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The Public Policy Implications of State Laws Pertaining to Automated Teller Machines

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In the early 1970s, as automated teller machines (ATMs) were beginning to grow in popularity, some states instituted mandatory sharing laws, whereby ATM-owning banks were required to share their ATMs with any other bank that wished to do so. It was perceived that ATM technology was subject to significant economies of scale, and it was thought that these laws would increase small bank customers' access to ATM services. Empirical tests in this paper reject the hypothesis that mandatory sharing increases the level of ATM services for small bank customers and show that mandatory sharing may in some cases decrease the level of ATM services for all *bank customers. It also is shown that, under certain conditions, branching restrictions may have negative effects on the supply of ATM services.*

In the early 1970s the automated teller machine (ATM) was introduced, enabling people to perform banking transactions such as cash withdrawals, deposits, balance inquiries, and interaccount transfers without the aid of a human teller. By the mid-1970s, banks had started sharing ATMs, allowing other banks' customers access to their machines.[1] Beginning at this time, too, certain states instituted *mandatory* sharing laws, which *required* that any ATM-owning institution share its off-premise machines for a "reasonable fee" with any other financial institution in the state that wanted to share. The intent of such laws was to ensure that customers of small banks would have access to ATMs, despite ATM systems being subject to significant economies of scale. In this paper, I will investigate whether there is any empirical evidence that mandatory sharing laws have been successful in this regard.

I will begin with a general discussion of the market for ATM services, economies of scale in ATM networks, and the legal environment surrounding ATMs before proceeding to the empirical analysis.

I. The Demand for and Supply of ATM Services

The Demand for ATM Services

According to one estimate, 137.7 million ATM cards were outstanding in July 1988.[2] Estimates of the percentage of households that own at least one ATM card run from 45 percent[3] to 54 percent.[4] The group that reports the 54 percent figure states that, as a comparison, 76 percent of households have at least one credit card.[5] ATM use has been increasing over time, and now, for the first time, more than 50 percent of all cardholders use their cards at least once a month.[6]

Whether a customer of a particular bank will choose to obtain transactions services from an ATM or a teller partially will depend on the direct charges the customer faces when using the two procedures. For example, a customer may face a choice between paying 25 cents to use the bank's ATM or paying 10 cents to cash a check through a teller.[7]

In addition to the levels of direct ATM and teller use charges, the convenience of using an ATM versus a teller will influence a bank customer's decision. Whether a particular customer will choose an ATM or a teller will depend on such factors as the value of the time and the effort that the customer needs to contribute in order to get to and use an ATM or a teller. The decision also will depend on the customer's attitudes and tastes regarding, for example, computers versus human interaction.

Apparently, age and income are determining factors in the choice between ATMs and human tellers. A typical ATM user is under 40 and uses an ATM three to four times a month, on average. Very heavy ATM users, those who use the machines as often as three times a week or more, are apt to be between 18 and 24 years of age.[8] A 1986 survey revealed that the percentage of families with less than $10,000 in yearly income that owned ATM access cards was 32 percent. This percentage increased with income, up to 60 percent for those earning $50,000 or more a year. However, the survey also revealed that those families in the lowest and highest income categories were the most frequent *users* of ATMs, at least for the purpose of withdrawing cash.[9]

The Supply of ATM Services

ATM industry observers have cited at least two reasons a bank might choose to offer ATM services to its customers. First, banks may introduce ATMs to increase market share. In a market where ATMs are not prevalent, or ATM networks are not extensive, a bank may be able to differentiate its services from those of other banks and thereby attract new customers. For example, one East Coast bank attributes the increase in its statewide share of checking and NOW accounts from 16 percent in 1984 to 19 percent in 1988 to its extensive ATM network. An executive vice president of the bank claims that the ATM network is one of the two factors people mention most often as reasons for banking with that bank.[10]

This bank's experience raises the possibility that some banks may adopt ATMs even if the per transaction cost is higher with ATMs than with tellers. ATMs raise the value of transactions services by, for instance, lowering the "time tax" that customers face when they carry out bank transactions. If this attracts new customers, it can lead to economies of scale in some other aspect of bank operations besides transactions services. However, given the ubiquity of ATMs, it seems unlikely that this is the primary means by which ATMs increase profitability for most banks.

A second, and more important, reason banks might choose to install ATMs is that, above a certain level of operations, the cost of a single transaction performed at an ATM potentially is less than the cost of a transaction conducted at a teller window.[11] This is because ATMs are capable of handling more transactions per unit of time than are tellers.

However, Allen Berger has found that the cost *per dollar* withdrawn is significantly higher for ATM withdrawals than for withdrawals conducted at a teller window.[12] This is because ATMs are sufficiently more convenient than tellers that customers tend to make more frequent trips and withdraw smaller amounts each time than they would if they had to use tellers. Despite this, ATMs still are attractive to banks as long as the price per transaction is lower and banks are able to cover the cost of transactions by charging transactions fees.

The per-transaction cost of ATMs apparently is subject to significant economies of scale, due to the relatively high fixed cost of installing and operating an ATM system. Purchasing and installing an ATM costs about $25,000 to $30,000. Moreover, armored car services and data processing can add $200,000 a year to the operating cost of an ATM system.[13] In light of these high fixed costs, Walker (1980) estimated that economies of scale associated with ATM transactions in a network of ATMs are realized up to at least 43,600 transactions per month per ATM.[14] This number should be interpreted with some caution, however, because Walker's cost data were from early 1974, a time when sharing of ATMs was not very prevalent. Therefore, this may be a better measure of

economies of scale for proprietary ATM networks that are used by only one bank's customers than for shared ATM systems.

Shared ATM Networks

Some have claimed that the economies of scale in ATM systems help to explain the rise of shared ATM networks. A shared network is a collection of ATMs that are owned by different banks but can be used by any customer of any bank in the network.[15] By spreading the fixed cost associated with ATMs over transactions initiated by customers of many different banks, a shared network can take advantage of economies of scale.

Shared networks also may be attractive because they increase the convenience of ATMs by enabling a given bank's customers to carry out banking transactions over a wider geographic area than would be possible with a proprietary network.[16] This factor may be particularly attractive to banks in states that place geographic restrictions on branching and the placement of ATMs.

Statistics show that ATMs more often than not are shared, and that customers take advantage of shared machines. In 1987, 75 percent of the banks that operated ATMs shared them with other institutions,[17] and in 1988, 90 percent of the ATM terminals in the U.S. were shared with at least one other institution.[18] A 1986 survey found that about 28 percent of families with ATM cards used another institution's ATMs.[19] ATM sharing also has been growing over time, as shown in Table 1.[20]

It is important to note, moreover, that banks form shared networks even in states that do not require sharing. In 1983, 23 states had mandatory sharing laws, yet *every* state had banks or other financial institutions that belonged to shared networks.

Banks that participate in a shared network pay fees to the network owners to cover the various costs of the network's operation. These costs include the costs of transferring "foreign" transactions, those transactions that are carried out by one bank's customers on another bank's ATMs. Such transactions are commonly sent through a central "switch," in which case the ATM-owning institution pays a "switch fee" to the network. In addition, "interchange fees" are paid by the card-issuing bank to the ATM-owning bank.

The fees charged by a given network depend on two countervailing factors. On the one hand, economies of scale associated with high transactions volume should help to keep network fees low. There appears to be some evidence that networks do, in fact, pass on cost savings resulting from economies of scale. For instance, the *American Banker* recently reported that increased transaction volume at many of the nation's largest regional networks has enabled them to reduce fees to network members. Last year, interchange fees averaged 15 to 20 cents per transaction, but are now running around five to 10 cents.[21]

On the other hand, network costs may rise as the number of network members rises, and this could partially offset cost savings from economies of scale in transaction volume. As the number of network members rises, costly telecommunications technology is needed, and negotiat-

Table 1
The Growing Importance of ATMs

Year	ATMs	Trans.* Per Month	Trans.* Per Mon. Per ATM	ATM Growth	Trans.* Growth	% of ATMs Shared
1978	9750	41.0	4204	NA	NA	NA
1979	13800	63.5	4603	41.5%	54.9%	NA
1980	18500	100.0	5408	34.1%	57.5%	16%
1981	25790	135.0	5235	39.4%	35.0%	23%
1982	33000	167.0	5060	28.0%	23.7%	33%
1983	40000	200.0	5000	21.2%	19.8%	40%
1984	55000	261.0	4745	37.5%	30.5%	46%
1985	60000	296.0	4933	9.1%	13.4%	59%
1986	64000	301.0	4703	6.7%	1.7%	76%
1987	68000	335.3	4930	6.3%	11.4%	81%
1988	72492	375.3	5177	6.6%	11.9%	90%

*Transactions in millions.
Source: *Bank Network News.*

Table 2
Switch Fees, By Volume
(Cents Per Transaction Sent Through Switch)

	Monthly Switched Transactions				
	Less than 100,000	100,000–250,000	250,001–500,000	500,000–1,000,000	More than 1,000,000
Minimum Switch Fee	5	3	9	10	6
Maximum Switch Fee	65	25	50	80	40
Average Switch Fee	24	18	20	24	17

Source: *Retail EFT Advisor,* Transdata Corp., September/October 1987.
Note: Figures are approximate.

ing costs and the costs associated with settling accounts among institutions also rise. Given that networks with high transaction volume also may have many members, it is not surprising that some fees apparently do not vary much with transactions volume. As Table 2 shows, the average switch fee across five different volume classes is very close to 20 cents a transaction.

These observations suggest that the marginal cost of adding a small bank to a shared network could outweigh the marginal benefit this bank would contribute by way of increased transaction volume. As a result, even with the existence of sharing, small banks are less likely than are large banks to own and operate ATMs. Table 3 shows that, indeed, relatively few small banks own and operate ATMs, and the small banks that do own ATMs own fewer terminals, on average, than do larger banks.

Table 3

ATMs Operated and Shared

(By Asset Size, $ Million)
(Mid-Year 1987)

	Less Than 50	50–100	100–500	500–1,000	1,000 or More
(1) % Banks Operating ATMs*	31.0%	76.7%	96.0%	99.0%	99.0%
(2) Average Number of ATMs Operated*	2.2	21.2	82.6	133.3	320.8

Source: *1987 Retail Deposit Services Report,* American Bankers Association, 1987.
*Included are ATMs that are shared, as well as those that are not.

Table 4

State Sharing Laws, ATM Placement Laws and Traditional Branching Laws, 1983

State	Sharing of ATMs Between like Institutions[1]	In-State Placement Limitations[1]	Type of Traditional Branching[2]
Alabama	Permitted	Statewide	Limited
Alaska	No statute	Statewide	Statewide
Arizona	n/a	n/a	Statewide
Arkansas	Mandatory	Countywide	Limited
California	Permitted	Statewide	Statewide
Colorado	Permitted	Statewide	Unit
Connecticut	Mandatory	Statewide	Statewide
Delaware	Permitted	Statewide	Statewide
Florida	Permitted	Statewide	Statewide
Georgia	Permitted	Countywide	Limited
Hawaii	Mandatory	Statewide	Statewide
Idaho	Mandatory	Statewide	Statewide
Illinois	Mandatory	County and contiguous county	Unit
Indiana	No statute	Countywide	Limited
Iowa	Mandatory	Statewide	Limited
Kansas	Mandatory	Statewide	Unit
Kentucky	Permitted	Countywide	Limited
Louisiana	Permitted	Statewide (if shared)	Limited
Maine	Mandatory	Statewide	Statewide
Maryland	No statute	Statewide	Statewide
Massachusetts	Mandatory	Statewide	Limited
Michigan	Mandatory	Statewide	Limited
Minnesota	Mandatory	Statewide	Limited
Mississippi	No statute	May be placed within or adjacent to corporate limits of any municipality or metropolitan area in which bank, branch bank, or branch office is located.	Limited

II. Mandatory Sharing Laws and ATM Branching Laws

The discussion in the preceding section suggests that the economics of shared ATM networks discourages the participation of smaller banks. The perception that smaller banks have more limited access to shared ATM networks may explain why a number of states have adopted mandatory sharing laws. Table 4 shows that as of September 1983, 23 states had instituted some sort of mandatory sharing, whereby banks *must* share their ATMs with any other in-state financial institution that wishes to do so and is willing to pay a reasonable fee.[22]

Many of the mandatory sharing statutes do not specify the level of payments which may "reasonably" be required of banks wishing to join a network. This is an important issue because it has implications not only for whether small banks join networks, but also for whether the incentives to form networks diminish with mandatory sharing.

Where legally imposed sharing requirements exist in other institutional contexts, courts have ruled that new members had to be admitted on the same terms applicable to the preexisting members, and that "open admissions" and "equal treatment" are called for.[23] Since many mandatory sharing laws predate the widespread formation of shared networks, the open admissions and equal treatment provisions are the most relevant of the three principles. Unfortunately, these provisions have been defined only vaguely by the courts. Nevertheless, they seem to imply that sharing requirements preclude discriminatory fees and fee schedules.

State	Like Institutions	Limitations	Branching
Missouri	No statute	Two within same city as main office of bank.	Unit
Montana	Mandatory	Up to 3 mi. outside limits of city where main office is located.	Unit
Nebraska	Mandatory	Statewide	Unit
Nevada	No statute	Statewide	Statewide
New Hampshire	Mandatory	Statewide	Statewide
New Jersey	Permitted[3]	Statewide	Statewide
New Mexico	Permitted	County of main office or branch, sharing permited statewide for withdrawal of funds.	Limited
New York	Permitted	Statewide	Statewide
North Carolina	No statute	Statewide	Statewide
North Dakota	Mandatory	Statewide	Unit
Ohio	No statute	Countywide and contiguous county.	Limited
Oklahoma	Mandatory	Statewide	Unit
Oregon	Mandatory	Statewide	Statewide
Pennsylvania	(No statute)	(No statute)	Limited
Rhode Island	Permitted	Statewide	Statewide
South Carolina	Permitted	Statewide	Statewide
South Dakota	Mandatory	Statewide	Statewide
Tennessee	No statute	Statewide	Limited
Texas	Mandatory	Countywide	Unit
Utah	Mandatory[4]	Statewide	Statewide
Vermont	No statute	Statewide	Statewide
Virginia	Permitted	Statewide	Statewide
Washington	Mandatory	Statewide	Statewide
West Virginia	Mandatory	Statewide	Unit
Wisconsin	Mandatory	Statewide	Limited
Wyoming	(No statute)	(No statute)	Unit

[1]Source: *A Profile of State-Chartered Banking*, Conference of State Bank Supervisors, 1984.
[2]Source: *Annual Statistical Digest: 1983*, Board of Governors of the Federal Reserve System, 1984.
[3]May be required by Commisioner if the institution requesting participation maintains a principal, branch, or mini-branch office within 5 miles of the proposed terminal location.
[4]Except in counties with a population of at least 100,000 where it is permitted but not mandatory.

Thus, the "reasonable fee" clause in mandatory sharing statutes may prohibit shared ATM networks from imposing surcharges on banks that contribute too few transactions to the network. Coupled with the open admission provision, this pricing approach likely would increase the number of small banks with access to ATM machines. However, the addition of these banks likely would decrease efficiency and increase network fees for all members, large and small, since the marginal cost of these banks' membership would outweigh the marginal benefits they contribute.

There is another problem with the "reasonable fee" provision; that is, it is difficult to determine what rate of return on risk taking in shared networks ought to be incorporated into the reasonable fee. Baxter, Cootner, and Scott (1977) argue that regulators are likely to underestimate the degree of risk faced *ex ante* by network founders, and are thus likely to underestimate the appropriate rate of return.[24] *Ex post,* the successful networks to which new members will wish to gain access will appear to the regulator not to have faced extraordinary risk, these critics maintain. Therefore, according to this argument, rates of return and compensating fees will be set too low. In expectation of this outcome, banks in mandatory sharing states will be discouraged from forming shared ATM networks.

The Justice Department's view on mandatory sharing is consistent with this line of reasoning. The Department argues that mandatory sharing "undercuts in advance any incentive to innovate, creating a 'free rider' problem with respect to initial risk-taking."[25] Other observers note that mandatory sharing may introduce an additional free rider problem simply by allowing banks to join in after the initial capital costs have been borne by the original ATM installing bank or network members.[26]

Other state laws pertaining to ATMs include those that set the geographic limits for off-premise ATMs within states. A list of these statutes can be found in Table 4. Note that all of the states that have constraints on ATM placement also constrain the geographic expansion of traditional branches. However, not all unit banking or limited branching states limit ATM placement.

III. A Model of the Market for ATM Transactions

As noted in the preceding section, mandatory sharing may increase small bank customers' access to ATM services, but also may make sharing more costly for all network participants, thereby *decreasing* the level of ATM services for all customers. To empirically test whether mandatory sharing laws have increased the supply of ATM services to small bank customers, I develop the following model of the supply of ATM transactions, which includes mandatory sharing as an explanatory variable.

The supply of ATM transactions will depend on the cost of ATM transactions and the price of ATM transactions. It may also depend on the banking market structure in the sense that a less competitive banking market will yield a lower supply of ATM transactions.

The aggregate supply of ATM transactions thus is given by:

$$\text{SUPPLY} = s(\text{BANKS, COST OF ATM TRANSACTIONS, STRUCTURE, PRICE OF ATM TRANSACTIONS}), \quad (1)$$

where s is a continuous function, BANKS is the number of banks, and STRUCTURE indicates the bank market structure. The aggregate supply of ATM transactions depends positively on the number of banks and negatively on the cost to each of those banks of providing ATM transactions. It depends positively on the price of ATM transactions.

The cost of ATM transactions, in turn, is given by:

$$\text{COST} = c(\text{BANK SIZE, ATM LAWS, BRANCHING LAWS}), \quad (2)$$

where BANK SIZE is the size of the bank in terms of *number of depositors,* ATM LAWS are laws governing ATMs, including mandatory sharing laws, and BRANCHING LAWS are laws governing traditional branching.[27] As bank size decreases, the cost of ATM transactions rises. For any given bank, however, this may be modified by the existence of mandatory sharing laws, other ATM laws or branching laws. I will test the hypothesis that mandatory sharing mitigates the negative effects of a decrease in bank size. The possible effects of other ATM laws and of branching laws will be discussed in more detail in the next section.

The aggregate demand for ATM transactions should depend on the population, its income, and its age. It should also depend on the price of ATM transactions and on the number of traditional branches and main bank offices available. The aggregate demand for ATM transactions is given by:

$$\text{DEMAND} = d(\text{POP, PER CAPITA INCOME, AGE, OFFICES, PRICE OF ATM TRANSACTIONS}), \quad (3)$$

where POP is population, AGE is the mean age of the population and OFFICES is the number of bank offices (main offices plus branches). Aggregate demand will depend positively on population and per capita income and negatively on the mean age. It also will depend negatively on the number of bank offices, since these are a substitute for ATMs, and negatively on the price of using an ATM.

This model was given a log-linear specification, and the resulting reduced form, derived in the Appendix, is:

$$\begin{aligned}\text{ATM transactions} = {} & B1 + B2*POP + B3*PCINC + \\ & B4*BANKS + B5*BRANCHES \\ & + B6*MAND + B7*ATMLIM \\ & + B8*(MAND)(BANKS) \\ & + B9*(ATMLIM)(BANKS) \\ & + B10*(UNIT)(BANKS) \\ & + B11*(LIM)(BANKS) \\ & + B12*CONC + B13*UNIT \\ & + B14*LIM + Z \qquad (4)\end{aligned}$$

where,

POP = population
PCINC = per capita income,
BANKS = number of banks,
BRANCHES = number of bank branches,
MAND is a binary variable indicating the presence or absence of mandatory sharing,
ATMLIM is a binary variable indicating the presence or absence of limitations on "branching by ATM,"
UNIT is a binary variable indicating the presence or absence of unit banking,
LIM is a binary variable indicating the presence or absence of limited branching,
CONC = the degree of concentration of the statewide banking market,
Z is a normally distributed error term with mean zero, and
B1 - B14 are coefficients to be estimated.

Data and Regression Specification

To determine the effect of mandatory sharing laws, I estimate the reduced form given in equation (4) for a cross-section of 50 states, using two different proxies for the number of ATM transactions. Data on monthly transaction volumes by state are not available. Although data on monthly transaction volumes are available for each network, these data are not useful for measuring the effects of mandatory sharing laws. Sharing laws affect ATM transactions initiated by customers of only the banks within a given state, while transactions on shared networks frequently involve banks that are located outside the state in question. As a result, I tried two different proxies for transaction volume, the total number of ATM debit cards in each state in 1987,[28] and the number of ATMs in each state in 1987.[29]

The first regression uses the number of ATM cards as the dependent variable. Population, per capita income, the number of banks, and the number of bank branches in 1987 are all included in the regression as explanatory variables.[30] Increases in population and per capita income should increase the aggregate demand for ATM cards. Increases in the number of bank branches should decrease demand for ATM cards, since traditional branches are to some extent substitutes for ATMs.

Variations in the number of banks, holding population and per capita income constant, should be negatively related to variations in the average size of banks, in terms of number of depositors. It is expected that states with banks that are larger on average, in terms of number of depositors, will have more ATM cards because larger banks are more likely to have ATM programs. Therefore, states with fewer banks, holding all other factors constant, should have more ATM cards. However, a decrease in the number of banks also may *decrease* the aggregate supply of ATM transactions by decreasing the number of suppliers. (See the Appendix for more detail.)

I also include a statewide concentration ratio on the right-hand side of the regression.[31] This controls for the competitive effects of bank market structure. It is possible that a less competitive banking market would lead to a lower supply of ATM cards. However, since bank services are a multi-dimensional "good," with many different characteristics, it is not obvious *a priori* that a decrease in competition would decrease the supply of ATM services or ATM cards in particular.

A binary variable for mandatory sharing enters the regression by itself and in an interaction term with the number of banks. The mandatory sharing binary takes a value of one if a state has mandatory sharing between like institutions and takes a value of zero otherwise.[32] Whether there is mandatory sharing between unlike institutions is not considered.

The interaction term is the product of the mandatory sharing binary and the natural logarithm of the number of banks. As such, it allows the effects of an increase in the number of banks to be modified by the binary, *and* it allows the effects of a change in the binary variable from zero to one to be modified by the number of banks. The interaction term is included on theoretical grounds. If mandatory sharing is working, it may modify the depressing effect that an increase in the number of banks, and thus a decrease in

their average size in terms of depositors, would have on the number of ATM cards.

A binary variable indicating the presence of ATM branching limitations is also included in the regression, by itself and in an interaction term with the number of banks.[33] ATM branching limitations should decrease the profitability of an ATM program, and may also exacerbate the effect of a decrease in bank size. For example, if large banks from metropolitan areas are prohibited from placing ATMs in communities with small banks that find ATMs too costly, those communities may have no access to ATMs at all.

Unit banking and limited branching laws also may have some negative effects on the number of ATM cards. Studies have shown that barriers to entry in the form of branching restrictions decrease competition in local banking markets.[34] Therefore, unit banking and limited branching binaries are included as indicators of the level of competition in the local market, in addition to the statewide concentration measure.

The unit banking and limited branching binaries also appear in interaction terms with the number of banks. There are two reasons for including these interaction terms. First, there is likely to be more dispersion in bank size in a unit or limited branching state than in a statewide branching state, all other factors equal. This is because under statewide branching, banks are freer to seek the most efficient scale of operations, unconstrained by geographic limitations. The greater size dispersion in states with narrower branching provisions may mean that average bank size is a less useful measure of the overall scale of banking operations in the state. Second, if unit banks are relatively small, on average, then they may want to take advantage of the "branching" opportunities ATMs can provide.

The data for all of the state law binary variables are as of 1983 and are reported in Table 4.[35]

Regression Results with ATM Cards

The regression results are presented in Table 5. The population coefficient has the expected positive sign and is highly significant. The coefficient on the number of branches has the expected negative sign, and it is highly significant. The per capita income coefficient is positive, but significant only at the 10 percent level. The coefficient on the number of banks is insignificant.

The coefficient on mandatory sharing is positive and significant at the 10 percent level, while the coefficient on the mandatory sharing-bank interaction term is negative and significant at the five percent level. This means that the overall effect of mandatory sharing will be negative whenever the number of banks is sufficiently large to cause the interaction term to outweigh the constant positive effect.

Table 5

ATM Access Cards

Dependent Variable:	ATM Access Cards	
Independent Variable:	Parameter Estimate	t-statistic
Intercept	4.1167**	2.2011
Population	1.6459***	7.0438
Concentration	-0.3577	-1.1249
Per Capita Income	0.8777*	1.7407
Banks	-0.2334	-1.2418
Branches	-0.4475***	-2.8884
Mandatory Sharing	1.1687*	1.7341
ATM Limits	2.7145	1.5159
Unit Banking	-8.0324***	-4.2252
Limited Branching	-1.9114	-1.1382
Mandatory-Bank Interaction	-0.2774**	-2.0050
ATM Limits-Bank Interaction	-0.5296*	-1.7203
Unit-Bank Interaction	1.2776***	3.9153
Limited-Bank Interaction	0.3862	1.2676

Note: All variables except the intercept and those involving legal variables are in logs.

Number of Observations	50
Adjusted R-Squared	0.8800
F-Value	28.6367
Probability>F	0.4330E-14

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

To aid interpretation of the mandatory sharing coefficients, Chart 1 compares the predicted effect of an increase in the number of banks in a mandatory sharing state with that in a state that does not have mandatory sharing, holding constant the other explanatory variables at their sample means and the other legal variables at zero.

The point estimates in Chart 1 show that mandatory sharing is associated with a *decrease* in the number of ATM cards when there are many banks.[36] This decrease is significant beyond about 270 banks.[37] There are nine mandatory sharing states in the sample with at least 270 banks. At 342 banks, the mean number of banks in mandatory sharing states, mandatory sharing reduces the number of ATM cards by about 36 percent.

Three possible explanations can be given for the negative effect of mandatory sharing. First, for the reasons

discussed above, mandatory sharing may increase the cost of ATM services. Thus, the growing strength of the negative effect as the number of banks increases may be because of member-related network costs, which would be higher the smaller are the banks in the state.

Second, mandatory sharing may mostly encourage two-way sharing, thereby eliminating the need for a customer to hold more than one institution's card in order to use more than one institution's ATMs. Thus, mandatory sharing simply may discourage customers from establishing secondary transaction accounts and obtaining multiple cards, which they otherwise would do. This argument assumes that the major reason bank customers hold more than one transaction account is to obtain relatively small amounts of cash at multiple locations. Available evidence indicates, however, the secondary checking accounts are typically used for large expenditures that constitute a significant proportion of a family's spending.[38] This argument also implies that an increase in ATM sharing would significantly reduce the use of secondary checking accounts. However, between 1984 and 1986 the percent of ATMs shared increased from 46 percent to 76 percent, *and* the proportion of families with secondary checking accounts increased, from 20 to 22 percent.[39]

Third, the existence of mandatory sharing laws may not *cause* a reduction in the number of ATM cards, but may instead be indicative of the existence of other factors, not included in the regression, that inhibit the establishment and growth of ATM systems. States with mandatory sharing laws may have passed them because they knew their banks would have difficulty supplying ATM services. The negative coefficient on the mandatory sharing-bank interaction term may merely be an indication that mandatory sharing did not succeed in overcoming whatever other forces were depressing the level of ATM services.

A likely left-out factor is some aspect of bank size that has not been considered. Table 6 shows the results of a regression of mandatory sharing on a constant and the number of banks and population. The significant positive coefficient on the number of banks and the significant negative coefficient on population indicate a positive correlation between mandatory sharing laws and small banks.[40]

Table 6
Mandatory Sharing

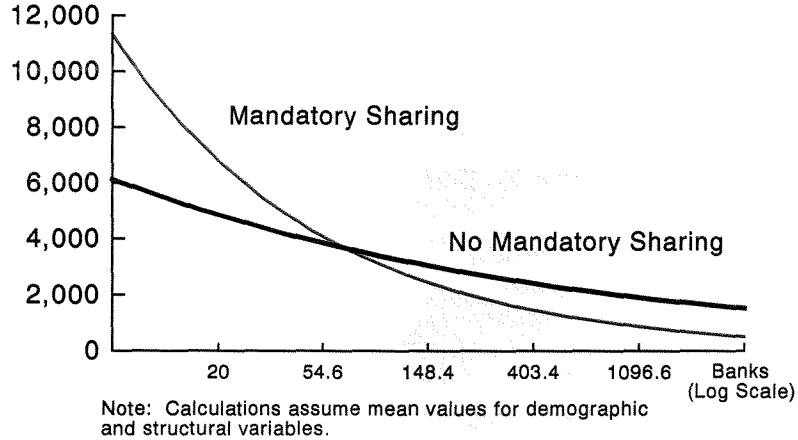
Dependent Variable:	Mandatory Sharing	
Independent Variable:	Parameter Estimate	t-statistic
Intercept	1.2085**	2.1430
Banks	0.1500**	1.9988
Population	-0.1846**	-2.0598

Note: All variables excedpt the intercept and those involving legal variables are in logs.

Number of Observations	50
Adjusted R-Squared	0.0583
F-Value	2.5180
Probability>F	0.0914

** Significant at the 5 percent level.

Chart 1
The Effect of Mandatory Sharing on the Number of ATM Cards



Note: Calculations assume mean values for demographic and structural variables.

I had presumably controlled for bank size, but it may be that the number of banks and population do not adequately control for the relevant aspects of bank size. For instance, although the number of banks and population should pretty closely determine the average number of depositors per bank in a state, they do not determine the distribution of bank sizes within a state. If mandatory sharing is correlated with particular size distributions in addition to being correlated with particular average sizes, and if size distributions influence the level of ATM services, then mandatory sharing may simply be reflecting this correlation and may have no causal effect on the supply of ATM transactions.

Some observers have suggested that mandatory sharing laws were passed under pressure from small rural banks hoping to protect their markets from larger metropolitan banks.[41] If so, and if small rural banks supply lower levels of ATM services, then mandatory sharing would be correlated with decreases in the number of ATM cards. There are several possible reasons small rural banks may be especially likely to supply lower levels of ATM services. One is that they are small and distant from large metropolitan banks, so sharing is more costly. Another is that they may have a protected monopoly market and may thus supply lower levels of services than would banks in a more competitive market. A third reason may be associated with the low population density. Even if a given rural bank has the same number of depositors as a metropolitan bank, it will be more costly for it to provide ATMs with the same level of locational convenience, since its depositors will be more geographically dispersed than the metropolitan bank's customers.

To test whether mandatory sharing is associated with the influences of small rural banks, I reestimated the regression reported in Table 6 with an additional explanatory variable, the percent of the population in metropolitan areas. The coefficient on this variable turned out to be insignificant, while population and the number of banks remained significant. Although this evidence does not completely dismiss the rural bank argument, it does cast some doubt.

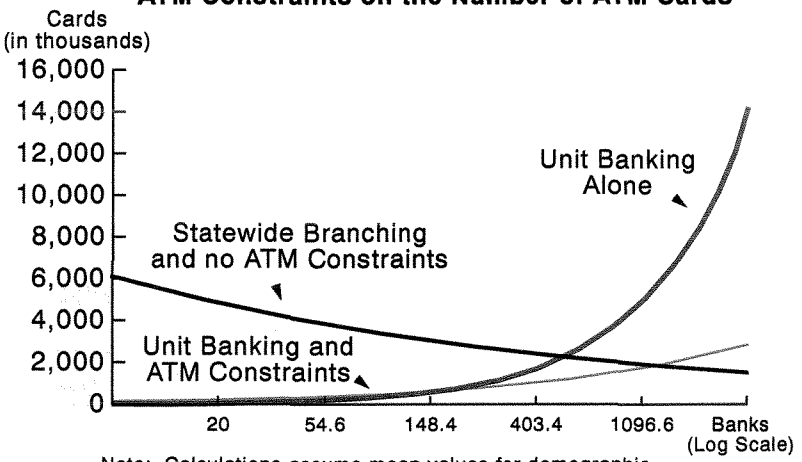
The effects of unit banking are shown in Chart 2. Unit banking has a significant negative effect up to about 284 banks.[42] This may be a consequence of reduced competition in local banking markets in unit banking states. All other things equal, local competition would be lower in states with fewer banks. This would help explain why the negative effects become stronger as the number of banks decreases.

The positive effects of unit banking, as seen in Chart 2, become significant beyond about 1,540 banks.[43] Texas, a unit banking state with 1,765 banks in 1987, is the only state in the sample with at least 1,540 banks. However, there are no states in the sample with this many banks, unit banking, and no ATM placement constraints. As explained below and as seen in Chart 2, ATM placement constraints eliminate the positive effects of unit banking.

The effects of ATM limitations in either unit or limited branching states are negative and significant beyond about 395 banks.[44] The effects of unit banking and ATM placement constraints together are negative and significant *up to* about 395 banks. It is interesting to note that, once ATM constraints are added, the positive effects of unit banking disappear. This may be because ATM placement con-

Chart 2

The Effect of Unit Banking and ATM Constraints on the Number of ATM Cards



Note: Calculations assume mean values for demographic and structural variables.

straints foreclose any opportunity that unit banks would have to "branch by ATM."

Several alternative specifications of the model were estimated. When regressions without the interaction terms were estimated, the coefficient estimate for the mandatory sharing dummy variable alone was insignificant. This indicates that bank size does play a role in helping to explain the effect of mandatory sharing. A regression using 1987 data for the legal variables also was estimated, and all of the legal variables were found to be insignificant. This suggests that the effects of regulation work with a lag.

Regression Results with ATM Machines

We have seen that mandatory sharing is associated with decreases in the number of ATM cards for states with relatively small banks. However, the number of ATM cards is only a proxy for the number of ATM transactions. Below, I have estimated a second regression, this time with the number of ATM machines as a proxy for ATM transactions.

I have estimated a regression of roughly the same form as the ATM cards regression. The explanatory variables in the regression are defined as before.

The results are presented in Table 7. As before, and as expected, population and per capita income have positive and highly significant coefficients. The number of branches has a significant negative coefficient. This time, though, the coefficients relating to mandatory sharing are insignificant.

This result makes it difficult to draw inferences regarding the effect that mandatory sharing may have on the

Table 7

ATMs

Dependent Variable:	ATMs	
Independent Variable:	Parameter Estimate	t-statistic
Intercept	−4.7288***	−2.8555
Population	1.4053***	6.7921
Concentration	−0.2737	−0.9721
Per Capita Income	1.4516***	3.2515
Banks	−0.1674	−1.0062
Branches	−0.3147**	−2.2941
Mandatory Sharing	0.5332	0.8935
ATM Limits	2.0732	1.3075
Unit Banking	−7.0176***	−4.1690
Limited Branching	−0.3331	−0.2240
Mandatory-Bank Interaction	−0.1355	−1.1056
ATM Limits-Bank Interaction	−0.4277	−1.5693
Unit-Bank Interaction	1.1390***	3.9420
Limited-Bank Interaction	0.1266	0.4693

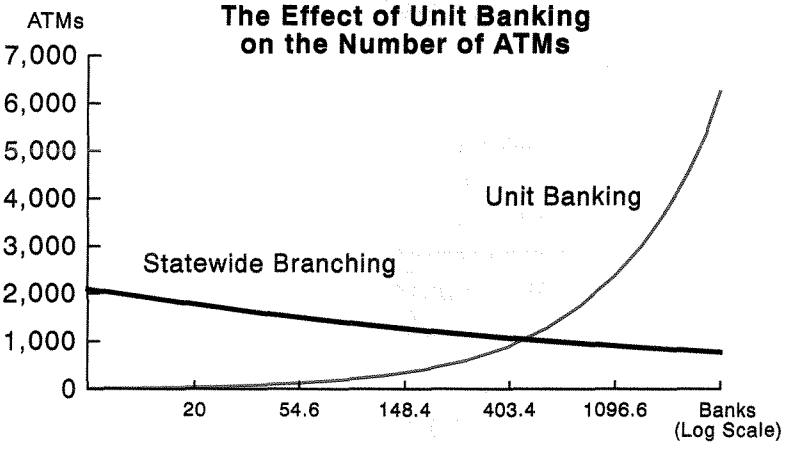
Note: All variables except the intercept and those involving legal variables are in logs.

Number of Observations	50
Adjusted R-Squared	0.9011
F-Value	35.3345
Probability>F	0.2220E-15

*** Significant at the 1 percent level.
** Significant at the 5 percent level.

Chart 3

The Effect of Unit Banking on the Number of ATMs



Note: Calculations assume mean values for demographic and structural variables.

number of ATM transactions. We already know that mandatory sharing has a significant negative effect on the number of ATM cards, and we assume that ATM cards and transactions volume are positively correlated. We also know that, across networks at least, ATM machines and monthly transactions are very strongly correlated.[45]

One possibility is that the number of ATMs in a *state* is not a very good measure of the number of transactions in a state. There may be more uniformity in the relationship between growth in ATMs and growth in transactions within networks than within states because networks seek an efficient level of operations across state lines. Thus, the close relationship between machines and transactions within networks may not hold within states.

Alternatively, changes in the number of cards may more sensitively measure changes in the number of transactions than do changes in the number of ATMs. Any given percent change in transactions volume is likely to be represented by a percent change in cards that is greater than the concomitant percent change in the number of ATMs.

The effects of unit banking are shown in Chart 3. Unit banking has a significantly negative effect on the number of ATMs up to about 254 banks and has a significantly positive effect beyond about 1,236 banks. Again, Texas is the only state in the sample with at least this many banks. The positive effect may be due to ATMs serving as a substitute for traditional branches in states with small unit banks.

IV. Conclusion

As of September 1983, 23 states had instituted mandatory sharing statutes that required banks to share their ATMs with any other banks that wished to do so. The purpose of these laws was to ensure that small banks would be able to offer their customers access to ATM systems. Since ATM systems were perceived to be subject to significant economies of scale, small banks feared that without mandatory sharing, only large banks would be able to participate in proprietary or shared ATM networks. There is some evidence that the cost structures of both shared and proprietary ATM systems do possess characteristics that make it difficult for small banks to gain access to ATMs.

However, mandatory sharing does not appear to accomplish its goal. It either directly *decreases* the number of ATM access cards in the hands of depositors, or it simply does not sufficiently counteract negative independent forces that were left out of the regression and with which mandatory sharing is correlated. If the "reasonable fee" clause in mandatory sharing statutes does not in fact constrain the fee-setting behavior of shared network owners in mandatory sharing states, then there must be some such independent factor, correlated with mandatory sharing, that reduces the number of ATM cards.

One such independent factor may be the presence of a large number of rural banks. However, there was no statistical support for this possibility. Although mandatory sharing *is* correlated with the presence of banks with few depositors, it is not correlated with the degree of urbanization of the population. Moreover, bank size, as measured by number of depositors, was controlled for in the ATM cards regression. Therefore, the negative effects of mandatory sharing do not appear to be due to rural banks.

Although mandatory sharing does not have a significant effect on the number of ATMs, it does reduce the number of cards, suggesting that mandatory sharing may be increasing the cost and price of ATM transactions, or may be associated with such an increase. Thus, it is possible that mandatory sharing does give small bank customers access to ATM machines, but only at a significantly higher price for all customers. Mandatory sharing does not appear to be able to legislate away the higher ATM costs faced by small banks.

Unit banking has a significantly negative effect on the number of ATM cards in states with banks of large average size, and a positive effect in the presence of relatively small banks, but the positive effect is reduced to insignificance if there are also ATM placement constraints. These results are consistent with the view that unit banking is associated with reduced competition, higher prices, and lower service. The fact that unit banking has a significant negative effect on the number of ATM machines in states with banks of large average size also is consistent with this view.

NOTES

1. Commercial banks, savings and loans, and credit unions all have ATM programs. However, most ATMs are owned by banks.

2. Source: Kutler (July 22, 1988). The number of access cards is one measure of the scale of long-run demand for ATM services. The Electronic Funds Transfer Act, passed in November 1978 as an addition to the Consumer Credit Protection Act, states that a financial institution may issue a *validated* access card to a consumer only in response to an oral or written request or application for the card. (Source: Regulation E, 12 C.F.R., Section 205.5(a)(1)). Invalidated cards *may* be distributed unsolicited, but the customer has to sign and return a form in order for the card to be validated for use. Therefore, the number of cards provides a better measure of the number of people that expect to use an ATM at least once than if validated cards could be distributed unsolicited.

3. *American Banker* (1988).

4. Kutler (September 30, 1988).

5. The group that reports the 54 percent figure states that out of all ATM cardholders, 13 percent never use ATMs, 46 percent use them less than once a week and 41 percent use them at least once a week. In contrast, two thirds of cardholders over 54 years of age report either never using ATMs or using them less than once a month. Only 22 percent of the *total* population use ATMs at least once a week.

6. *Bank Network News* (November 10, 1988).

7. Informal surveys indicate that consumer demand for ATM transaction services is fairly insensitive to direct fees. Although studies of actual ATM use are not available, in a 1988 survey of customers who use ATM cards, 35 percent of those who pay fees said the fees caused them to cut back on their use of ATMs and 43 percent said fees did not do so, while 19 percent said they had always paid fees and 3 percent were unsure whether they paid fees. (Source: Kutler, September 30, 1988.) Another survey concluded that customers were not too price sensitive around a charge of about 30 cents. (Source: Herscher, 1988.)

8. *American Banker* (1988).

9. Avery, *et al.* (1987).

10. Source: Kutler (September 30, 1988).

11. See, for example, Kantrow (1989), Herscher (1988), and *ABA Banking Journal* (1988).

12. Berger (1985).

13. *American Banker* (December 12, 1988).

14. "Electronic Funds Transfer Cost Models and Pricing Strategies," David A. Walker, *Journal of Economics and Business,* Fall 1980, pp. 61–65.

15. The network logos on the back of a customer's ATM card tell the customer that he has access to machines displaying those logos, as well as his own bank's machines. Different customers of the same bank may have different logos on their cards. It is nonetheless a fair generalization that there is universal access for all card-holding customers of all banks in the network.

Also, it should be pointed out that a bank need not necessarily own any ATMs itself in order to belong to a shared network.

16. Many shared networks operate across state lines.

17. American Bankers Association (1987), p. 21.

18. *Bank Network News* (November 24, 1988).

19. Avery, *et al.* (1987), p. 186.

20. TransData Corporation (1987).

21. Cox (1989).

22. Source: Conference of State Bank Supervisors (1984). More recent data are available, and some changes in state laws have occurred since 1983, but these are the data that were used for the regressions.

Mandatory sharing laws are not completely uniform. Some states require sharing between like institutions, for example, banks with banks, but not between unlike institutions, for example, banks with savings and loans. All states that address the topic, however, at least *permit* sharing between like institutions. Furthermore, Nebraska is the only state that explicitly prohibits sharing between *unlike* institutions, though it allows third parties to own, operate, and maintain shared systems between unlike institutions.

Most states that have mandatory sharing do not require sharing with out-of-state banks which request it. Those states that do not explicitly restrict mandatory sharing to in-state banks appear to be those which, under separate statutes, *prohibit* customers of out-of-state banks from using ATMs belonging to in-state state chartered banks.

23. The information on case law is from Baxter, *et al.* (1977), pp. 138–140.

24. Baxter, *et al.* (1977), pp. 141–143.

25. Einhorn (1988), p. 44.

26. However, as far as development costs go, initial owners of ATMs or participants in a network can expect the courts to uphold their right to demand some compensation for these expenses from any new members. See Baxter *et al.* (1977), p. 141.

27. This measure of bank size differs from the traditional measures that use assets or deposits.

28. The figures for ATM cards do not include *credit* cards that may be able to access a line of credit for cash. The card data were obtained from a private consulting firm.

29. Network-level data on both the number of ATMs and transaction volume are available. These data show a strong positive relationship between the number of machines and transaction volume. In a regression of the log of ATM transactions on a constant and the log of the number of ATMs, the adjusted R^2 was .8, and the coefficient on the number of ATMs was estimated to be 1.01,

with a t-statistic of 19.98. Assuming this relationship holds at the level of individual states, it appears that the number of machines is a good proxy for transaction volume.

30. The number of banks and number of branches were obtained from the year-end 1987 *Reports of Condition and Income* (Federal Financial Institutions Examination Council (1987)). Population and per capita income in thousands in 1987 were obtained from the U.S. Bureau of the Census (1989).

Neither the mean age of the population nor variables indicating the age distribution of the population were found to be significant in preliminary regressions. Therefore, age variables were excluded from the final reported regression.

31. The concentration ratio is the total share of deposits held by the four largest banking organizations in the state. It was obtained from the Board of Governors of the Federal Reserve System (1988).

32. I classified New Jersey as a mandatory sharing state, even though it was classified as a non-mandatory sharing state in the data source. I did so, because, as noted in a footnote in that source, sharing may be required by the New Jersey Banking Commissioner if the institution requesting to share maintains a principal, branch, or mini-branch office within 5 miles of the proposed terminal location.

33. The limited ATM placement dummy variable takes a value of one if ATMs are not allowed to be placed statewide and zero otherwise. If the state has no statute or a silent statute regarding this topic, this dummy was given a value of zero. Louisiana, which allows statewide placement of ATMs only if they are shared, was assigned a value of one for this dummy.

34. For a review of these types of studies, see McCall (1980).

35. Data for mandatory sharing laws and ATM branching laws were obtained from the Conference of State Bank Supervisors (1984). Data for traditional branching laws were obtained from the Board of Governors of the Federal Reserve System (1984).

36. Because of the log-linear specification of the regression, proportional changes in predicted values matter, not arithmetic differences in predicted values. This should be kept in mind when viewing Chart 1. Statistical tests reveal that the *positive* effects of mandatory sharing that appear in Chart 1 are insignificant.

37. The linear combination of coefficient estimates, B6 + B8*ln(banks), was tested for sign and significance at values of ln(banks) between 1 and 8 (banks between about 3 and 2980).

All positive values of B6 + B8*ln(banks) were found to be insignificant. Negative values of B6 + B8*ln(banks) were found to be significant at a 5 percent level at and beyond ln(banks) = 5.6 (banks = 270).

The sample range for the number of banks is from 11 (Alaska) to 1,765 (Texas).

38. Avery *et al.* (1986).

39. Avery *et al.* (1987).

40. The high correlation between mandatory sharing and small banks may help to explain why the coefficient on BANKS is insignificant. There may not be enough states with both small banks and no mandatory sharing to obtain a good estimate of the coefficient on BANKS.

41. Baxter *et al.* (1977), p. 139.

42. Montana, North Dakota, West Virginia, and Wyoming are the unit banking states in the sample with fewer than 284 banks.

43. At 602 banks, the mean number of banks in unit banking states, the effects of unit banking are insignificant.

44. The specification of the model assumes that the effects of ATM placement constraints in statewide branching states also would be negative and significant beyond about 395 banks. However, because there are no such states, this result is doubtful.

45. See note 29.

APPENDIX

Derivation of Reduced Form of the ATM Transactions Model

Assume that all variables are in log form. The aggregate supply of ATM transactions in a state is given by:

$$S = a1 + a2*BANKS + a3*SIZE + a4*MAND + a5*ATMLIM + a6*MANDSIZE + a7*ATMLSIZE + a8*UNITSIZE + a9*LIMSIZE + a10*CONC + a11*UNIT + a12*LIM + a13*PRICE + e, \quad (1)$$

where BANKS is the number of banks,
SIZE is the average size of a bank, in terms of number of depositors,
MAND is a binary variable indicating the presence or absence of mandatory sharing,
ATMLIM is a binary variable indicating the presence or absence of limitations on "branching by ATM,"
UNIT is a binary variable indicating the presence or absence of unit banking,
LIM is a binary variable indicating the presence or absence of limited branching,
CONC = the degree of concentration of the statewide banking market
MANDSIZE = (MAND)(SIZE),
ATMLSIZE = (ATMLIM)(SIZE),
UNITSIZE = (UNIT)(SIZE),
LIMSIZE = (LIM)(SIZE), and
PRICE = price of an ATM transaction.

The error term *e* is assumed to be normally distributed with mean zero.

All the right-hand side variables except for PRICE are assumed to be exogenous. The variables UNIT and LIM are included as indicators of local market structure, in addition to the measure of statewide market structure, CONC. The bank size interaction terms are included because the effect of changes in bank size may depend on whether or not laws regarding branching and ATM placement are in place.

The signs of many of the coefficients are uncertain *a priori*. However, a2, a3 and a13 should all be positive.

The aggregate demand for ATM transactions is given by:

$$D = b1 + b2*POP + b3*PCINC + b4*AGE + b5*OFFICES + b6*PRICE + n, \quad (2)$$

where POP = state population,
PCINC = per capita income
AGE = mean age, and
OFFICES = total bank offices (main bank offices plus branches).

The error term *n* is assumed to be normally distributed with mean zero. All of the right-hand-side variables in (2) except for PRICE are assumed to be exogenous. The coefficients b2 and b3 should be positive, while b4, b5, and b6 should be negative.

Setting S in (1) equal to D in (2) allows us to solve for PRICE. Substituting this solution back into (2), we eliminate PRICE from the equation for ATM transactions. Two further assumptions are made in order to arrive at the final reduced form that is estimated. First, the SIZE variable should depend negatively on BANKS and positively on POP. It is assumed that SIZE is a non-stochastic function of BANKS and POP:

$$SIZE = k1*BANKS + k2*POP, \quad (3)$$

where k1 is negative and k2 is positive. Second,

$$OFFICES = BANKS + BRANCHES, \quad (4)$$

by definition.

Substituting from (3) and (4) into (2), and simplifying, we arrive at:

$$ATM\ transactions = A1 + A2*POP + A3*PCINC + A4*AGE + A5*BANKS + A6*BRANCHES + A7*MAND + A8*ATMLIM + A9*(MAND)(BANKS) + A10*(MAND)(POP) + A11*(ATMLIM)(BANKS) + A12*(ATMLIM)(POP) + A13*(UNIT)(BANKS) + A14*(UNIT)(POP) + A15*(LIM)(BANKS) + A16*(LIM)(POP) + A17*CONC + A18*UNIT + A19*LIM + W, \quad (5)$$

where *W* is an error term.

A regression of this form was estimated, and AGE and all of the population interaction terms were found to be insignificant. Eliminating them did not significantly change either the size or significance of the remaining variables' coefficients, so these variables were dropped from the final regressions.

The final reduced form is then:

$$ATM\ transactions = B1 + B2*POP + B3*PCINC + B4*BANKS + B5*BRANCHES + B6*MAND + B7*ATMLIM + B8*(MAND)(BANKS) + B9*(ATMLIM)(BANKS) + B10*(UNIT)(BANKS) + B11*(LIM)(BANKS) + B12*CONC + B13*UNIT + B14*LIM + Z, \quad (6)$$

where *Z* is an error term.

The coefficients B1 through B14 are functions of a1 through a13, b1 through b6 and k1 and k2. Given the assumptions about the signs of a2, a3, a10, a13 and b2 through b6, B2 and B3 should be positive, and B5 should be negative. The sign of B4 is ambiguous because of the coexistence of a positive direct effect of an increase in the number of banks on the aggregate supply of ATM transactions and a negative effect of an increase in the number of banks on the size of banks.

The coefficients B6, B7, B12, B13 and B14 will have the same signs as a4, a5, a10, a11 and a12, respectively. The coefficients B8, B9, B10 and B11 will have signs opposite from those of a6, a7, a8 and a9, respectively.

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