The Role of Interstate Banking in the Diffusion of Electronic Payments Technology

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I. Introduction and Conclusions.

The most important technological change in payment methods has been the development of electronic alternatives to paper-based cash and check systems. During the 1970s, the firms involved in this development and the popular press projected a near-term cashless and checkless society as a result of this technological change in payments means. However, it is currently clear that the electronics revolution is not arriving on time. The electronic payments transaction volume performed by ACH (automated clearing houses) and wire transfer networks was less than .3 percent of all payments (cash, check, ACH, and wire) in 1983.

The problem is that while technological change makes certain things possible, such as the substitution of electronic payment means for cash and checks, institutional factors and their resultant economic impacts effectively block implementation of such a substitution on a large scale. In addition to technological feasibility, two necessary conditions for electronic payments diffusion are currently unmet. First, it is necessary for users, particularly the lay public, to become familiar with and comfortable with electronic payment methods and perceive them to be safe. Second, the effective user costs of electronic payments must be close to or lower than the user costs of non-electronic alternatives--which is not currently the case. On average, checks have lower user costs--in fact these costs are negative--because of the float benefits attached to check use but not to electronic payments. The current high cost-low usage situation for electronic alternatives appears to be a sustainable equilibrium because (1) as long as user costs of electronic payments remain high, the public will not become familiar with these alternatives and use them regularly, and (2) the possibility of exploiting cost-reducing scale economies in the production of electronic payments will be foiled as long as usage is low.

This paper demonstrates how long-standing institutional factors have essentially neutralized the diffusion of electronic payments practices. We discuss these institutional factors, which include: (1) the existing framework of legal rights and liabilities governing the payments system, (2) the "market failure" involved in the use of checks, due to the externalities of float transfer payments, (3) the difficulty of negotiation among large groups of agents with regard to the distribution of benefits from adopting new techniques, (4) the reluctance of users to alter set behavior patterns, and (5) the pricing practices of retail establishments that accept payments which have shown strong resistance to change. We also demonstrate that the technologically-determined scale economies involved in processing electronic payments can not be sufficiently exploited to reduce costs to the degree necessary to overcome these institutional barriers given the current structure of the banking industry. Finally, we posit an alternative scenario that we expect to drive the future development and use of electronic payments. This scenario involves an important institutional change--interstate banking--which will take place for reasons exogenous to the payments system.

Our premise, supported by the results of our forthcoming empirical study (Berger, Humphrey, and Frodin (1985)), is that interstate banking can profoundly affect the way in which checks are cleared, with important spillover effects onto electronic funds transfers. Interstate banking will increase the proportion of "on-us" checks, those requiring no external processing and creating no interbank float. It will also dramatically reduce the number of handlings required for transit check items--checks that are now sent between some 15,000 different banks. Bank consolidation will concentrate check handlings into fewer and larger correspondent banks, with fewer items processed by the Federal Reserve. These changes alone will encourage electronic payments diffusion somewhat, as the

float benefits of check usage decrease and the costs of electronic payments processing falls since larger payment volumes could be sent to fewer presentment endpoints.

However, more important is that a smaller number of larger correspondent banks will, because of cost economies, encourage check truncation, which is a "back-office" method of "electronifying" paper check transactions. Users may continue to write checks, but their processing and collection will be through an ACH network. This aspect of increased ACH use will also reduce costs for non-truncation ACH users, as scale and scope economies are exploited. Another possibility, albeit less likely than check truncation, regards the internalization of more of the payments externalities in an interstate banking environment. Larger banks may (1) induce consumers to become familiar with replacing checks by electronic transfers by temporarily raising charges on the former to subsidize development of the latter, and/or (2) induce merchants to price-differentiate their products by payments means by giving subsidies to merchants who do so.

II. Substitutability Among Payments Means.

In this section, we briefly describe the major payments instruments and show their uses. We also outline the possibilities for substitution between electronic and non-electronic payments media and illustrate the primary variables affecting the relative demand and supply functions for payment instruments.

A. Description of Payments Means.

In the list below, we briefly describe each payments means, how the underlying processing might be performed, and indicate with an asterisk (*) when electronics are used. Note that virtually all transactions other than cash become electronic once they reach the bank of last deposit.

Cash - May be obtained from a teller, automated teller machine (ATM)*, or cash dispenser (CD)*.

Checks - Provide provisional funds that often engender mail float and inter-bank processing and transportation float. May be processed as an on-us item, through a direct exchange, correspondent bank, the Federal Reserve, or be truncated, where the interbank funds are sent by ACH*. This last method of check collection should be distinguished from check safekeeping or truncation at the bank of last deposit, where the collection of funds is conventional but the bank saves postage by not mailing the physical items to the payor.

Money Orders and Travelers Checks - May be purchased from merchant or financial institutions using only good funds. Substitutes for checks when provisional funds are unacceptable. Processed and issued by bank holding companies and service companies.

Credit Cards - Provide provisional funds, verifiable for large transactions, usually creates processing and billing float. May be processed entirely through service companies (e.g. American Express) or in conjunction with banks (e.g. Visa). May be collected by monthly check payment or automatic ACH debit to bank account via prior agreement*.

Automated Clearing House (ACH)* - Allows a party to initiate a debit or credit with another party automatically with one or two days notice to the bank and a signed agreement between the parties. Trailing descriptive data accompany the funds transfer. Usually used for direct deposit of payroll or U.S. government income payments (about 60 percent of current use), or other regular payments like insurance premiums. Most of the processing is done by the Federal Reserve. The Corporate Trade Payments (CTP) pilot program is an experiment in which participating corporations initiate the transfers, which include more detailed trailing information. Banks and the Federal Reserve collaborate on processing and settlement for CTP.

Wire Transfers* - Can be used to transfer same-day good funds to any other party in the U.S. almost immediately. Can be processed through Fedwire (Federal Reserve System) or CHIPS, CHESS or CashWire (international, regional, and national private-sector systems).

Point of Sale (POS)* with Debit Card or Smart Card - Provide non-provisional payment in which the customer's account is debited immediately and transfer made to the merchant's account, or the funds may be already withdrawn and enbedded in the card (smart card). May be operated by one or more banks in conjunction with one or more merchants and perhaps a service agency.

Automated Teller Machine (ATM)* or Cash Dispenser (CD)* - CD's may be used only to withdraw cash from an account. ATM's may be used to withdraw cash, determine balances, transfer funds among an individual's accounts, or to make regular bill payments, for items such as loans, credit cards, utilities, etc. Bill payments may be transfers between accounts of different customers at the same bank or may be processed as ACH items for transfers between banks.

Telephone Transfer*, Home Banking* - Can be used for any of the ATM functions above, except cash disbursement.

It is important to note that the only non-electronic payment form that can be made electronically without the user's active participation is check truncation with interbank funds collection by ACH. Even this form requires some type of user participation since check writers will not receive the canceled checks. Currently, truncation is practically non-existent, except for credit union share drafts, which must be truncated by law.

B. The Use of Different Payment Means and the Range of Substitutability.

The current use of the major payments methods is shown in Table 1. These data apply to all types of users, both individual and business. In terms of volume, non-electronic payments comprise more than 99 percent of all transactions. In terms of dollar value, however, the roles are reversed; non-electronic payments account for more than 75 percent of the total dollars transacted.

The differences in average dollar size across payments methods limits the range of potential future substitutability between non-electronic and electronic payments means. For small dollar payments, cash currently predominates. However, POS is a possiblility to replace some retail store cash payments in the future. ACH, ATM and telephone transfer payments are too cumbersome to replace cash in small transactions. Checks, credit cards, money orders, and travelers checks generally are used for middle-sized transactions. POS systems could replace many of these transactions in retail stores. For routine payments, such as those to utilities, loan payments, etc., ACH, ATM, telephone transfer, and home banking could be substituted. ACH also can be important in payroll disbursement. High dollar payments are almost exclusively corporate-to-corporate transfers or financial market transactions via wire transfer networks.[1] The only effective substitute for these is the Corporate Trade Payments ACH. The following chart illustrates the main substitutions possible between major non-electronic and electronic payment media.

Table 1

Volume, Value, and Growth of Different Payment Instruments

Type of Payment Instrument	Volume (millions)	Total Value ($trillions)	Average Dollar Value	Annual Growth (1981-1983)	Percent Volume Composition
Non Electronic					
Cash	112,000	$2.8	$25	9%	
Checks	40,000	$36.0	$910	6%	
Credit Cards			$70		
Money Orders			$70		
Travelers Checks					
Electronic					
ACH	400	$0.7	$1800	27%	
ATM*					
POS					
Wire Transfers	57	$142.0	$2,500,000	11%	

*Bill payment transaction only. Excludes cash withdrawal, balance inquiry, and balance transfer transactions.

Source: Humphrey (1984), p.6.

Value of the Transaction	Non-Electronic Payment Method	Electronic Payment Method
Low dollar	Cash	POS
Medium dollar	Checks, credit cards money orders, travelers checks	POS, ACH, ATM, telephone transfer, home banking
High dollar	—	Wire transfers, Corporate Trade Payments ACH

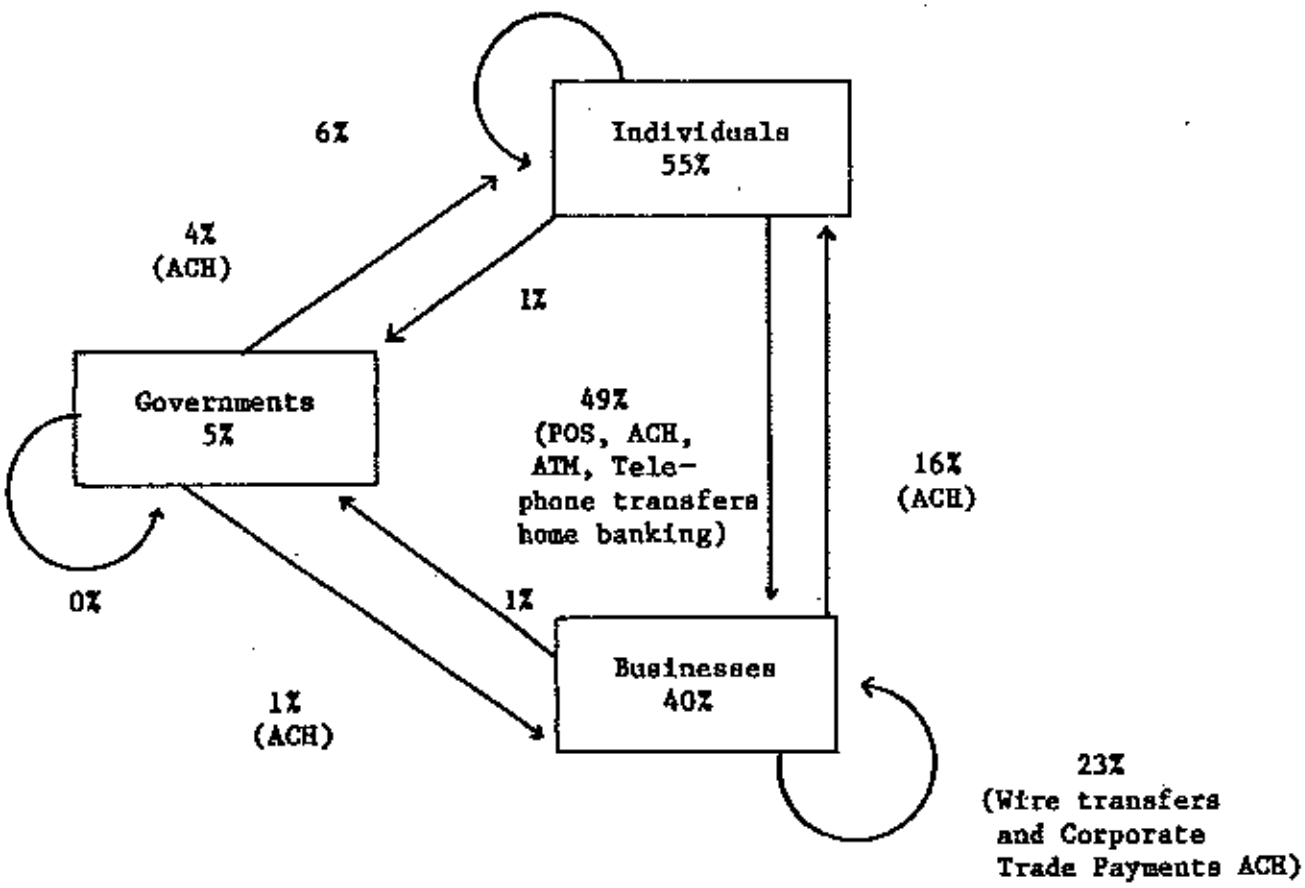
The most important substitution from a social viewpoint would be between checks and electronics, since check payments constitute 93 percent of the non-electronic payment dollars and, as shown in a later section, are the most socially wasteful of resources. The current distribution of check usage among individuals (55%), businesses (40%), and government (5%) is shown graphically in figure 1. The three most important classes of transfers--individuals writing checks to businesses (49%), businesses writing checks to businesses (23%), and businesses writing checks to individuals (16%)--accounts for fully 88 percent of all checks written. But the potential electronic substitutes for these three classes of check payments often require different types of electronic access arrangements. For example, direct access to electronics is needed for government and business but indirect access--through ATM, POS, or telephone transfer systems--is required for individuals, as shown in parentheses in Figure 1. Clearly, substantial investment and effort will be required to break the public of its check writing habits.

The remainder of this section broadly outlines demand and supply relations for payments instruments. Future changes in technology, institutions, and industrial structure can lead to substitution of electronic for non-electronic payments methods through these demand and supply functions. Following sections will outline how these changes might occur.

Figure 1

Percent Composition of Check Usage

(Electronic substitutes are shown in parenthesis)



C. Demand and Supply for Payments Instruments.

The demand for a payment instrument can be expressed notationally as:

(1) $D_i = f(P(U)_i - P(U)_j, V_i, DIS, POP, AS, Y, R)$

where:

D_i = demand for payments instrument i relative to total transactions (the latter are assumed to be fixed);

$P(U)_i$ = own user price;

$P(U)_j$ = user prices of alternative payments instruments;

V_i = value of the transaction underlying the payment;

DIS = distance of the user to the closest bank branch;

POP = population growth;

AS = age structure of the population;

Y = income level of the user; and

R = race of the user.

The relative demand function in (1) is straightforward except for the formulation of relative user prices. The total demand for payments instruments is assumed to be exogenous, depending upon the transactions that individuals and firms choose to make. The distribution of transactions across payments instruments depends on the differences between user prices of alternative instruments; $P(U)_i - P(U)_j$ is the extra payment the user must make for use of instrument i rather than instrument j.

The user cost of payments, P(U), has three cost components, each springing from a different source:

(2) $P(U)_i = P(S)_i + MHFC_i - FTP_i$ with $FTP_i = r \cdot A_i \cdot V_i$

where:

$P(S)_i$ = supply price of instrument i charged by the payment supplier, such as a per-check fee and/or the cost of a balance requirement;

$MHFC_i$ = Merchant Handling and Float Charge—what the payee charges the payor for using instrument i over and above the price of the good or service

being purchased for the purpose of recovering payment handling and float costs, such as a premium for using a credit card gas stations;

FTP_i = Float Transfer Payment--the interest earned by the payor and lost by the payee before the funds are actually collected;

r = daily market interest rate; and

A_i = average number of days until collection of funds from the payor (or the debit to his account);

P(S) is charged directly by the supplier of the payments instrument. We assume for simplicity that P(S) is directly assessed on the payor. MHFC is the fee charged directly by the merchant or other payee which may or may differ across payment forms. The merchant's price $P(M)_i$ includes the basic cost of (and normal return on) goods and services P(G+S) plus the merchant's handling and float costs of the different payment instruments used in the transaction:

(3) $P(M)_i = P(G+S) + MHFC_i$.

P(G+S) may be thought of as the price the merchant would charge if customers would simply walk out of the store and immediately deposit good funds in his bank account instead of having him handle the payment transaction. Merchants have no doubt attempted to pass on to the consumer the marginal costs of handling different payment instruments (MCH_i) plus the costs of float (FTP_i). Until recently, this has been done by raising the price for using <u>all</u> payments instruments equally using a a weighted average—setting $MHFC_i = MHCF$, where $MHCF = \sum n_i (MCH_i + FTP_i)$ and n_i is the proportion of transactions using instrument i--rather than recovering the costs of each instrument separately—$MHFC_i = MCH_i + FTP_i$, for all i. If the latter condition holds, then we say that the merchant is neutral with respect to the payor's choice of payment means; the same profit will be made regardless of payment choice. If a firm accepts payment in forms i and j, where $MCH_i + FTP_i > MCH_j + FTP_j$, and sets $MHFC_i < MCH_i + FTP_i$ and $MHFC_j > MCH_j + FTP_j$, we say that the firm is "subsidizing" the use of the high cost instrument i and "taxing"

the use of the low cost instrument j.

Numerous cross-section survey studies of the use of different subsets of payments instruments (citations here) have shown that usage differs considerably with the value of the underlying transaction (V), the distance of the user to a bank branch office (DIS), population growth (POP), and the age (AS), income (Y), and race (R) of the user. No study, to our knowledge, has ever determined the importance of relative user costs, $P(U)_i - P(U)_j$, in the demand for payments instruments. Accurate series of supplier price data, P(S), are difficult to obtain and the existence of surcharges and transfer payments, MHFC and FTP, substantially complicate estimation of user prices.

The variables other than user price which should affect the demand for payments instruments are relatively straightforward and can be summarized as follows:

- Value of the transaction (V): Related to safety, convenience, regularity of payments and relations between payor and payee. Small, infrequent transactions between anonymous participants are most easily handled in cash or by POS which give payment in non-provisional funds requiring no complex certifications. Middle-sized regular payments are more suited to checks, POS, ACH, or ATM, to avoid the safety problems of cash. Large transactions usually require speedy transfers, often across large distances, requiring use of wire transfers. Regular large business transactions may also be handled by CTP ACH.

- Distance to a bank branch (DIS): This variable is important in influencing the relative use of cash versus checks for those users with checking accounts (80 to 90 percent of the population). Distance to a bank branch, or to an ATM or CD, reflects the convenience aspect of being able to withdraw cash. Some studies (citations here) indicate that the increasing convenience both in place and time (with 24 hour access) of cash withdrawal made available by ATMs and CDs has lowered the public's average holdings of idle cash balances (while the growth of the underground economy has moved cash holdings in the opposite direction).

- Population growth (POP) and age structure (AS): Domestic U.S. use of cash and checks for normal consumer transactions are affected by the overall expansion of the population and its division into adult and non-adult age classes, due to consumer inertia, electronics anxiety, etc. Current use of ATMs, CDs, POS, and ACH for bill payments are primarily concentrated in the young adult age groups. However, these variables do not affect financial market transactions (e.g., interbank funding, foreign exchange transactions, and U.S. government securities transfers), which dominate wire transfer volume; and

- Income level (Y) and race (R) of user: Income and race are empirically associated with the use of credit cards and checks versus cash and money order use. Use of provisional funds (credit cards and checks) is restricted by past and present discrimination and persists in part due to consumer inertia, favoring the use of final funds methods (cash and money orders) for lower income and/or nonwhite groups.

We assume an oligopolistic pricing mechanism for payments. The supply price of payments instruments takes the form of a multiplicative markup over the unit costs of a firm:

$$(4) \qquad P(S)_i = m \cdot g(P_{wi}, P_{ki}, P_{Ii}, Q_i, Q_j, t_i)$$

where:

$P(S)_i$ = unit supply price of the i^{th} instrument offered by a payments-producing or supplying institution;

m = markup factor, where $m = 1$ indicates that normal profits are being earned;

$g(\cdot)$ = short-run unit cost function which includes normal profits;

P_{wi}, P_{ki}, P_{Ii} = the unit costs of labor, capital, and intermediate inputs or services which are used to produce the i^{th} payment instrument;

Q_i = the level of output produced, to capture scale effects;

Q_j = vector of all other payment instruments produced by the firm, to capture scope effects or complimentarities in production; and

t_i = technological changes not already embodied in the unit cost of capital (P_{ki}).

The supply function in (4) is entirely technologically determined, except for the markup factor m. We will say that the producer is "subsidizing" the use of payment instrument i if $m < 1$, and "taxing" its use it $m > 1$.

Given the notational framework of the demand and supply relations (1) to (4), we may now more clearly state our central thesis. To date, the electronics revolution in payments has not arrived because institutional factors have dominated the technological determinants of the user price of payments instruments. In particular, the influences of high handling costs (MHC) and high float transfer payments

on checks and credit cards (FTP), which are not offset by differentiated merchant charges (MHFC), have dominated the influences of scale economies (Q_i), scope economies (Q_j), and embodied and disembodied technological change (P_{ki} and t_i). Moreover, the marketplace is likely to remain this way until the emergence of interstate banking. Interstate banking will help induce the electronic revolution by (1) reducing float transfer payments (FTP) by speeding check collection (by reducing A_i on checks), and (2) introduce check truncation and electronic check collection on a widespread basis, so that ACH scale and scope economies can be exploited (increasing electronic Q_i and Q_j). In addition, large interstate banks may internalize some of the externalities of altering the public's non-electronic habits by (3) temporarily subsidizing electronic payments at the expense of non-electronic payment methods (by reducing m on electronics and raising m on checks and credit cards), and (4) give direct financial incentives to merchants to install POS systems and to price-differentiate among customers using different payments methods (increase MHFC on checks and credit cards and reduce it on cash, POS, ACH and ATM). The remainder of this paper more fully describes the technological and institutional determinants of payments usage and how institutional changes can affect usage patterns in the future.

III. User Prices and Social Costs of Payments in Today's Institutional Environment.

This section gives estimates of the user prices and social costs of the major payments instruments. We show the prospects for changes in costs due to exploitation of scale economies, given the current environment. We also demonstrate how the legal status of check payments and the structure of the banking industry have combined to make check float a primary determinant of payments patterns in the United States.

Three important conclusions are drawn from this analysis. First, checks are used too frequently because of the float benefits that accrue to users. ACH payments use about one half the real resources used by check payments, so that substitution of ACH for checks is in the public interest. Second, even when only "back-office" operations are considered, ACH unit processing costs would likely be substantially lower than check unit processing costs if a substantial proportion of checks were truncated, indicating that truncation is in the public interest. Third, neither of these changes are likely to occur in the current institutional environment. The vast majority of consumers are unlikely to replace checks with electronic payments as long as check float is protected by statute and inter-bank negotiation on float reduction is effectively blocked by the costs of negotiation among the very large number of institutions which supply payments services. Check truncation and electronic funds collection via ACH is unlikely to occur on a widespread basis because each bank's checks would have to be truncated by a large number of relatively small processors, given the current structure of the banking industry.

A. User Price Versus Social Cost of Payments Instruments.

Table 2 shows the estimated real resource and transfer payment costs for each of the major payment methods. The real resource cost estimates shown here include all production and processing costs. However, the important point to note is that these real expenditures are of only secondary importance for most transactions. For both checks and cash, which account for 99 percent of all transactions, the transfer payments involved outweigh the real resource costs. A critical difference is that cash users pay this transfer payment (to the government) while check users receive this transfer payment (from payees). In either case, there has been a substantial wedge driven between the private and the

Table 2

User Prices and Social Costs of Different Payment Instruments
(1983: $ millions)

Type of Payment Instrument	Production Cost	Processing Cost	Float Cost (negative sign for benefit)	Opportunity Cost of Holding Idle Funds	Total User Charges[1] (Unit Price)	Total Social Costs (Unit Cost)
Non-Electronic						
Cash	$327	$7,195	0	$13,604	$20,648[2] ($.18)	$7,522 ($.07)
Checks	1,250	25,828	-$33,000	0[3]	-5,922 (-$.15)	27,078 ($.68)
Credit Cards						
Money Orders						
Travelers Cks.						
Electronic						
ACH	0	137	-6	0	131 ($.33)	137 ($.34)
ATM	0					
POS	0					
Wire Transfers	0	297	5	0	302 ($5.30)	297 ($5.21)

[1]The supplier prices are assumed to equal unit costs, i.e., the multiplicative markup m = 1. The user charges and unit prices of the different payment instruments reflect all handling costs and float benefits attainable to each instrument, even though these costs may be recognized by merchants in the price they charge.

[2]This figure excludes the government production cost of $327 million and the portion of processing cost borne by the Federal Reserve, $151 million, both of which are provided free. The remaining private-sector costs are assumed to be passed onto cash customers through higher prices.

[3]The cost of holding funds earning little or no interest in a checking account is assumed to be soft-dollar payment for services, and is therefore already included under production and processing costs.

social costs of a payments transaction with these two instruments. These wedges lead to "market failure" and encourage overuse of checks and underuse of cash from a social viewpoint.

Because of check float, the imputed user price is -15 cents per check transaction, as opposed to 33 cents for ACH, indicating that, on average, a user is paid 48 cents for using a check instead of an ACH transaction. This is despite the fact that check transactions are twice as costly in terms of real resources, 68 cents for checks versus 34 cents for ACH. Similar results would no doubt hold for a comparison of checks with other electronic alternatives, such as POS. As a result, it is difficult to believe that technological change, which can at best only reduce the cost of electronic payments to some lower positive level, will be the sole determining factor in inducing users to voluntarily shift away from checks to electronics.

In addition to any technological developments, institutional changes will be required to offset the float benefits of check writing before significant substitution will occur. Evidence on the (lack of) substitution into electronics to date substantiates this claim. Electronic payments have captured the (small) market share they have because the users have received some compensation for substituting electronics for checks, credit cards, or cash. The Corporate Trade Payment ACH program works only because the participants are able to retain their estimated distribution of check float benefits while using electronic payments. In terms of our model, the Merchant Handling and Float Charge (MHFC) would have to be reduced for ACH and raised for checks to cover the float costs involved (FTP). POS and ATM use in bill payment has been associated with price discounts (e.g., POS use in gas stations) or increased convenience and postage cost savings (e.g., ATM use in bill payments). These inducements resemble reductions in

electronic MHFC with an increase in check or credit card MHFC. The substitution of an ATM or CD cash withdrawal for an "on us" check written for cash at a bank branch office has occurred because of an increase in convenience due to improved hours or shorter teller lines, which is similar to a decrease in the distance to a bank branch (DIS).

The largest single user of ACH--the U.S. government, which accounts for about 60 percent of current ACH volume--uses it not because of direct savings, but because of the social benefits involved. Although this is stretching the point, we may think of the government as a rational consumer, setting its own merchant charge on checks equal to the float transfer payment, so that transfer payments from taxpayers to government income recipients are ignored in decision making. Dudley's (1984) analysis of the government's ACH direct deposit program supports these conclusions, finding that government ACH is socially beneficial and that the user price of checks to the government is negative, as was the case for all check usage in Table 2. The real resource costs of government payments are 27 cents for an ACH direct deposit and 40 cents for a check payment. However, the government gives up 66 cents in check float for each transfer made by ACH direct deposit, so that the user price of a check is -26 cents (40 cents in real resource costs less 66 cents in check float benefits). Thus, it "costs" the government 53 cents per payment via direct deposit, 27 cents less -26 cents, which it pays for the purpose of increasing social welfare. These estimates of user price and social costs between checks and ACH for one important user mirror the estimates for all users shown in Table 2.

B. Technological Determinant of User Prices: Scale Economies in Processing Non-Electronic and Electronic Payments.

The question arises as to whether technologically-induced changes in costs can change prices enough to induce significant payments substitution by users.

In the discussion below, we concentrate of necessity on scale economies, rather than scope economies or future technological innovations, as little information exists on the latter categories. However, as will be seen, even if improving techniques are heavily biased towards electronic payments instuments, large scale user substitution seems unlikely without institutional changes.

Cash Processing Scale Economies. Cash processing operations at Federal Reserve offices, the only group of processors for which data are available, were shown to experience scale economies at low processing volumes but scale diseconomies at higher volumes (Zimmerman, 1981). Federal Reserve coin and currency processing operations are (largely) provided without charge to users as a "free" central bank service. However, this subsidy of $151 million plus the subsidy of $327 million in production costs from the U.S. Treasury together are too small to substantially offset the opportunity cost tax on holding idle cash balances of over $13 billion. Private sector cash handling and processing costs, on the other hand, presumably are passed on to users. Assuming that private sector processing techniques have properties similar to those of the Federal Reserve, it appears unlikely that significant cash price changes will occur as a result of scale economies in the future.

Check Processing Scale Economies. Estimates of Federal Reserve check processing costs, using a translog cost function, suggested a U-shaped average cost curve prior to the pricing of this service (Humphrey, 1981, Zimmerman, 1981). Diseconomies of scale prevailed at the majority of Federal Reserve offices. Pricing this service led to an overall reduction of 25 percent in market share from 1981 to 1983 and, subsequently, the Federal Reserve experienced constant average costs (near the bottom of the U) at each of its 48 offices (Humphrey, forthcoming). No scale economy estimates exist for the private sector's check operations, which

processes about 70 percent of all checks written (including "on us" checks). However, the same production techniques are used by both Federal Reserve and correspondent banks so that it is reasonable to assume that the private sector also experiences constant costs. Therefore, check unit cost changes that substantially offset the user price advantage due to check float are unlikely in the future.

ACH Scale Economies. Estimates of ACH scale economies have used a translog cost function with five sets of annual cross-section data on Federal Reserve processing costs, excluding certain fixed expenditures. Over the five year period 1978-1982, these estimations produced SCE values ranging from .70 to .80, where SCE = $\partial \ln C / \partial \ln Q$, the cost elasticity of output or marginal cost divided by average cost. The annual estimates had an average of .75 and were all significantly different from 1.0, indicating statistically significant scale economies (Humphrey, 1984, pp. 63-6).

The fact that scale economies exist in Federal Reserve ACH operations, coupled with the observation that some 95 percent of current ACH volume is processed by 38 Federal Reserve offices across the nation, raises the possibility that ACH costs could be even further reduced in the long run if some Reserve Bank ACH operations were consolidated with others. A long-run cost reduction can occur even though in the short run such a consolidation may raise unit costs, due to transition costs. By the same logic, it is conceivable that new entrants into the ACH market, if they aim for a large market share, could experience lower unit costs than those now incurred at unconsolidated Federal Reserve ACH offices. Some simple and illustrative calculations have suggested that current ACH processing costs could be significantly reduced in the long-run--by perhaps upwards to 50 percent--if consolidation were to occur (Humphrey, forthcoming). The important point here is that scale economies by themselves need not

be an important barrier to entry if the existing supplier is not taking full advantage of these economies by consolidating operations. The traditional barrier to entry argument assumes that the most cost-effective production configuration is always being used while recent new entry into ACH processing suggests that this may not now be the case.

No data exist on scale economies for non-Federal Reserve ACH costs (two-thirds of total user ACH costs). However, most of these costs are incurred directly by the payor-users. It seems likely that the Federal Reserve estimates of scale economies in ACH processing given above overstate the degree of scale economy for ACH as a whole, since most of any future widespread expansion of use would be by increasing the number of payor-users, rather than increasing the scale of use for individual payors. These results suggest that scale economies or other technological cost reductions are unlikely to substantially offset the average 48 cents advantage that check users currently enjoy over ACH users.

Wire Transfer Scale Economies. Constant average costs were the general rule for FedWire transfers when a translog cost function was applied to cross-section data for 1979. At only 4 of the 36 Federal Reserve offices which process wire transfers were the SCE estimates significantly different from 1.0; 98 percent of the wire transfers were processed at offices experiencing constant average costs. When all offices were restricted to have the same SCE, the SCE ranged from .97 to 1.04 for three years 1977-1979, and none of these annual estimates were significantly different from constant average costs (Humphrey, 1982).

Data do not exist to estimate the SCEs that apply to wire transfer networks operated by the private sector. CHIPS, the largest private sector network, processes half the transaction volume of FedWire and two-thirds of the dollar value. Other networks, such as CashWire and CHESS, are very small and can

be safely neglected at this time. SWIFT and BankWire are message transfer networks that rely primarily on FedWire and CHIPS to obtain the correspondent balances used to transfer funds in accordance with the messages sent.

As discussed above, the only suitable substitute for most wire transfers is the Corporate Trade Payments ACH. Currently, ACH is dramatically cheaper than wire transfers, $.34 versus over $5, and the difference appears likely to widen, if anything, so that we might expect some substitution from wire transfer to CTP ACH over time.

ATM and POS Scale Economies. Estimated scale economies in automated teller machines are significant. Walker (1978, 1980) estimated ATM SCEs to be .26 to .50, both significantly different from 1.0.[2] Recall, however, that 98 to 99 percent of all ATM transactions are not bill payments but reflect cash withdrawal (76%), account deposits (19%), or account transfer operations (4%). The 1 to 2 percent of ATM transactions which represent bill payments lead either to an ACH payment by the customer's bank or the bank simply cuts a check and mails it for the customer. Thus the ATM is a device for consumer electronic access to an ACH electronic payment or, more typically at present, just another way to initiate a paper check.

No real empirical analysis has been performed on the degree of scale economies in POS use, although the popular press and knowledgeable banking sources assert that such economies exist. At this point, the volumes of POS transactions are so small (estimated to be only XXX thousand in all of 1984) that very little of a definitive nature can be said as to how costs will behave as volumes reach mature levels.

It is useful to emphasize that ATM and POS systems typically are not in themselves complete electronic payment systems. Most POS systems allow

customers of different banking organizations to initiate a payment to, say, a supermarket. The funds are then moved from the customer's bank to that of the supermarket by means of an ACH transfer. In the case of a proprietary POS system where only one banking organization has access, the POS transaction will likely be between the customer's and the supermarket's accounts at the same bank and no ACH transfer would need to be initiated (since the transfer is internal to one bank rather than external between two or more banks).

C. ACH as a Substitute for Check Processing.

Technologically induced changes in user prices are unlikely to be sufficient to overcome the current float-induced advantage of checks at the retail or user level. A remaining possiblility, however, is that ACH may be substituted for check collection at the wholesale or back-office level. Banks may find it cost-effective to truncate checks at the bank of first deposit or some other intermediary (correspondent bank or the Federal Reserve) and have the payments processed, transported and collected via ACH. Check safekeeping by itself, i.e., truncation at the payor bank without processing and collection by ACH, would save payor banks an estimated $7 per year per customer in postage and handling expenses.

Use of ACH in the interbank collection process offers an additional possibility of savings. In 1983, the average variable processing cost for an ACH electronic funds transfer image at Federal Reserve offices was 4.7 cents. The Federal Reserve's average variable cost of processing and transporting a paper check item was 1.4 cents. To faciliate comparison of ACH and conventional processing, transportation, and collection, we assume that each of the 2.74 handlings that correspondent banks and Federal Reserve offices make on the average transit check cost 1.4 cents. We also assume that additional paper

check handling costs will be 1 cent for the bank of first deposit prior to truncation. Using these figures and the ACH and check processing scale economy figures cited earlier, we find that check truncation with ACH funds collection would be cheaper for the average transit item with only a modest increase in average ACH volume per office (from the current 13 million items per year to 15 million items per year). Thus, only a modest increase in current volume or consolidation of Federal Reserve offices (which may reduce costs by up to 50 percent) is required to make check truncation and collection via ACH cost-effective for most transit items.

Although check truncation and electronic collection is rapidly becoming cost-effective in terms of real resources, it is unlikely to occur on a widespread basis in the near future without institutional change. While collecting banks would save resources, payor banks (and/or their customers) would give up some float benefits and the legal right to inspect the item and verify the signature prior to payment. As shown below, the current structure of the U.S. banking industry makes the negotiation costs required to arrange truncation prohibitively high.

D. Institutional Determinants of Payments Usage: The Check Float Barrier.

Float exists because all payments instruments do not involve the instantaneous or "same day" transfer of good or final funds between payor and payee. Payment instruments which generate little or no float for the payor are cash, money orders, travelers checks, ACH, wire transfer, POS, and ATM bill payments. Cash, money orders and travelers checks in fact cause a loss of float by both the payor and payee that is recovered by the issuer. For our purposes, all of these will be considered to be "no float" payment instruments since the payor generally gains no float advantage and uses them for other reasons.

Checks and credit cards, in contrast, embody substantial amounts of

payor float. Float gains to payors, of course, are exactly offset by float losses by payees so float is a transfer payment. Unfortunately, real resources are spent to influence the distribution of this transfer payment. Payors spend extra resources to disburse checks from points remote to the payee (or the payee's collecting bank) to increase mail plus interbank float, the total time between when the payor sends the check and presentment occurs at the payor bank for payment in final funds. In response, payees and collecting banks spend extra resources to offset these payor strategies by reducing their processing and collection times through the use of costly expedited collection procedures (c.f., use of special ground or air couriers in place of slower but less costly regularly scheduled bus, truck, rail, and air transportation alternatives).

The problem of check float is unique to the United States among developed economies. This is due to historical differences in institutional evolution. Other nations either do not rely heavily on checks for transactions or, if checks are heavily used, have solved the problem of float by negotiation among the banks supplying this service.

In most European countries, the giro system has evolved in place of what would otherwise have been the checking system. A giro payment is a credit transfer between the accounts of the payor and payee, which are typically located at a post office. In a giro system, float does not occur because the payor's account is debited and the amount is credited to the payee account simultaneously. Thus, payment processing and collection occur at the same time. A giro is similar to an ACH credit transfer in the U.S.. The closest check equivalent to a giro is an on-us item, where debiting and crediting take place the same day. However, the payor still generally earns float on an on-us item, since payment is usually considered completed when the check is transmitted to the payee which is often one

day in advance of the check's deposit at the bank or, if deposited the same day, the payee's account may not be credited until the next day.

In Japan, on the other hand, cash and electronics are both more heavily used. Until recently, workers were usually paid in cash. The current trend is toward using a system of transfers on magnetic tape handled by the Tokyo clearinghouse, similar to direct-deposit ACH. The dominant form of non-cash transaction in Japan is the direct debit, where individual payors may transfer funds directly into the payee's account using a private-sector wire system (the Zengin). Checks and giro transfers are used only by businesses. The one exception to the Japanese rule of little or no float is an increasing use of credit cards.

We now turn to a comparison of the U.S. system with the Canadian system. Both of these countries rely heavily on check usage for retail payments, but have evolved a substantially different treatment for float.

Check float results because checks are essentially sight drafts subject to signature verification prior to payment and because it takes time to receive, process, and transport a check for presentment and signature verification at the payor bank. In the U.S., the collection and verification process has evolved historically with few major changes, other than those aimed at standardizing the size of the check, the placement of the payment order information, and the magnetic ink encoding of the payor bank and customer account number. All these changes have speeded up the processing, collection, and presentment process but substantial payor float still remains. The rights and liabilities governing checks are extensively covered in the Uniform Commercial Code (UCC), while those pertaining to electronic payments are legally less clear because of the relative newness of these types of payments.

In Canada, which has about the same relative use of checks as the

U.S., payor float has been virtually eliminated. For checks written by consumers, the major Canadian banks have negotiated away much of what would otherwise be payor benefits from check use by agreeing that consumer (not business) checks drawn on one another will be paid on a same-day basis, even though settlement between the banks occurs the next day. For large-dollar business checks, float costs are assessed on the payor (not on the payee as in the U.S.). These negotiated arrangements were made possible because:

1) The Canadian banking system is very concentrated--five major banks operating nationwide account for more than 90 percent of total banking assets;

2) This concentration is relatively even in different regions since an extensive national branching network exists for these five banks; and

3) the major banks have roughly equal shares of the consumer deposit market, and therefore, the check market.

The first condition implies that negotiation and coordination costs among the Canadian banks will be relatively low compared to the U.S. where negotiation among 3,283 banks would be necessary to cover 90 percent of U.S. banking assets.[3] Negotiation is necessary since each bank offering same-day funds availability incurs float costs that could only be offset by the reciprocation of other banks. The first condition, also means that more "on-us" checks will exist. This is where a payee deposits a check at the same bank that the payor has drawn the check on. On-us checks, about 30 percent of all checks, do not require any processing past the bank of first deposit since the funds transfer is not between different accounts at different banks but between different accounts at the same bank.

The second condition, the geographical dispersion of Canadian banks, also permits transit items, those checks drawn on other institutions, to be collected overnight at low cost. This is made possible because presentment for

collection at any branch office of a bank is permitted, even if the payor's account is physically located at a branch office distant from where the check was deposited.

In the U.S., on the other hand, interstate and intrastate bank branching prohibitions and regulations requiring presentment at each of 15,023 head offices or 40,808 branches of these banks make for a slow, cumbersome and expensive system of exchanges. Each transit item in the U.S. is handled an average of 2.74 times, and the Federal Reserve has found it necessary to establish 48 check processing offices nationwide, since no commercial bank may branch nationwide.

The importance of the third condition, equal shares, is that the principals to the negotiation have roughly equal stakes in its success. The overall loss in float benefits by one bank's retail payor customers, through a same-day debit to their account for the checks they wrote to payees of different banks, is basically offset by the improved availability these customers receive when they are payees and deposit checks drawn on other institutions. The customers of one bank are not disadvantaged relative to customers at another bank.

The Canadian negotiated solution to the check float problem is not unlike that of the new ACH Corporate Trade Payment (CTP) program in the U.S. today. When only a few payors and payees are involved, and especially when any real resource cost savings can be captured by these same parties, there has been sucessful negotiation regarding the benefits of check float among the participants enabling them to substitute cost effective ACH payments for checks. In the CTP program, the participants have:

1) Calculated the average float obtained from check disbursements between themselves;

2) Agreed to alter their trade credit terms to one another to offset the float benefits lost by using ACH transfers in place of checks; and

3) Saved real resources by automating their internal processing of accounts payable and receivable by placing accounting, invoice, and posting information in the addenda records to ACH payment files.[4]

While ACH processing of payment information can be cheaper than writing, disbursing, and otherwise handling checks, as seen in Table 2 above, this is not where significant real resources are saved. The important savings come from automating the other related payment/accounting/posting operations associated with the complete processing of payment information. The CTP program does not substantially alter the current distribution of check float benefits between payee and payor so that institutional change could occur.

In sum, the evidence presented in this section has shown that the existence of large amounts of check float encourages the overuse of checks. This incentive is unlikely to be reversed by technological change since the real resource costs are less than the float benefits of check usage. Check truncation with electronic collection via ACH is a possible socially beneficial substitution of electronics for checks at the "back-office" level which requires no or only a small change in consumer behavior. However, this is unlikely to occur without institutional changes within the banking industry which will make a negotiated settlement of interbank float costs and benefits cost-effective and where the otherwise external benefits can be internalized. Finally, the problem of check float is unique to the U.S. Other nations (Europe, Japan) do not use checks so frequently and Canada, which is dominated by a few large, nationwide banks, has solved the problem through interbank negotiation. Again, such negotiation seems unlikely in the U.S. given the present institutional structure.

IV. Types of Institutional Changes That May Lead to Increased Use of Electronic Payments Without Interstate Banking.

In this section, we examine institutional changes that could induce significant substituion into electronic payments, without requiring a change in

the current banking structure (which is covered in the next section). Four possible institutional changes are:

(1) Change the legal rights and liabilities regarding check payments, so that check payors (or their banks) could be charged directly by payees or collecting banks for the processing and collection float they create by using checks;

(2) Widespread adoption of merchant handling and float charges differentiated by payment form, especially surcharges for checks and credit cards. This would reduce or eliminate the current cross-subsidization of check and credit card users through higher and undifferentiated prices to all consumers regardless of the payment method used;

(3) Widespread installation of POS systems by merchants to facilitate the use of debit cards in place of cash, checks, credit cards, money orders, and travelers checks; and

(4) Adoption, by businesses, of the ACH Corporate Trade Payments program for most business-to-business payments, where the distribution of check float benefits are unchanged but the cost-reducing benefits of electronic payments can still be realized.

The first institutional change would affect all check payments by all types of users, the second and third changes would affect consumer payments to business, which account for 49 percent of all check payments, and the fourth institutional change would impact business-to-business payments which account for 23 percent of check payments--see Figure 1.

Looked at from another perspective, all the listed institutional changes except the fourth involve a redistribution of float costs. In the first change, payee check float expenses are shifted to the check payor, reducing the float benefits of check use. In the second case, check and credit card float costs are redistributed away from payors using cash and other "no float" payment methods to the check and credit card payors who create the float. Similarly, when float is not priced in the market place, the third institutional change, making POS more easily available, eliminates the float benefits to check writers

and credit card users who switch to POS and distributes these benefits (actually removes the associated costs) to all users of no float instruments.

Changing the Uniform Commercial Code (UCC). Changing the UCC to charge payors (or payor banks) for interbank float would reduce, but not eliminate, the float incentives for writing checks. Use of checks would continue to create mail float and float from payee delay in depositing the checks. In terms of our demand and supply model, equations (1) - (4), this adjustment to the UCC would reduce the float transfer payment on checks, (FTP) from payees to payors. This would reduce the prices of goods and services (P(M)), by merchants who do not price differentiate by payment means, which would also reduce the subsidy to check users financed by the tax on non-check users.

When Federal Reserve payment services were being priced, in response to the Monetary Control Act of 1980 (MCA), serious thought was given to assessing payor banks the float costs absorbed by Reserve Banks in processing and collecting checks. Federal Reserve float had reached a maximum of $6.5 billion a day in 1979, with an opportunity cost of $770 million a year to federal taxpayers. This is small compared to recent estimates of total daily check float (which includes mail float, payee delay in depositing checks, delays in bank collection, and Federal Reserve float) of $380 billion (Dudley, 1983, p. 11), with an opportunity cost of $33 billion a year (see Table 2). Nevertheless, charging the payor for Federal Reserve float would have provided a strong and direct stimulus for certain check users, primarily businesses who write checks for relatively large dollar amounts, to develop and utilize alternative electronic payment methods.

Unfortunately, after extensive legal analysis, it was concluded that a sufficiently strong legal case could not be made for charging the payors. This was inspite of the fact that a strong economic argument could be made for charging

the payor as the float's beneficiary. The UCC, as written and interpreted by the courts, instead supported a float cost charge on the collecting bank (and payee), not on the paying bank (and payor). From a legal point of view, Reserve Banks were seen to be providing a processing and collection service to the collecting bank, not the paying bank, so the legal rationale for shifting float costs to payors was weak.[5] Past efforts to alter the UCC regarding different issues suggest that any attempts to expressly permit collecting banks to charge payors the cost of check float would be very difficult to achieve. While changing the UCC would be the most straightforward method to remove the wedge between the user and social costs of checks to correct this market failure, it is unlikely to be sucessful, especially considering the pressure which would be brought to bear by those who currently benefit from float.

Changing Retail Pricing Practices. For large dollar inter-corporate or financial transactions, it is customary to negotiate the method and timing of payment. For small-to-moderate dollar value retail transactions, however, another custom has evolved. For these transactions, the cost of direct negotiation is prohibitively high and price differentiation by payment means is viewed as competitively disadvantageous, so merchants have chosen to fold their float costs and payment handling costs into a single price for the good or service being sold.

The differences between float and handling cost for different payments instruments can be substantial. Firms that accept checks and credit cards for payment require greater working capital to finance the float they absorb and incur higher labor costs for the extra time spent in handling these transactions. For example, supermarkets must keep extra checkout lines staffed because validation of checks takes so much longer than cash. In addition, merchants that accept

provisional funds also bear more risk and often must pay outside agents (e.g. Telecheck, VISA) to absorb risk and handle some of the additional paperwork and payments processing.

In terms of our demand and supply model, merchants who do not price differentiate among payment instruments set the merchant handling and float charge equal for all instruments: $MHFC_i$ = MHFC for all i, and all customers pay P(M) = P(G&S) + MHFC. We assume that merchants attempt to pass all these costs forward at the margin to customers, so that MHFC is set to recover all marginal handling and float costs $MHFC = \sum n_i (MHC_i + FTP_i)$, where n_i is the proportion of customers using instrument i.

To see the "market failure" in this arrangement, simply note that the merchant payees are not neutral with respect to the payee's choice of payment instrument. Merchants lose money, i.e., make less than a normal profit, on check and credit card customers and have to make it up with super-normal profits on cash and electronic payment payors. Without price differentiation by payment means or some other inducement, merchants cannot optimize over all the transactions. Instead, merchants "tax" customers
using low-float, low-handling cost instruments like cash and electronics, where $MHFC > MHC_i + FTP_i$, in order to subsidize users of high-float, high-handling cost instruments like checks and credit cards, where $MHFC < MHC_i + FTP_i$. As a result, payors are given an incorrect market signal to overuse these relatively costly payment forms.

We assume in our model that the float and handling costs of payment are "assessed" to customers in the form of higher prices. In fact, the "incidence" of some of these costs may be absorbed by the merchant payees themselves or their suppliers. How much of the float costs and handling costs

are ultimately passed forward to purchasers or backward to their suppliers depends on the elasticities of demand and supply, both between the purchasers and the merchant and between the merchant and his suppliers. In addition, merchants themselves are assessed float benefits when their suppliers, especially employees, accept (with indifference) payment by check. While no one has actually determined the true incidence of float and handling taxes imposed by check and credit card use, it seems likely that 1) retail merchants have been assessed more float and handling costs than they have assessed on their suppliers, and 2) a large portion of the incidence of the net float and handling costs are passed forward and reflected in retail prices.

Our point is not that most or all of the retailer's handling and float costs have been passed on in price increases over time. It would in fact be efficient to pass all of the float costs on to the beneficiaries, the check and credit card users. Our point is that <u>because</u> these price increases have usually not discriminated between consumers who use different types of payment methods, purchases by cash or electronics are made more expensive since no float is obtained by payors to offset the price rise instituted by payees. In this sense, efficient payment method users have been cross-subsidizing users of inefficient methods. Merchant pricing practices <u>encourage</u> the use of socially inefficient payment forms.

Some investigation has been made into the relative costs of various payments methods. Unfortunately, in these discussions, the focus has only been on the relative real resource cost to merchants, MHC in our model (Board of Governors of the Federal Reserve System, 1983). Float costs borne by the merchant, (FTP), were not directly estimated. In addition, the costs of different payment methods to society as a whole were not ascertained. Only the merchant's costs

have been estimated, without regard to their assessment or incidence on payment users or supplier.

Some price diffentiation by payment method occurs today but it is not widespread. Price discounts exist at some gas stations when cash is used rather than a credit card while other retail establishments refuse to accept checks or impose cumbersome credit verification procedures as nonprice barriers. Still other merchants apply minimum purchase requirements for check or credit cards. Many of the legal issues regarding premiums and discounts for users of different payment forms are as yet not fully resolved.[6]

Expanding the Availability of POS. Point-of-Sale systems with debit cards have been in place for more than a decade now, but their use is still restricted. Only about 100,000 POS terminals are in place nationwide. If POS terminals were made available to consumers on a widespread basis, there is a reasonable likelihood that these would be frequently used in place of cash, checks, and credit cards. In terms of our demand and supply model, making POS available is equivalent to lowering its supply price, P(S), from its current infinite level (when it is not available) to a level more or less in line with unit costs.

The problem with setting up POS systems with widespread consumer access is that the benefits are spread over a large number of banks and stores. Internalizing these external benefits properly requires negotiation among these many participants. Difficulty of negotiation and uncertainty of use has prevented widespread diffusion of this technology to date.

Given today's banking structure, the logical choices for organizing POS networks are either interstate-branching chains of retail outlets, such as 7-11 stores, or payment service corporations such as VISA. Such networks may have limited success, however. There is a danger that individual banks who

control the customer accounts may try to extract too much rent from the system by raising fees for its use. A similar pattern seems to be occuring presently, where some banks are charging a 75 cent fee to customers for using their ATM cards at another bank's terminal. As long as banks continue to have monopoly access to Federal Reserve payment settlement facilities, their negotiated cooperation will be required for any expansion of electronic payments to be successful. As long as the present banking structure remains, there will always be such difficulties of agreement.

Changing Business Payment Practices. Business use of electronic payments via the ACH through the Corporate Trade Payments program has been encouraging. Participation in the program requires negotiation of terms and requires that businesses run both a paper and an electronic payments/accounting system during the transition period. Nevertheless, the CTP program offers significant cost savings to all participants after a large number of business payments are converted. The problem is that the costs of converting to electronic disbursement and receipt of business payments and the costs of running a dual (paper and electronic) system during a long transition period are worthwhile only if they can be offset by actually receiving most business payments in electonic form. Therefore, most or all business payments will have to be in electronic form in order for each sender to effectively internalize what are now external benefits given to receivers. This will require a high participation rate by businesses in the CTP program. It is now too early to determine whether or not this condition will be met in either the near or the distant future.

Of the four institutional changes discussed, only the last three have (in our judgement) a reasonable probability of future success. The CTP program is viewed to be the most likely future route of these three to substantially in-

crease use of electronic payments. While these changes may come about of their own accord, there is an additional institutional change which can by itself greatly expand the use of electronic payments and, in addition, serve as a catalyst to induce merchants to price diffentiate by payment instrument, to install POS systems, and help expand the CTP program. This change is interstate banking.

V. Interstate Banking Structure and the Future Use of Electronic Payments.

There are about 15,000 commercial banks in the U.S., far more per capita than other nations, due to restrictions on within-state and interstate branching.[7] Canada has only one one-hundredth the bank density of the U.S., with about one-tenth the population and deposits, but fewer than 15 domestically chartered commercial banks. The next 10 to 15 years will likely bring an end to much of this disparity, primarily through mergers among existing U.S. institutions, as banking deregulation continues and interstate banking becomes possible.[8] Limited regional interstate banking is in fact now underway in certain parts of the U.S. As well, the recent expansion of so-called "nonbank banks" across state lines is in part another expression interest in interstate branching of financial institutions.[9]

This section explores the possible, and, in some cases likely, roles of interstate banking in the diffusion of electronic payments technology. The first and surest result of interstate banking on electronic payments will be a reduction in the float benefits from checkwriting, as the banking industry becomes more concentrated, with larger and more geographically dispersed correspondent banks. Second, and of greater potential importance, is a widespread adoption of check truncation with interbank funds collection via ACH. This would substantially boost ACH processing output, allowing for exploitation of scale and scope economies. Of greatest importance in the latter category would

be cost reduction for the Corporate Trade Payments ACH program. Large interstate banks may also internalize externalities better than current banks. They may encourage POS expansion, encourage merchants to price-differentiate by payments method, and encourage use of electronics by temporarily subsidizing electronics and taxing checks and credit cards.

Reduction of Float. The large number of banks in the United States requires a complex and costly payments system. Of the roughly 40 billion checks deposited by bank customers annually, about 70 percent are items drawn on other banks. These must be physically sorted, transported and presented to one of the other 15,000 banks before funds are transferred to the collecting bank. As noted earlier, some collectors expedite this process at significant real resource cost in order to avoid overnight float costs while some payors invest real resources in attempts to delay payments and create check float benefits. The Federal Reserve, the nation's only unrestricted interstate "correspondent bank", maintains 48 offices located nationwide for processing, transporting, and clearing checks, and these offices compete with numerous regional correspondent banks and service bureaus. The typical externally processed check (checks other than on-us or local clearinghouse items) is handled 2.74 times, with the Federal Reserve participating in the handling of about one-half of these items.

Bank mergers pursuant to interstate banking will significantly impact check processing markets because:

- More checks will become "on-us" or non-transit items as the banking industry becomes more concentrated with larger participants, so that fewer will require any external processing (being transfers among accounts within a single bank); and
- Those items requiring external processing--transfers between accounts located at different banks--will require fewer handlings as the larger and more geographically dispersed banks are able to transport and exchange items more efficiently through direct presentments and clearinghouse exchanges.

A simple measure of the net impact of these two market changes is the reduction in Federal Reserve market share (an inverse measure of the private-sector share). Detailed, accurate data exist on current Federal Reserve volume, while little consistent information is available on the current characteristics and distribution of volumes across different private-sector clearing arrangements. We therefore model the effect of interstate banking on the various components of the Federal Reserve's payments market share (Berger, Humphrey, and Frodin, 1985). These results are combined with independent information to infer the effect on private-sector clearing arrangements, so that all segments of the check payments market are covered.

Three dimensions of banking market structure that will change under interstate banking that are relevant to the payments market are:

1. Bank Deposit Concentration (measured by a Herfindahl index). More concentration will reduce the total number of externally processed (check plus electronic) payments.

2. Bank Deposit Mass (measured by average bank deposits and average bank office deposits). Larger banks and larger bank offices can take better advantage of scale and scope economies in processing and transportation.

3. Bank Geographical Dispersion (measured inversely by the proportion of all local banks' deposits that are located locally). Expanded branching into different locations can expedite incoming transportation and expand use of local clearinghouse exchanges for out-of-town items.

Our methodology uses existing cross-section data on banking structure (concentration, mass, and dispersion) and Federal Reserve and non-Federal Reserve check volumes to predict how the nation's payments system will look under full interstate bank branching, assuming that conventional collection methods continue to be used. All the information is sorted by the 48 Federal Reserve check clearing zones to provide a cross-section data set. The endogeneous variables to be explained are the proportions of checks deposited in each of 48 zones

that are drawn on banks within and outside of the zone, and given these proportions, in which of the seven ways the checks will be cleared (five ways through the Federal Reserve plus two methods that do not use the Federal Reserve). Multinomial Conditional Logit methods are used to predict the probabilities that checks will be cleared in each of these seven ways as functions of the banking structure variables and some demographic indices.

Several future interstate banking scenarios are simulated, each with its own implications for U.S. banking structure. The banking structures of California, New York State, and Canada are alternatively assumed to prevail in each of the 48 zones, with an allowance made in each case for some banks to operate on a nationwide basis. Simulations of the estimated model with California, New York, and Canadian data produce estimates of Federal Reserve check volume losses of 43, 60, and 93 percent, respectively. The California simulation example, which we believe best represents the likely outcome of interstate banking, is combined with independent estimates of the breakdown between internally and externally processed items.

The results provide some indication of the reduction in number of handlings and associated expenses that might result from interstate banking with conventional collection of check funds through presentment of the physical items at the payor bank. The large drop in the number of handlings implies a substantial reduction in interbank float. An upper bound to the reduction in the value of float benefits for checkwriters would be about $5 billion annually (out of $33 billion total check float). This would increase the user price of checks from -15 cents to -2 cents—see Table 2. This average increase of 13 cents in the cost of check writing should lead to a decrease in the number of checks written. This would be especially true for large dollar items, which

are frequently written primarily to gain float benefits.

Check Truncation with Electronic Collection. The institutional changes discussed thus far would increase the use of electronic payments by changing user prices to encourage substitution. Unfortunately, consumer habits and customs are subject to considerable inertia that often requires population growth and shifts in the age structure of the population to overcome substantially. Our major thesis, simply put, is that the electronics revolution is most likely to begin at the "back office" level, with banks collecting check payment funds electronically through ACH, and that this first revolutionary step will not take place until interstate banking begins in earnest.[10]

The only change required of retail banking customers in this back-office revolution is that a substantial proportion accept check safekeeping (where canceled checks are not returned to the payor). This requirement is likely to be met whether or not interstate banking occurs. Valley National Bank of Arizona, for example, has convinced nearly half of its customers to accept safekeeping by convincing them of the increased convenience and safety of having the bank store their canceled checks and provide legal proof of payment (when needed). The $7 per customer per year estimated savings in handling and postage expenses should provide sufficient incentives for banks to persuade their customers to accept safekeeping, by advertising its convenience to the consumer or by reducing fees.

As discussed earlier, given that customers accept check safekeeping, interbank collection of funds by ACH is nearly as cost-effective as conventional collection of an average transit item today. Truncation is now cheaper currently for most transit items that require greater than average handling. Given the scale economies estimated for ACH and the constant average costs found for check

processing, if most or all transit checks were cleared today by ACH then check truncation would be very cost-effective.

Nevertheless, check truncation using ACH is unlikely to occur in todays' institutional environment. The payor and his bank are required to give up float benefits and the right to inspect the item and verify the signature. The structure of the banking industry makes negotiating away these benefits prohibitively expensive. Interstate banking will change this. As explained above, our empirical estimates suggest that the external processing of check payments will be concentrated into fewer, larger, and more geographically dispersed correspondent banks, with a reduction in the Federal Reserve's role in check processing. These large correspondents can internalize the externalites and reduce negotiation costs for truncation.

We envision more or less the following stylized form for interstate banking. Each correspondent correspondent and its respondents together will form an efficient network for payments collection and negotiation of float benefits and costs. The correspondent would negotiate one-on-one with each respondent on behalf of all its other respondents. The respondent will be asked (1) to offer check safekeeping to its customers and (2) to allow all of its payor items collected through the correspondent to be truncated (either by the correspondent or another bank upstream in the collection flow). The respondent would be debited and receive information on its payor items through ACH or receive a single daily debit to a correspondent account with the payment data delivered electronically or provided on a magnetic tape from the correspondent. In exchange for giving up some float and legal rights on its payor items, the respondent would receive float and collection cost benefits of truncating or having its correspondent truncate the checks drawn on all reciprocating banks in addition

to the benefits of check safekeeping. Assuming that the respondent has roughly equal values of payor and collection items, it is neutral with respect to the net impact of the float redistribution and would agree to split the real resource savings of truncation between itself and the correspondent bank. Note that one-on-one negotiations between one correpondent and n individual respondents reduces the number of negotiated agreements needed by $n(n-1)/2$, for $n > 2$.

The other half of this scenario concerns the agreements to truncate among correspondent banks. We envision correspondents agreeing bilaterally to electronic direct exchanges, truncating items drawn on each other, including the items of all their respondents. This would be similar to the current relations among Canadian banks, where agreements are made to exchange items overnight without creating float. A critical difference, however is that the U.S. system would be electronic while Canada may remain paper-based. The reason for this difference is that we envision the United States as continuing to have hundreds, if not thousands of banks, while Canada has fewer than 15 domestically chartered banks. Electronics is only a cost-effective substitute for the more complex external handling of paper items required for U.S. banks. In addition, the physical exchange of items in Canada is relatively more efficient than in the U.S. because virtually all Canadian bank branches lie in the compact, 100-mile wide geographical interval congruent to the U.S., whereas U.S. banks are spread over a considerably wider north-south interval of the same length.

A further possibility that would complete a nationwide system of truncation and electronic check collection would be a set of national correspondent banks. A group of perhaps 10 to 15 "nationwide" banks would have at least one representative in each city's electronic clearinghouse. These national correspondent banks would form a network overlaying the other correspondent networks.

Each regional correspondent would agree to truncation arrangements with at least one of these national correspondent banks. These national correspondent banks in turn would reach truncation agreements among themselves. This completes a system in which almost every bank could truncate items or have its correspondent bank truncate items drawn on almost every bank in the United States.

Other Impacts of Interstate Banking on the Use of Electronic Payments. There are several ways in which interstate banking might also promote the retail use of electronic payments. First, as mentioned earlier, the difficulty with widespread installation of POS systems is the required negotiation between many banks and retail outlets. Interstate banking could substantially reduce this problem. Large, well-branched banks could simply set up their own systems and franchise their access to smaller banks.

Second, large interstate banks may internalize some of the externalities of the current market failure in payments pricing and induce merchants to differentiate prices by payment method. Banks may do so directly by offering generally lower fees to merchants who price-differentiate as a subsidy. Alternatively, banks may adjust their fee schedules for processing merchants' payments, so that cash and electronic payments are processed and sold for less than cost and checks and credit cards are processed and sold for higher than cost. This would accentuate the merchants' opportunity costs of uniform pricing.

Finally, large interstate banks may become sufficiently far-sighted to encourage the electronics revolution at the retail customer level by subsidizing electronic payments like POS and financing the subsidy by a "tax" on checks and credit cards. In terms of our demand and supply model, banks would set the multiplicative markup factor $m < 1$ on POS and $m > 1$ on checks and credit cards. Currently, $m < 1$ almost universally on checks and credit cards

and often $m = 0$. This occurs when banks do not charge per-transaction fees adequate to cover costs, but make up the losses on balance requirements or periodic fees. This encourages overuse of checks and credit cards by those who have them. Large interstate banks would likely correct this under-pricing and perhaps even over-price check and credit card transactions in the short run in the interest of long-run efficiency.

Footnotes

1. Occasionally, checks are used for high value transactions, as also occurs in the ACH. The classification shown is meant to be general, and not cover every case which has occurred.

2. Walker (1980) estimated both a log-linear total cost equation and a cubic equation (not in logs). The log linear version assumed that the SCE was a constant at all output levels and gave SCE = .26. The unlogged cubic equation gave SCE = .49 when evaluated at the mean of the data set.

3. The extreme disaggregation of the U.S. banking system is illustrated by noting that the largest bank only accounts for 4 percent of total domestic U.S. banking assets, the largest 14 banks account for 25 percent of banking assets, while it takes 78 banks to account for 50 percent of assets.

4. Normal ACH payment information contains only the identification of the paying and receiving financial institution along with the date and amount of the payment. In the CTP program, additional information on the corporate paying and receiving institutions are added, such as the amount and number of different invoices for which total payment is being made and other information regarding trade credit, late delivery, and returned goods which affect the payment value.

5. A different legal interpretation, however, may hold when paying banks return checks to payees because of insufficient funds in the payor's account. Here Reserve Banks are providing a service at the request of the paying bank, so that both return item processing fees and float costs could in principle be assessed on the paying bank. Over 1 percent of all checks written are returned unpaid (some 85 percent of the returned checks are due to insufficient funds in the payor's account).

6. In 1984, it was illegal to assess a surcharge on purchases by credit card, although a price discount to noncredit card users was not prohibited. Today a surcharge is legal but is subject to Truth in Lending Act restrictions applying to finance changes and, for that reason, has been little used by merchants. In Congress, the Senate has passed a bill stipulating that price differences between users of different payment methods of up to 5 percent of the purchase price could exist without Truth in Lending Act restrictions. The House, however, is attempting to reinstitute the lapsed ban on surcharges. This controversy exists even though the effect on the relative prices faced by consumers would be the same with a surcharge for credit cards or a discount for other payment methods. Merchants, of course, favor the surcharge (since their advertised prices could stay the same or perhaps be lowered), while credit card issuers prefer the discount to a surcharge (since credit card users would not be as explicitly penalized, although merchants would be required to raise all prices to offset the discount--a difficult thing to do in a competitive market).

7. Along with more than 14,000 commercial banks, there are 24,000 other types of depository institutions (savings and loan associations, mutual savings banks, and credit unions) which also participate in the payments system.

8. Mergers have historically been preferred to de novo entry--establishing new coming) has shown that mergers have accounted for 72 percent of the current size of the 20 largest U.S. banking organizations. In this context, mergers between large banks are more likely than mergers between small banks or between large and small banks so bank concentration, when it does increase, can increase rapidly.

9. A "non-bank" bank is a bank which does not take deposits (but instead uses equity or nondeposit funds) or a bank which does not make commercial loans. Since the legal definition of a bank for purposes of the interstate banking restrictions concerns an institution which both takes deposits and makes commercial loans, institutions which do one but not the other are not subject to interstate banking restrictions as currently written.

10. Although still in the discussion stage, it is possible that widespread check truncation will occur prior to interstate banking. The Federal Reserve may begin truncating items at the Reserve Bank of last, and eventually first deposit using the current ACH network. Such a development, coordinated with the current ABA check truncation pilot program would have a major impact on electronic payments since around one-half of all checks requiring external processing are currently handled by the Federal Reserve.

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