Another Look at Payment Instrument Economics

ALLAN SHAMPINE *

Lexecon

Abstract

This article revisits the research in "The Move Toward a Cashless Society: A Closer Look at Payment Instrument Economics" in order to clarify assumptions underlying the theoretical model and how they impact the included cost and benefit categories; evaluate the estimates' plausibility by comparing the model's results to observed behaviour; and extend the sensitivity analysis.

1 Introduction

In a recent issue of this *Review*, Daniel D. Garcia-Swartz, Robert W. Hahn and Anne Layne-Farrar ("GHL") explore how one may go about determining the overall costs to society of different payment methods. (Garcia-Swartz et al., 2006a, 2006b) In their study, and in a companion article describing some of their assumptions and computations, the authors present an interesting extension of the existing literature on payment method costs.[1] As the authors note, they have undertaken a very difficult exercise. They seek to identify all parties affected by retail payment choices and account for and estimate as precisely as possible each element of incremental costs or benefits which accompany those payment choices. Given the magnitude of this task, GHL offer only a limited discussion of some elements of their estimation of costs and benefits.

GHL are careful to explain that their analysis is intended to be viewed as "suggestive" and "illustrative" of the way one may answer the questions they pose. It is important to emphasize this point because as GHL note, conclusions about the cost associated with retail payments can influence public policy. Indeed, GHL's analysis has been widely cited in public policy discussions (Evans et al., 2006). While it is gratifying to see academic work influencing public policy, it can also be a matter of concern when preliminary results are cited without the caveats in the original work.

This article extends GHL's effort. Section 2 further explores some assumptions underlying GHL's work. Section 3 traces the flow of funds and discusses which cost categories are appropriately included in light of the assumptions discussed in Section 2.

* Contact Author. Allan Shampine, Lexecon, 332 S. Michigan Ave., Chicago, IL 60604, E-mail: ashampine@lexecon.com The author has been engaged by a variety of parties, including regulators and merchants, regarding payments systems.

[1] The articles were published in the same issue with sequential pagination. I refer to them here as a single body of work.

Section 4 provides sensitivity analysis of additional cost categories that were not addressed in GHL. Finally, Section 5 compares the results of the sensitivity and flow analyses with GHL's original estimates and discusses the implications of the differences for the ongoing policy debate.

2 Clarification of assumptions

There are three areas where GHL's approach may benefit from further examination: clarification of the question being asked; clarification of the time frame; and clarification of the welfare standard being used.

With respect to the question being asked, GHL focus on a "representative consumer" and attempt to estimate the marginal cost of an additional transaction using a particular payment method. This terminology is somewhat misleading. First, it is not clear what a "representative consumer" means in this context. Any particular individual will utilize their lowest marginal cost payment method. Furthermore, consumers are heterogeneous, as evidenced by their diverse usage of payment methods. The results may be better interpreted as some form of weighted average across consumers. Similarly, the costs being evaluated are average incremental costs, not marginal costs, and will be referred to as such in this analysis. The overall results may then be interpreted as the average effect on social welfare if every consumer made one additional purchase with a given payment method. This particular approach, while useful analytically, may not reflect the effects of changes in the real world since changes in behavior will generally occur at the margin rather than across the board.

With respect to the time frame, GHL attempt to evaluate the costs and benefits conditional upon a transaction taking place, that is, beginning at the point in time when the consumer is standing at the cash register trying to decide what payment method to use. This approach has the significant advantage of simplifying the analysis by excluding overhead related questions such as the costs and benefits of expanding networks. It is important to adhere strictly to the conditional analysis since inconsistent application will bias the results. For example, ATM maintenance costs and ATM fees are included in GHL's analysis (costs incurred prior to the customer arriving at the cash register) but credit card reader and electronic network maintenance costs and credit card annual fees are not.

When estimating benefits, it is best to be clear what welfare standard is being used. The standard is not entirely clear in GHL. For example, the term "consumer surplus" never appears in GHL, although the concept appears to be used in several places in their analysis, such as the valuation of airline mile rewards. GHL estimate that consumers are willing to pay 2.2 cents per airline mile, but that those miles cost banks 1 cent per mile, resulting in a 1.2 cent per mile benefit to society. Regardless of terminology, the inclusion of non-pecuniary benefits should be handled with care in order to include all such benefits. For example, surveys show that consumers select their payment methods based on, among other things, cost, convenience, timing, safety, privacy, likelihood of going into debt, recordkeeping, errors and ability to reconcile their bank accounts (Benton et al., 2007). Every one of these elements has an associated benefit which may potentially be estimated.

An alternative approach is to trace the flow of funds and estimate the resource costs at each stage (which is what most analysts have historically done). One may then ask directly what the consumer benefit associated with each payment method is, or simply estimate the

consumer surplus directly. By directly estimating consumers' willingness to pay for the payment method itself, one can, to some degree, avoid concerns about missing individual pieces. However, the inclusion of non-pecuniary consumer benefits itself may still be problematic from a public policy perspective as it involves weighing trade-offs between different groups. To see why, imagine an analysis comparing Toyota Corollas with Ferraris. From a pure resource use perspective, society is better off with just Toyota Corollas. The picture becomes murkier when one tries to include consumer benefits. This example immediately makes clear the difficulty of conceptualizing a "representative consumer" in this sort of analysis. The vast majority of consumers will never own or drive a Ferrari. Is society as a whole better off with a handful of Ferraris in the world? The answer will depend upon the welfare measure used.

3 Flow analysis

Following the flow of funds is a useful technique for determining which cost categories are appropriate to include. As a general matter, the analysis begins with the consumer standing at the cash register and proceeds from there, considering only costs incremental to the transaction. This section will briefly review the steps in cash and credit transactions (focusing on those because they are the highest and lowest cost forms of payment for society and for consumers per GHL's estimates) and then discuss how GHL's cost categories fit into the flow. The results from this discussion are presented in Table 1 in Section 5 as the "flow test."

Cash

The consumer pays cash at the register. This transaction takes some amount of time for the consumer, those in line and the cashier. The cash is then handled by the merchant using their equipment (cash registers, vaults, etc.) and personnel. The cash is eventually transferred from the merchant to either other customers (through cash back or check cashing) or to the merchant's bank. The merchant pays the bank for transportation and processing of the cash. The cash will then likely go through many more transactions in its lifetime but those are not incremental to the transaction at hand.

Credit

The consumer presents a credit card at the register. This transaction takes some amount of time for the consumer, those in line and the cashier. The cashier uses equipment in the store and a leased or owned telecommunications system to transmit a signal to the merchant's bank, which transfers the signal through the relevant credit card network to the issuing bank, which approves or denies the transaction. If approved, the merchant receives the amount paid by the consumer less a fee. That fee is divided between the merchant's bank, the network and the consumer's bank. The consumer typically does not pay off their balance until the end of the month, receiving an interest free loan (or "float"). The consumer may also receive rewards from their bank. If the consumer does not pay off their balance at the end of the month, or was already carrying a balance, they will be responsible for interest payments on the value of the transaction.

3.1 Consumer categories

GHL have 13 categories of consumer costs and benefits. Of those, three, which are applied only to cash, are inconsistent with the analysis' assumptions: explicit price, implicit price and seigniorage.

GHL's estimates of the explicit and implicit price of cash both involve ATMs: the explicit price of cash is the prorated ATM fee, while the implicit price of cash is the time cost of a trip to the ATM. These are costs in having the payment method available which are incurred prior to the choice at the cash register. As such, the principle of evaluating the choice at the cash register indicates that they are not appropriate to include. If one were to change the moment of evaluation, then one should also include similar costs for other payment methods, such as annual fees for credit cards.

Seigniorage, however defined, occurs prior to the transaction. At the cash register, the consumer's cost will be the same whether she pays for a $10 purchase with a debit card or with cash. In either case, the consumer will obtain the item and have $10 less. The consumer will not lose an additional $0.33 from seigniorage at the cash register. Seigniorage may be viewed as foregone interest, but again, the interest is foregone prior to the decision at the cash register, in the same way as maintaining funds in a no-interest checking account or low-interest savings account are costs of having checking or debit cards available. Accordingly, seigniorage should be excluded from the calculation. If one were to include seigniorage, then one should also include similar foregone interest for other payment methods, such as lower interest rates on savings and checking accounts.

3.2 Merchant categories

GHL's three categories of theft/counterfeit, float and processing costs all appear to be incremental to the consumer's choice at the cash register and so are appropriate to include.

3.3 Central bank categories

GHL list four categories for the central bank: production, processing, processing revenue and seigniorage (the latter of which is discussed above). None of these appear to be incremental to an individual consumer transaction.

Production and processing are overhead costs involved in the availability of currency generally. They do not change incrementally with an individual transaction, and dividing overhead costs among transactions in this way will bias the results. If one were to divide up overhead costs on a per transaction basis, then one should include the costs of the credit, debit and ACH networks as well.

3.4 Commercial bank categories

Of the six commercial bank categories, two raise concerns: ATM maintenance and production.

Production is the cost of making and replacing credit cards. This is an overhead cost that occurs prior to the transaction and is not incremental to the transaction in question.

ATM maintenance costs include rent, telephone costs, servicing costs and cash replenishment (according to the cited ATM Fact Sheet). Given a regular servicing

schedule, none of these costs appear to be incremental to an individual cash withdrawal.[2] ATM withdrawals also occur prior to the transaction, as discussed in the consumer categories. If one were to include ATM maintenance, then one should also include the maintenance of electronic card readers, including data line costs and servicing costs.

4 Extension of sensitivity analysis

GHL discuss sensitivity for only two of their cost categories – opportunity cost of time and bank fees to grocery stores – and estimate the effects on their analysis of only one of the two. The results of their sensitivity analysis for that category (opportunity cost of time) are summarized below for cash and credit (the payment methods with the highest and lowest social net incremental costs per GHL).

	Cash		Credit/Charge
POS Time			
High	0.85	<	0.86
Mean	0.80	≤	0.81
Low	0.77	>	0.75
Queue			
0	0.66	>	0.57
1	0.80	=	0.80
2	0.93	<	1.04
3	1.07	<	1.27
Payer Wage			
High	0.91	<	0.99
Mean	0.80	=	0.80
Low	0.72	>	0.67

Both the magnitudes and the rankings prove to be highly sensitive to variations in the assumed values, with each of the three variations producing all three possible rankings. That is, the analysis' rankings and magnitudes are not robust to any of the tested variations. The highest and lowest cost payment methods can switch for each category of tested variation. The sensitivity of the results to this cost category suggests that other categories' sensitivity should be tested as well.

Another indication that further sensitivity analysis is warranted is that the observed market shares do not correspond to the computed costs and benefits. (By contrast, surveys have found that consumers rate payment methods' costs and benefits in a manner that is broadly consistent with their actual usage (Benton et al., 2007). For an average transaction at a grocery store, GHL estimate that credit produces a net incremental benefit for consumers of $0.14, followed by signature debit (-$0.30), PIN debit (-$0.39), checks (-$0.46 to -$0.51) and finally, cash (-$0.75). However, the survey data used by GHL to obtain their estimates report that consumers use payment methods in the opposite order: cash was used at the grocery store roughly 39% of the time, checks 33%, online debit cards

[2] It seems likely that most ATMs are serviced on a schedule rather than on as "as needed" basis. For example, any ATM that accepts deposits will require regular service visits to pick up the deposit envelopes regardless of the amount of cash remaining in the ATM.

12% and credit or off-line (signature) debit cards 12% of the time.[3] GHL's Figure 1 (reproduced below) also indicates that consumers use cash and checks more frequently than debit and credit at all transaction sizes. The inconsistency of the estimated benefits with the observed usage and the degree to which paper payment methods are estimated to be inferior to other payment methods from the consumer's point of view suggest that many of the benefits of using cash and checks are omitted or underestimated.

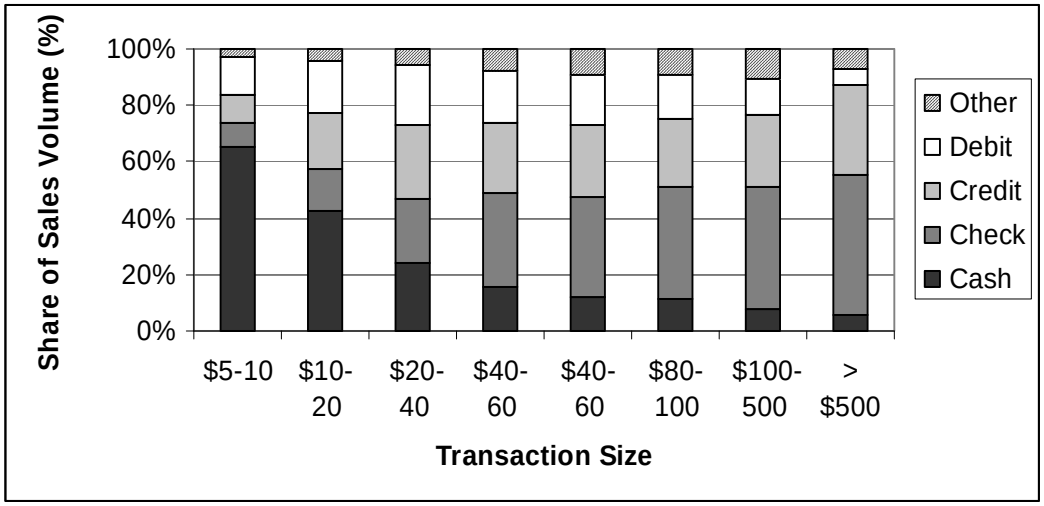

Figure 1: Payment instrument transaction shares at various sizes for 2004

Note: Debit includes both signature and PIN debit. Charge cards are included with credit.
Source: Visa U.S.A. (2005).

Finally, if consumers minimize net cost, GHL's estimates indicate that cash would be on net the most costly substitute if credit or debit were made unavailable. In fact, empirical estimates support a different ordering. For example, a recent paper by Ron Borzekowski and Elizabeth Kiser at the Federal Reserve Board in Washington, D.C. uses survey data to estimate substitution effects across payment methods. They find that if consumers are unable to use a given payment method, credit is never the most commonly chosen alternative. For example, if consumers are forced to switch transactions from, say, debit, then 45% of those transactions will be switched to cash, followed by checks, with credit being the least frequent alternative (Borzekowski and Kiser, 2006).

There are a large number of categories that GHL do not provide sensitivity analysis for. This section provides sensitivity analysis for the rest of the major assumptions underlying the cash and credit estimates. The results of this discussion are presented in Table 1 in Section 5 as the "sensitivity test". This discussion is limited to cash and credit for the sake of brevity and because those are the highest and lowest cost payment methods according to GHL's estimates.

[3] PricewaterhouseCoopers and the Food Marketing Institute (2000) "It All Adds Up: An Activity-Based Cost Study of Retail Payments," at p.13.

4.1 Consumer assumptions

This section will focus on the four largest cost/benefit categories for cash and credit: implicit price of cash, seigniorage, reward cards and privacy. There is also one category which is not included in GHL but appears to be relevant – interest payments on credit cards.

Interest Payments

GHL exclude interest payments made by credit card users from their analysis, although they note that roughly 54 percent of cardholders carry a balance and so begin paying interest immediately. GHL explain this decision on the basis that they are not interested in the credit function of credit cards and that these finance charges are transfer payments and so are not counted as a social cost. However, their estimates include the benefit to consumers of having credit available from a credit card and are filled with other transfer payments between the various parties. There may also be incremental resource costs associated with the credit function, such as monitoring or bad debt recovery.

Michael Katz has estimated that, on average, cardholders pay 1.23% of the product price in interest payments.[4] This amount is added as a new cost category for consumers and a benefit category for the commercial banks. Incremental resource costs for the banks are assumed to be zero.

Implicit Price of Cash

GHL estimate an implicit price of cash by assuming that for every $120 spent, a consumer must make a trip to the ATM with a time value cost equal to the average wage rate. This estimate appears too high.

First, it seems unlikely that most, or even many, ATM visits require specific trips, particularly in the analysis' venue – grocery stores. In general, consumers are likely to use ATMs as a matter of convenience while on other trips. Many grocery stores have ATMs on site, and ATM owners generally attempt to locate their ATMs in high-traffic areas specifically so that people will use their ATMs while en route.[5] People also receive cash in other ways, such as when they deposit their paychecks, from cash-back at grocery stores or from cash income.[6]

Second, the economics literature on the value of transit time typically does not count the full wage rate as the cost to consumers. In general, consumers can find some value during transit, such as making telephone calls or listening to an iPod or the radio. A more common assumption is that the time cost for personal travel is roughly 50 percent of the average wage rate.[7]

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[4] Brief for the United States, United States of America v. Visa, et al., Second Circuit Court of Appeals, No. 02-6074(L), August 30, 2002 (citing Michael Katz direct testimony).

[5] Food Marketing Institute and AC Nielsen estimates. www.factsfiguresfuture.com/archive/october_2004.htm

[6] The model includes a benefit to consumers of using cash back from debit transactions but does not reflect that possibility in the implicit price of cash calculation.

[7] See, for example, the U.S. Department of Transportation "The Value of Saving Travel Time: Departmental Guidance for Conducting Economic Evaluations," April 9, 1997; and Revision 1 to that document, February 11, 2003.

The sensitivity of the model to these assumptions may be tested by assuming that half of consumer trips to ATMs do not require going out of one's way and that transit time cost is 50 percent of the average wage rate rather than 100 percent, resulting in an implicit price one quarter as large as GHL's estimate.

Cost of Seigniorage

GHL estimate the cost of seigniorage by taking an estimate of the annual benefit of seigniorage to the government ($11.2 billion) and dividing it by U.S. cash transactions over 18 months (the average life span of frequently used paper currency) to get an estimate of seigniorage per transaction. This computation is puzzling in several respects. First, there are no theoretical models that I am aware of that associate seigniorage with consumer transactions. Second, there is no obvious logic in taking one year's worth of seigniorage and dividing it by 18 months worth of transactions. Third, the vast majority of U.S. currency is not held by, and does not pass through the hands of, U.S. consumers. Federal Reserve officials have estimated that between half and two-thirds of all U.S. currency (by value) is held outside of the United States, and that the incidence of most U.S. seigniorage income derives from non-U.S. holders of U.S. currency (Judson and Porter, 2003, p.5). Most domestic currency, meanwhile, is held by businesses or banks – not by consumers. A 1995 survey commissioned by the Federal Reserve found that adults held only five percent of total currency held outside of depository institutions, down from 11 percent in 1986.[8]

Seigniorage, if it is included at all, may be estimated as the interest foregone by the consumer by holding cash instead of keeping their funds in an interest-bearing account. Assuming 6% annual interest on a savings account, two weeks of foregone interest would be roughly 0.25%.

Value of Credit Card Rewards

GHL estimate the value of credit card rewards by using the cost to consumers of airline reward miles. Specifically, GHL use American Airlines' offering of miles to consumers at 2.2 cents a mile, and the fact that reward cards typically offer one mile per dollar spent. This valuation appears too high. Consumers cannot sell their miles at 2.2 cents each, nor do consumers typically choose to purchase miles at that price. Such miles are marketed by the airlines as "filler" miles to add a few to finish up a reward. If a frequent flier mile customer is 100 miles short of a trip to Australia, she may well value those marginal 100 miles at 2.2 cents each, but an economy class American Airlines domestic ticket without blackout dates costs 50,000 frequent flier miles. At 2.2 cents per mile, that is $1,100. This valuation is well in excess of the typical cash cost of such a ticket. In other words, GHL assume that the average mile is valued as highly as the marginal mile used to reach a rewards plateau. The difference may be seen by considering that mileage cards typically offer 20,000 miles as an inducement to enroll. If consumers valued those miles at 2.2 cents each, then consumers would be indifferent between a mileage card offering 20,000 miles and a mileage card offering a cash signing bonus of $440. It seems unlikely that many consumers would choose the 20,000 miles over $440 in cash. Furthermore, the vast

[8] Federal Reserve Bulletin (1996) "The Location of U.S. Currency: How Much is Abroad?" at p.887.

majority of frequent flier miles are never used, again suggesting that they are unlikely to be valued so highly.

An alternative method for valuing rewards is to note that airline reward cards compete with cash back cards, whose value rarely exceeds 1% of purchases. This valuation is consistent with the cost of the rewards programs, which provide 1 mile per $1 spent at a cost which GHL assume is about $0.01 per mile. Following GHL, the rewards benefit is then the fraction of credit cardholders with rewards cards (43%) times the transaction value ($54.24) times 1%.

Value of Privacy

GHL estimate the value of privacy by assuming that it is equal to the discount provided by a loyalty card at the grocery store. This estimate appears low. Privacy is frequently cited as one of the most important reasons why cash remains the most popular payment method in the United States.[9] It is not clear how much privacy one gives up by using a loyalty card but at most, it seems negligible compared to having itemized transactions appear on one's credit card or banking statement (indeed, some very large purchases are made with cash precisely so that they are not traceable). Privacy – an anonymous transaction – also eliminates any risk of identity theft associated with a transaction. Estimating the value of privacy is difficult but for sensitivity testing, it is assumed to be 1.5 times the discount provided by a loyalty card at the grocery store.

4.2 Merchant assumptions

GHL discuss three categories of merchant costs: theft/counterfeit, float and processing costs. Processing costs are relatively straightforward and float costs are de minimus, so the sensitivity analysis in this section is limited to the theft/counterfeit category.

Fraud, strictly speaking, is a transfer, not a resource cost. The resources spent in attempting to prevent fraud are real costs, of course, and it may be socially desirable to treat benefits to criminals differently. The welfare standard used should, however, be addressed explicitly.

GHL only apply the theft/counterfeit category to cash. All other payment methods are assumed to have no such incremental costs for the merchant (or any other listed entity). However, there is some probability of fraud on any transaction with any payment method, so the expected average cost of fraud for an incremental transaction should be non-zero for all payment methods. Indeed, consumer surveys consistently report concerns about misuse and identity theft as being important determinants of payment method choice (Benton et al., 2007). Credit transactions may involve fraud on the part of the consumer (such as a stolen card or identity theft), fraud on the part of the merchant (such as increasing the amount of the submitted charge), or fraud on the part of the processors (such as having credit card numbers stolen by hackers from the processors' records). To test the sensitivity of the results to GHL's assumption that credit has zero fraud costs, the fraud costs for credit are alternatively assumed to be equal to those of cash.

[9] See, for example, Federal Reserve Bank of San Francisco "1995 Annual Report: A Brief History of Our Nation's Paper Money". See also Benton et al. (2007).

4.3 Central bank assumptions

As discussed in the flow test, there is no theoretical support for associating central bank seigniorage with retail transactions by domestic consumers but following GHL, the cost of seigniorage to consumers is treated as a benefit to the central bank.

4.4 Commercial bank assumptions

GHL assume that processing costs for cash are forced by competition to be equal to the price charged to merchants.[10] By contrast, GHL estimate that credit card revenues are substantially in excess of cost. This inconsistency indicates either that the resource costs for credit card processing are being underestimated or that the banks are enjoying monopoly profits. GHL's credit card cost estimates are derived using otherwise undocumented Visa U.S.A. cost studies, making it impossible to evaluate their accuracy. If the estimates are accurate and the difference is due to monopoly profits, then the welfare standard to be applied should be made explicit – that is, should monopoly profits at the bank level be weighted equally with consumer benefits? This question is not trivial, as standard antitrust welfare analysis credits only consumer benefits and assigns a weight of zero to monopoly profits.

5 Results and discussion

Two sets of alternative assumptions have been developed above. The first set is obtained by examining whether particular cost categories should be excluded on the basis that they occur before the transaction or that they are not incremental to the transaction. This set of assumptions is referred to as the "flow test". The second set is obtained by taking GHL's cost categories as given and evaluating alternatives to the different assumptions. This set is referred to as the "sensitivity test". The results of these alternatives are presented in Table 1.

Flow Test Results

The "flow test" analysis indicates that GHL's original analysis significantly overstates the incremental costs of cash to consumers by including overhead type costs that were not included for other payment methods. The inclusion or exclusion of overhead costs depends upon the question being asked. It is perfectly reasonable to pose the question of whether a significant expansion of a payment method is socially beneficial. However, that question would involve looking at changes at the network level. The question as posed here is more limited – what are the incremental social effects of an additional transaction at the cash register?

[10] Despite this statement, the processing costs for cash listed in GHL's tables are not the same as the processing revenues. Consistent with this section, the costs are made equal in the sensitivity analysis.

	Cash			Credit		
		Sensitivity			Sensitivity	
	GHL	Test	Flow Test	GHL	Test	Flow Test
Merchants						
Theft/Counterfeit	-0.140	-0.140	-0.140		-0.140	
Float	-0.004	-0.004	-0.004	-0.010	-0.010	-0.010
Processing	-0.280	-0.280	-0.280	-1.210	-1.210	-1.210
Total	**-0.424**	**-0.424**	**-0.424**	**-1.220**	**-1.360**	**-1.220**
Consumers						
Processing Time	-0.140	-0.140	-0.140	-0.230	-0.230	-0.230
Queue Time	-0.140	-0.140	-0.140	-0.230	-0.230	-0.230
Explicit Price	-0.030	-0.030				
Implicit Price	-0.650	-0.163				
Seigniorage	-0.330	-0.136				
Interest Payments					-0.667	
Float				0.040	0.040	0.040
Credit Option				0.020	0.020	0.020
Record Keeping				0.040	0.040	0.040
Cash Back Option						
Signature Debit						
Reward Cards				0.480	0.233	0.480
Discover Cards				0.020	0.020	0.020
Privacy	0.540	0.810	0.540			
Total	**-0.750**	**0.202**	**0.260**	**0.140**	**-0.774**	**0.140**
Central Banks						
Production	-0.010	-0.010				
Processing	-0.002	-0.002				
Processing Revenue	0.002	0.002				
Seigniorage	0.330	0.136				
Total	**0.320**	**0.126**	**0.000**	**0.000**	**0.000**	**0.000**
Commercial Banks						
ATM Maintenance	-0.300	-0.300				
Production				-0.010	-0.010	
Processing	-0.020	-0.050	-0.020	-0.400	-0.400	-0.400
Rewards				-0.240	-0.233	-0.240
Float						
Processing Revenue	0.050	0.050	0.050	1.010	1.010	1.010
Interest Payments					0.667	
Total	**-0.270**	**-0.300**	**0.030**	**0.360**	**1.034**	**0.370**
Avg. Incremental Social Benefit	**-1.124**	**-0.397**	**-0.134**	**-0.720**	**-1.100**	**-0.710**

Table 1: Average incremental benefits – Sensitivity analysis

GHL estimate a $0.40 difference between the average incremental social benefits of cash and credit. The adjustments from the "flow test" generally reduce the net costs of cash and increase the net costs of credit. The net effects on the difference between the two are as follows:

- GHL estimated social advantage of incremental credit over cash

  $0.40

- Effect on advantage of removing:

  1. Explicit price of cash: -$0.03
  2. Implicit price of cash: -$0.65
  3. ATM maintenance: -$0.30
  4. Credit card production: +$0.01

The exclusion of any one of these categories will have a significant impact on the magnitudes and rankings of the estimates. Even a $0.01 change is a 2.5% change in the difference between the methods.

Similarly, GHL estimate a $0.89 advantage for consumers of incremental credit over cash. The adjustments from the "flow test" also reduce the net costs of cash and increase the net costs of credit from the consumer viewpoint. The net effects on the difference between the two are as follows:

- GHL estimated advantage of incremental credit over cash to consumers

  $0.89

- Effect on advantage of removing:

  1. Explicit price of cash: -$0.03
  2. Implicit price of cash: -$0.65
  3. Seigniorage: -$0.33

Again, the impact of these categories is large relative to the gap, particularly since the gap between credit and cash is the largest found in GHL's estimates.

Sensitivity Test Results

The "sensitivity test" covers primarily the following elements:

(1) Adjusting the "implicit price" of cash to reflect the prevalence of ATMs and the common treatment of time cost in travel analyses.

(2) Assuming that consumers value privacy more highly than the savings from a grocery store discount card.

(3) Treating credit rewards as a transfer and valuing them at the cost to banks.

(4) Applying an incremental fraud cost to credit as well as to cash.

(5) Re-characterizing seigniorage as the foregone interest on carrying cash.

(6) Adding average interest payments to credit.

Each of these elements has a significant effect on both the participants' relative rankings and the societal magnitudes and rankings. GHL estimate a $0.40 difference between the average incremental social benefits of cash and credit. The adjustments generally reduce the net costs of cash and increase the net costs of credit. The net effects on the difference between the two are as follows:

- GHL estimated social advantage of incremental credit over cash

  $0.40

- Effect on advantage of:

  1. Adjusting the "implicit price" of cash: -$0.487
  2. Adjusting the value of privacy: -$0.27
  3. Adjusting the value of credit rewards: -$0.24
  4. Including fraud cost for credit: -$0.14

GHL estimate a $0.89 difference between the average incremental net costs of credit and cash from the consumer viewpoint. The net effects of the sensitivity analysis on this difference are as follows:

- GHL estimated advantage of incremental credit over cash to consumers

  $0.89

- Effect on advantage of:

  1. Adjusting the "implicit price" of cash: -$0.487
  2. Adjusting the value of privacy: -$0.27
  3. Adjusting the value of credit rewards: -$0.247
  4. Treating seigniorage as foregone interest: -$0.194
  5. Adding interest payments to credit: -$0.667

Again, these categories result in changes that are significant relative to the size of the difference, particularly since the gap between credit and cash is the largest in GHL's estimates. The results generally change both the magnitudes and the rankings.

These results, taken in conjunction with GHL's own sensitivity analysis, indicate first that the results are extremely sensitive in the majority of categories, and second that the original estimates overstated the costs and understated the benefits of cash relative to credit. Extending the analysis to include checks and debit may well result in significant changes in their magnitudes and rankings as well.

Future research may profitably re-examine all of the payment methods in the manner done here for credit and cash. Research may also profitably try varying the timing to look at effects on the network and overhead levels or varying the welfare standards used, such as estimating all resource costs and then performing an explicit consumer surplus estimation.

6 Conclusions