | Credit/ Charge | Signature Debit | PIN Debit |
|---------|----------------------|-----------------------|-------------------|-------------------|--------------------|-----------|
| Highest | 0.01 | 0.07 | 0.37 | 2.01 | 0.82 | 0.24 |
| Average | 0.003 | 0.05 | 0.13 | 0.87 | 0.41 | 0.19 |
| Lowest | 0.001 | 0.04 | 0.06 | 0.42 | 0.27 | 0.15 |

Notes: Fees reported are for instrument-specific average transaction sizes and are therefore not comparable across payment instruments.

Source: FMI (1998).

The bank charges reported in Table 11 highlight the diversity among grocery store costs. Even within one narrow retail segment, bank processing fees vary considerably. Variation of this sort is a key driver behind merchant acceptance decisions. Keep in mind, though, that the charges in Table 11 are for 1998—as we discussed above, charge card and signature debit fees have fallen since then, while PIN fees have risen (as reflected in our updated case study figures). Moreover, since bank charges represent transfer payments from merchants to commercial banks (or to independent card systems such as American Express)—not resource costs—the variation in fees does not translate necessarily into variation in net social marginal cost. Ideally, we would use similar data to specify a range of commercial bank

¹⁷⁵ Leslie Beyer, “The Interchange Stranglehold (of Visa and MasterCard),” *Grocery Headquarters*, October 1, 1999.

processing costs, which are actual resource costs and would thus affect our net social marginal cost estimates, but this information is unavailable.

3. Accounting for Consumer Differences

Several of the benefits included in our net social marginal cost calculations are likely to exhibit substantial variation across individuals. For instance, consumers most concerned about a payment mechanism that helps them to spend within a budget are not likely to view the option value of credit cards as a benefit. In point of sale transactions in particular, consumers choose the payment instrument, although merchants can limit and/or influence their choices.¹⁷⁶ Thus, consumer preferences can dictate to a large degree which instruments are used more heavily.

In this section, we construct several scenarios to demonstrate how cost-benefit calculations can change when heterogeneity among consumers is introduced. Following consumer research, we develop profiles that stress different aspects embodied in the payment instruments considered here.¹⁷⁷ We then calculate net consumer costs (consumer costs minus consumer benefits), illustrating how differences in perceived costs and benefits can drive payment choices. We consider five consumer profiles, described in more detail below, each driven by one key benefit: payment control, budget enforcement, low cost, security, or familiarity.

In the control profile, consumers' primary concern is the ability to control the timing of a payment.¹⁷⁸ That is, these consumers want control over when they actually have to pay the charge, which is different from when they pay the merchant for every payment instrument except for cash. Control also covers the ability to stop payments and to dispute charges if problems arise after a purchase is made. Checks, credit and charge cards all meet these criteria. While signature debit cards do provide dispute resolution benefits, automatic payment

¹⁷⁶ Recall that consumers initiate more than 90 percent of all transactions. Mantel, *supra* note 9, at 8.

¹⁷⁷ Mantel reports the results of focus group interviews. Based on those interviews, he discusses a number of customer preferences, noting that "Some consumers might value more than one preference, but it appeared that most consumers were primarily driven by just one or two preferences across the different payments they were making." Mantel, *supra* note 9, at 15.

¹⁷⁸ Mantel, *supra* note 9, at 16.

deductions mean consumers relinquish control. Table 12 presents consumer benefits consistent with this profile. For clarity, any benefits not related to the control profile are set to zero.¹⁷⁹ Credit card rewards, for instance, have little to offer consumers in terms of payment control. Certainly, consumers valuing control could also value card rewards, but in order to provide the cleanest profiles possible, we ignore any benefits that are not directly related. The last line of Table 12 adds a new benefit specific to the profile. This number is not based on consumer research, but instead equals the benefit necessary to make the instruments fitting the profile emerge as the most preferable for consumers. Here, a consumer “control benefit” of twenty cents is enough to make checks and credit cards the lowest net cost instruments for consumers (shown in bold text).

**Table 12. Net Consumer Costs, Control Profile
Grocery Store Cash Transaction \$11.52 (\$)**

| | Cash | Non-Verified Check | Verified Check | Credit/Charge | Signature Debit | PIN Debit |
|-----------------------------|------|--------------------|----------------|---------------|-----------------|-----------|
| Float | 0 | 0.002 | 0.002 | 0.02 | 0.002 | 0.001 |
| Credit Option | 0 | 0 | 0 | 0 | 0 | 0 |
| Record Keeping | 0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0 | 0 | 0 | 0 | 0 |
| Signature Debit | 0 | 0 | 0 | 0 | 0 | 0 |
| Reward Cards | 0 | 0 | 0 | 0 | 0 | 0 |
| Discover Cards | 0 | 0 | 0 | 0 | 0 | 0 |
| Privacy | 0.12 | 0 | 0 | 0 | 0 | 0 |
| Control/Stop Payment | 0 | 0.20 | 0.20 | 0.20 | 0 | 0 |
| Consumer Marginal Benefits | 0.12 | 0.24 | 0.24 | 0.26 | 0.04 | 0.04 |
| Consumer Marginal Costs | 0.44 | 0.37 | 0.35 | 0.23 | 0.23 | 0.34 |
| Net Consumer Marginal Costs | 0.33 | 0.14 | 0.11 | -0.03 | 0.19 | 0.31 |

Notes: Bold numbers represent instruments meeting the profile. Numbers may not add due to rounding. Consumer Marginal Costs are taken from Table 4a, but exclude queue time, which is a social not a private cost. Net Consumer Marginal Cost equals Consumer Marginal Costs minus Consumer Marginal Benefits, to be consistent with other tables.

Source: Authors’ calculations as detailed in the Appendix.

¹⁷⁹ To make the numbers representative of all retailers, we zero out cash back benefits for checks in all the heterogeneity scenarios since grocery stores are the only retailers providing this benefit.

Table 13 conducts a similar exercise for a consumer profile driven by budget enforcement. Here the primary concern is fiscal restraint—these consumers want to ensure they spend within their means.¹⁸⁰ They therefore want a payment mechanism that does not allow them to overspend. Every instrument except for credit cards meets this profile, although our calculations indicate that debit cards emerge as the best option.

**Table 13. Net Consumer Costs, Budget Enforcement Profile
Grocery Store Cash Transaction \$11.52 (\$)**

| | Cash | Non-Verified Check | Verified Check | Credit/Charge | Signature Debit | PIN Debit |
|------------------------------------|-------------|--------------------|----------------|---------------|-----------------|--------------|
| Float | 0 | 0.002 | 0.002 | 0.02 | 0.002 | 0.001 |
| Credit Option | 0 | 0 | 0 | 0 | 0 | 0 |
| Record Keeping | 0 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0 | 0 | 0 | 0 | 0.13 |
| Signature Debit | 0 | 0 | 0 | 0 | 0.13 | 0 |
| Reward Cards | 0 | 0 | 0 | 0 | 0 | 0 |
| Discover Cards | 0 | 0 | 0 | 0 | 0 | 0 |
| Privacy | 0 | 0 | 0 | 0 | 0 | 0 |
| Spending Limited to Available Cash | 0.30 | 0.30 | 0.30 | 0 | 0.30 | 0.30 |
| Consumer Marginal Benefits | 0.30 | 0.34 | 0.34 | 0.06 | 0.46 | 0.46 |
| Consumer Marginal Costs (Table 4a) | 0.44 | 0.37 | 0.35 | 0.23 | 0.23 | 0.34 |
| Net Consumer Marginal Costs | 0.14 | 0.04 | 0.01 | 0.18 | -0.23 | -0.12 |

Notes: Bold numbers represent instruments meeting the profile. Numbers may not add due to rounding. Consumer Marginal Costs are taken from Table 4a, but exclude queue time, which is a social not a private cost. Net Consumer Marginal Cost equals Consumer Marginal Costs minus Consumer Marginal Benefits, to be consistent with the other tables.

Source: Authors' calculations as detailed in the Appendix.

The three remaining profiles are calculated analogously, zeroing out unrelated benefits and adding in profile-specific benefits, where needed, to make the instruments fitting the profile emerge as the most desirable for consumers. Table 14 summarizes the findings. For the low-cost scenario, the focus was on out-of-pocket expenses. Thus, we set all opportunity time costs to zero. The security profile emphasizes a consumer's perceived safety of an instrument. Cash is the instrument with the worst safety image. Merchants typically require an ID before

¹⁸⁰ Mantel, *supra* note 9, at 17, 24-25.

accepting a check; credit, charge and signature debit card systems have elaborate security mechanisms where each purchase is electronically screened; PIN debit cards require a numeric password; plus all payment cards can be easily cancelled if lost or stolen. A security benefit equal to ten cents was necessary to push check cost below that of cash. The last scenario, familiarity, is meant to capture the still-sizable portion of consumers relying on checks for many purchases. A familiarity benefit of twenty cents was necessary to push net consumer costs for checks below the other instruments.

**Table 14. Net Consumer Costs, Summary Profiles
Grocery Store Cash Transaction \$11.52 (\$)**

| | Cash | Non-Verified Check | Verified Check | Credit/Charge | Signature Debit | PIN Debit |
|--------------------|-------------|--------------------|----------------|---------------|-----------------|-------------|
| Low Cost* | | | | | | |
| Marginal Benefits | 0 | 0.002 | 0.002 | 0.09 | 0.13 | 0.13 |
| Marginal Costs | 0.03 | 0.04 | 0.04 | 0 | 0 | 0.13 |
| Net Marginal Costs | 0.03 | 0.04 | 0.04 | -0.09 | -0.13 | 0 |
| Security | | | | | | |
| Marginal Benefits | 0.12 | 0.14 | 0.14 | 0.21 | 0.14 | 0.14 |
| Marginal Costs | 0.44 | 0.37 | 0.35 | 0.23 | 0.23 | 0.34 |
| Net Marginal Costs | 0.33 | 0.24 | 0.21 | 0.02 | 0.09 | 0.21 |
| Familiarity | | | | | | |
| Marginal Benefits | 0 | 0.24 | 0.24 | 0.06 | 0.04 | 0.04 |
| Marginal Costs | 0.44 | 0.37 | 0.35 | 0.23 | 0.23 | 0.34 |
| Net Marginal Costs | 0.44 | 0.14 | 0.11 | 0.18 | 0.19 | 0.31 |

Notes: Bold numbers represent instruments meeting the profile. Numbers may not add due to rounding. Consumer Marginal Costs are based on Table 4a, but exclude queue time, which is a social not a private cost. Net Consumer Marginal Cost equals Consumer Marginal Costs minus Consumer Marginal Benefits, to be consistent with the other tables.

* All time costs are set zero, only direct expenditures (such as the cost of checks) are included.

Source: Authors' calculations as detailed in the Appendix.

As the earlier sensitivity results demonstrate, our net social marginal cost calculations are robust to several variations in the cost components. Benefits, however, are more difficult to pin down. The tables in this section illustrate that any payment instrument can emerge as

preferred, given small benefit adjustments (10 to 30 cents). However, the adjustments made above, while based on consumer interviews, are arbitrary, set at whatever level was required to make the instruments fitting the profile most preferred. In contrast, the benefits reported in the case studies, while imprecise, are supported by data. By revealed behavior, we know that some consumers prefer one payment instrument while other consumers in similar circumstances prefer another. We also know that merchants in different settings place different restrictions on the payment instruments that can be used. Because the distribution of consumer preferences is not known, however, we feel that comparing net costs across payment instruments is best done with average agent calculations of the sort presented in our case studies (e.g., group calculations for consumers, merchants, and commercial banks).

4. Relaxing Conditional Assumptions

At the beginning of this paper, we briefly discussed the implicit assumption behind cost-benefit calculations like those in the case studies: they are conditional on the transaction occurring in a predetermined venue at a given dollar amount. We next explore the effect of relaxing some of those assumptions by considering a relatively new alternative to grocery shopping at the local supermarket: ordering groceries online for at-home delivery. Consumers can choose to purchase groceries from services such as Peapod, saving time spent shopping in a store but incurring a delivery fee instead. In terms of payment, switching to this venue affects both the transaction value—the services typically have a minimum purchase in the \$25-\$50 range—and the available payment methods—cash and PIN debit are not accepted while automated checking account deduction often is.¹⁸¹ We do not have merchant cost information for online grocers, so social marginal cost calculations are not possible. We do have data on consumer costs, however, and these are presented below in Table 15.

Because the delivery service handles payments on its own time, checks—which must be written on the spot—are the only instrument with a marginal processing time cost. Delivery entails no queue time either. Benefits look different as well. The higher minimum dollar value translates into larger float benefits, for instance. Finally, Peapod offers a \$1 discount for all

¹⁸¹ For example, see www.peapod.com and www.simons.com.

consumers paying with automated checking account draft. This last benefit pushes consumers' marginal cost for EFT into the lowest position. If Peapod discontinued the discount, credit cards would be the lowest cost option for consumers. Traditional paper checks are by far the highest cost payment method.

**Table 15. Consumer Costs and Benefits
Online Grocery Transaction \$50.00 (\$)**

| | Verified Check | Credit/ Charge | Signature Debit | Automated EFT |
|------------------------------------|-------------------|-------------------|--------------------|------------------|
| Costs: | | | | |
| Processing Time | 0.31 | 0 | 0 | 0 |
| Queue Time | 0 | 0 | 0 | 0 |
| Explicit Price | 0.04 | 0 | 0 | 0 |
| Implicit Price | 0 | 0 | 0 | 0 |
| Seigniorage | 0 | 0 | 0 | 0 |
| Consumer Marginal Costs | 0.35 | 0 | 0 | 0 |
| Benefits: | | | | |
| Float | 0.01 | 0.09 | 0.01 | 0 |
| Credit Option | 0 | 0.25 | 0 | 0 |
| Record Keeping | 0.04 | 0.04 | 0.04 | 0.04 |
| Cash Back Option | 0 | 0 | 0 | 0 |
| Signature Debit | 0 | 0 | 0.13 | 0 |
| Reward Cards | 0 | 0.05 | 0 | 0 |
| Discover Cards | 0 | 0.02 | 0 | 0 |
| Privacy | 0 | 0 | 0 | 0 |
| Merchant Rebate | 0 | 0 | 0 | 1.00 |
| Consumer Marginal Benefits | 0.04 | 0.45 | 0.17 | 1.04 |
| Net Consumer Marginal Costs | 0.30 | -0.45 | -0.17 | -1.04 |

Notes: These calculations are based on the Peapod service, which has a minimum order of \$50 and offers a discount of \$1 per transaction for all consumers using EFT. Numbers may not add due to rounding. Consumer Marginal Costs are calculated analogously to those in Table 4a. Net Consumer Marginal Cost equals Consumer Marginal Costs minus Consumer Marginal Benefits, to be consistent with the other tables.

Source: Authors' calculations as detailed in the Appendix.

Thus, as predicted earlier, relaxing some of the conditional assumptions does alter the payment comparison significantly. The instruments accepted by the merchant change, costs and benefits for the instruments remaining change, transaction size is affected, and the final ranking is different than in the conditional case.

5. Implications

Accounting for the inherent variation in selected cost elements and relaxing key assumptions to allow for uncertainty result in substantially different net social marginal cost estimates, as the graphs and tables in this section demonstrate. Nonetheless, our overall conclusion, that increased use of payment cards appears to raise economic welfare, or at least does not lower it, remains intact. Allowing for heterogeneity in consumer costs and benefits illustrates how different instruments can be preferred under different circumstances. Consumer heterogeneity is most likely responsible for a great deal of the diversity we witness in actual payment method usage.

V. CONCLUSION

Consumers are gradually moving away from paper payment instruments and toward electronic ones, especially payment cards. The implications of this shift toward a cashless society are hotly debated. Courts and regulators in the United States, Europe and Australia are already making substantial policy interventions in the markets for various payment instruments. We believe that this debate needs to be better informed by both economic theory and empirical research.

As a step in that direction, we develop an approach for evaluating the marginal costs and benefits of payment instruments from both a private and a social perspective. With few exceptions, the existing empirical literature has not used this approach. Chief among the literature's shortcomings is its disregard for benefits.

While this study cannot address the issue of how costs and benefits of payment instruments are likely to vary in all settings, nor can we be exhaustive in the costs and benefits included, our analysis represents a substantial improvement over the existing literature.

Conceptually, our calculations are fairly straightforward. In practice, the individual cost and benefit components are quite difficult to estimate but are crucial for understanding payment instrument use. We construct three case studies that focus on the shift away from paper instruments and toward payment cards. We demonstrate that transaction size assumptions are critical in analyzing payment processing costs; that retailer type influences the individual cost elements and thus affects private cost calculations; and most importantly, that the relative merits of different payment methods change significantly when all parties are counted and benefits are included. The case studies highlight the difficulty of quantifying benefits. As such, our net social marginal costs should not be interpreted as definitive numbers, but rather as illustrative. Although calculations along these lines are a critical element in cost-benefit analysis, they have not been done before. Our calculations are necessarily rough, but we believe they offer some fresh insights.

We find that when all key parties to a transaction are considered and benefits are added, cash and checks are more costly than earlier studies suggest. In general, the shift toward a cashless society appears to improve economic welfare.

The fact that the shift away from cash and checks is probably economically beneficial does not imply that all parties have benefited. Our analysis suggests that certain groups, notably consumers, are likely to gain from this shift. In contrast, some merchants may not benefit. Parties bearing relatively more of the costs for a given instrument are likely to push for regulatory changes—as was the case in the Australian inquiry. The distributional implications of the shift toward payment cards need to be examined more carefully, which we plan to do in future research.

So too does the issue of payment instrument subsidization, which seems to be a central concern of policy makers. Some studies have suggested that consumers' payment card use is subsidized by non-card users because merchants cannot charge cardholders for the costs of processing payments. This may be true, but it also appears to be true of checks, debit cards, and even cash. Commercial banks bundle together many checking account services and the Federal Reserve does not charge for cash processing; both practices involve subsidies from one group to another. Answers to whether and how particular instruments are subsidized need to be

informed by data on the total (and not just marginal) costs and benefits of payment instruments as well as by a deeper understanding of the structure of the markets in which those instruments operate.