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Compatibility and Pricing with Indirect Network Effects: Evidence from ATMs

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Abstract

Incompatibility in markets with indirect network effects can reduce consumers' willingness to pay if they value "mix and match" combinations of complementary network components. For integrated firms selling complementary components, incompatibility should also strengthen the demand-side link between components. In this paper, we examine the effects of incompatibility using data from a classic market with indirect network effects: Automated Teller Machines (ATMs). Our sample covers a period during which higher ATM fees increased incompatibility between ATM cards and other banks' ATM machines. We find that incompatibility led to lower willingness to pay for deposit accounts. We also find that incompatibility benefited firms with large ATM fleets.

1   ATM Markets as Hardware/Software Markets

ATMs markets are a classic example of a market with indirect network effects.[1] Consumers must employ both an ATM card and an ATM machine to perform a cash withdrawal - these are the complementary components of the network. Because ATM machines operate on shared networks, consumers can use their card at an ATM owned by their bank or another bank. The "mix and match" construction of the latter transaction type is a common feature of emerging technologies, and is analogous to that involved in consumers' matching of computer hardware and software, operating systems and spreadsheets, different components of audio/visual systems, and a variety of other products with indirect network effects. In ATM markets as in many of the aforementioned examples, firms offer both components of the network, but consumers also have the opportunity to mix and match.

In markets with indirect network effects, compatibility between components of the network offered by different firms can have important effects on consumers. In ATM markets, the compatibility issue involves whether consumers can use their cards with other banks' ATM machines. In its brief history, the ATM market has exhibited varying degrees of compatibility along this dimension. At its inception the market exhibited complete incompatibility. ATM machines accepted only ATM cards issued by their owning bank. Over the 1980s, compatibility emerged as banks formed "shared ATM networks" that allowed customers to use their cards at other banks' "foreign" ATM machines. At that point, banks' network membership determined the degree of compatibility. By the early 1990s, all banks essentially subscribed to common networks, allowing full compatibility between cards and machines.

In this paper, we examine a later shift toward partial incompatibility between cards and foreign ATMs. This shift resulted from banks' imposition of fees associated with foreign transactions. There are two such fees: a "foreign fee" levied by the customer's home bank, and a "surcharge" imposed by the bank owning the foreign ATM. These fees in the limit can create complete incompatibility, but as they stand create partial incompatibility. This partial incompatibility has been the focus of the literature on "adaptors." Our attention is primarily devoted to surcharges, because in our sample foreign fees remain roughly constant while there is a regime change in surcharging. Before 1996 the largest networks barred banks

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[1]Economides (1989, 1991) and Matutes and Regibeau (1988, 1992) cite ATMs as an example of a market with indirect network effects.

from imposing surcharges, while after 1996 surcharges became widespread.[2] This represents a discrete move toward incompatibility. There is also a certain amount of variation after 1996 in the degree to which surcharging is adopted. Some banks adopted surcharging quickly, while others moved more slowly. Finally, within the set of banks that surcharge we observe variation in the level of fees.

Empirically, this represents a rare opportunity to observe the effects of a transition from compatibility to incompatibility in a network industry. For any given bank, the compatibility of its ATM cards with other banks' ATM machines depends on the surcharging behavior of other banks. Customers of a given bank will therefore link their valuation of deposit accounts —which provide their ATM card—to the surcharging behavior of other banks owning ATMs in their local market. It is this variation that we exploit. We benefit from possessing detailed geographic data regarding the local markets in which banks in our sample compete, as well as rich information regarding ATM fees and ATM density for these local markets. There is considerable cross-sectional and time-series variation in the extent to which banks' competitors adopted surcharges. This allows a full examination of the effects of transitions from compatibility to incompatibility.

The theoretical literature on networks suggests that moving from compatibility to incompatibility will change consumer and firm behavior in a variety of ways. Incompatibility should reduce aggregate willingness to pay for network systems, because it limits consumers' ability to "mix and match" components offered by different firms. In our data, this should manifest in a lower willingness to pay for deposit accounts, which provide consumers with an ATM card and access to a bank's own ATMs. A second partial equilibrium effect of incompatibility is that it can strengthen the link between pricing and/or quality for components sold by the same firm—since consumer demand for components is now more tightly linked. In our case, we expect that the advent of surcharging would increase the importance of having a large fleet of ATMs. This shift should be reflected in account pricing, and also in the relationship between ATM fleet size and deposit market share.

Our empirical approach consists of first estimating a set of hedonic regressions linking bank deposit account characteristics to pricing deposit accounts. These characteristics include not only hardware characteristics related to deposit accounts, but also ATM-related characteristics. The hedonic regressions allow us to examine how incompatibility changes

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[2]Sixteen states overrode the ban prior to 1996; we account for this in the empirical work below. See Prager (2001) for an examination of this episode.

overall prices on deposit accounts. They also allow us to examine how incompatibility changes the link between ATM fleet size quality and deposit account pricing; this link is the indirect network effect. Our findings are broadly consistent with the implications of models with indirect network effects. We find that incompatibility reduces prices *ceteris paribus*, but increases the strength of the link between ATM density and deposit account pricing. It also reduces the strength of the link between other banks' ATM density and deposit account prices.

To further explore the relationship between compatibility and indirect network effects, we also estimate a set of reduced form regressions relating ATM density to deposit market share. We find that banks' share of ATMs in their local ATM markets are positively related to their shares of deposits, and that the strength of this correlation increases as other banks impose surcharges. This is consistent with the theoretical result that incompatibility increases the strength of indirect network effects.

Our work relates to a small body of research examining the effects of compatibility in network markets. Greenstein (1994) finds that mainframe buyers prefer to upgrade to compatible systems, a result suggesting that compatibility between past and future hardware is important. Gandal (1994, 1995) and Brynjolfsson and Kemerer (2001) find that computer spreadsheets compatible with the Lotus system commanded higher prices during the early 1990s. Our work differs from this early work, in that it estimates the effects of compatibility across different components of the network—rather than the effects of incompatibility between different networks. It also differs in that it primarily relies on within-firm and within-market rather than cross-sectional variation in compatibility for identification.[3]

Our study also relates to work establishing empirical relationships in network, taking compatibility as given. Gandal, Greenstein and Salant (1999) study the link between operating system values and software availability in the early days of the microcomputer market. They find evidence supporting the existence of complementary feedback.[4] More recent work by Gandal, Kende and Rob (2002) seeks to establish a positive feedback link between adop-

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[3]More precisely, the analyses in Gandal (1994, 1995) and Brynjolfsson and Kemerer (2001) do not separate within-firm from cross-sectional effects of compatibility. The datasets are panels, but too small to allow the examination of within-firm variation.

[4]Their primary tests are a set of vector auto regressions (VARs) estimating whether there are significant intertemporal links between hardware (OS) advertising and software (actual software) advertising. they compare the strength of these links for the two competing PC operating systems of the early 1980s (DOS and CP/M), finding a much stronger complementary relationship for DOS than for CP/M.

tion of Compact Disks (CDs) and CD players. Rysman (2000) provides evidence supporting the existence of complementary demand relationships in a two-sided platform market (Yellow pages). More recent work by Shankar and Bayus (2002), Nair, Chintagunta and Dube (2003) and Karaca-Mandic (2003) also applies structural econometric techniques to test for the existence of network effects in markets where compatibility is fixed.

Finally, we also add to the empirical literature examining ATM markets. Much of this literature only indirectly addresses the indirect network effects between ATM cards and machines. For example, McAndrews et al. (2002) examine banks' propensity to impose surcharges as a function of a variety of characteristics, although they do not explicitly link their analysis to deposit account pricing. Prager (2001) tests whether small banks lost market share in states that allowed surcharges prior to 1996; this is implicitly a test of whether incompatibility favored banks with high-quality ATM fleets, although she does not pose the question in those terms. She finds no evidence that small banks lost market share. It should be noted, however, that her measure of the degree of incompatibility is indirect because there is little data regarding the extent to which banks actually imposed surcharges in the states that permitted them. Hannan and McDowell (1990) find that markets in which large banks adopted ATMs became more concentrated during the 1980s, although they do not discuss their finding in terms of network economics. Finally, Saloner and Shepard (1995) examine the diffusion of ATM machines from 1972-1979 and find that adoption occurred earliest for firms with many branches and deposits, a result they interpret as consistent with the existence of indirect network effects in demand.[5]

2 Deposit Accounts and ATM Services

ATM cards are generally sold as part of the service bundle attached to a consumer's deposit account. The deposit account is a checking account into which the customer deposits funds, and from which the customer withdraws funds periodically for cash, debit card or check purchases.[6] In addition to deposit account services, bank offer savings account services and

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[5]Earlier work by Hannan and McDowell (1984a, 1984b) also examines the causes of ATM adoption but does not test for network effects.

[6]During our sample most ATM cards began serving as debit cards. We do not directly model the link between these markets, although it appears that they are linked. The advent of surcharging in 1996, for example, appears to have spurred increased use of debit cards for purchases. Consumers' ability to substitute away from ATM use following the imposition of surcharges would attenuate the link between surcharging

a wide variety of other financial services such as loans, brokerage and investment services and insurance. In principle, consumers can purchase these separate services from separate banks, and often do. However, deposit and ATM card services are bundled.

The standard deposit account agreement also offers customers free access to the bank's own (ATMs). ATMs allow bank customers to perform transactions electronically on their deposit accounts. Banks locate their ATMs "on-premise" at bank branches, and also "off-premise" at locations such as convenience stores, movie theaters, bars, and other locations where consumers typically need cash.

While banks' strategic behavior is not the focus of our analysis here, it is worth highlighting the most important features of competition between banks. In our sample, approximately 10,000 commercial banks compete for deposit account customers in their local markets.[7] Smaller banks often operate only within a small geographic area such as a county, in many cases using a single branch. The largest banks conduct operations in many states or even nationally, and can have thousands of branches and ATMs. Markets are typically assumed to exist at the county level, a convention that we adopt in our analysis in identifying banks' competitors.[8] There is considerable heterogeneity in market structure across regions, with rural markets typically being more concentrated than urban markets. Even within markets, there is considerable variation in banks' ATM strategies—some banks blanket their markets with ATMs, while others deploy them sparingly. As we will illustrate below, one of the most systematic differences across banks regarding ATMs is that large banks deploy them more aggressively than small banks (relative to maintaining branches, for example). Another is that ATM deployment is largely concentrated in areas of high population density. We discuss the implications of this fact in some detail below.

Banks subscribe to "shared ATM networks" that allow their customers to use other banks' ATM machines. In most cases access to these "foreign" ATMs is incomplete because it only allows consumers to withdraw cash; more complex transactions such as making deposits

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and willingness to pay for deposit accounts, biasing our results toward zero.

[7]Our data omit observations for credit unions and thrifts. However, these institutions collectively hold only a small share of the deposit market.

[8]Some work treats multi-county MSAs rather than individual counties as markets in urban areas—we have seen no evidence that doing so makes a difference empirically. Recently, the question of whether banking markets have become less local has come to light (see Radecki [1998] for a discusison). While this may be true for products such as mortgages, it is unlikely to be true for consumers' ATM usage, which is necessarily local.

are not permitted through the shared network. The networks themselves are typically joint ventures formed by banks in order to share the fixed costs of interconnection infrastructure. Banks usually pay a fixed monthly or annual membership fee to the network. They also pay a "switch fee" for each transaction made by one of their customers on another bank's ATMs; the switch fee is roughly $0.40 on average during our sample, and does not vary significantly across networks or regions. Part (on the order of $0.10) of the switch fee is paid as "interchange" to the network, and the remainder flows to the ATM's owner in order to compensate it for providing services to a non-customer.

Bank customers therefore purchase from their home bank a bundle of services associated with the deposit account, including both an ATM card and unlimited access to that bank's ATMs. These bundles are differentiated both horizontally and vertically. Horizontal differentiation primarily stems from geography; consumers strongly prefer banks with branches and ATMs that are conveniently located.[9] The services other than deposits provided by banks can confer both horizontal and vertical differentiation. These complementary services include offering savings and money market accounts, offering loans ranging from mortgages to credit cards, and offering brokerage services. Large banks are more likely to offer these services, although they become more widely available at banks of any size over our sample period. Vertical differentiation also exists across features of the deposit account; banks vary in quality of customer service, for example. A good deal of vertical differentiation stems from ATM fleet density.

For any given account bundle, customers will also base their willingness to pay on the degree to which they can use other firms' software—foreign ATMs. This depends on the compatibility between cards and other banks' machines, which in turn is a function of the fees imposed by other banks for such use. Because discussing the impact of incompatibility relates so closely to the network literature on incompatibility, we now discuss that literature in order to motivate our empirical work.

3   Incompatibility and Network Effects

In recent years a wide-ranging theoretical literature has emerged examining the effects of compatibility in markets with indirect network effects. Indirect network effects are strong

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[9]See Stavins (1999) for a discussion of the characteristics that consumers favor when making their deposit account choices.

complementary relationships in demand between component products that consumers assemble into systems. In such settings there is a further distinction between components that are "hardware" and components that are "software." In such settings, "hardware" is the component of the system that is durable or otherwise incurs greater switching costs. In the case of ATMs, cards are hardware because they require the purchase of a subscription good—the deposit account—that carries switching costs.

Considering the institutional detail of the ATM market, the most relevant models of competition in markets with indirect network effects are those in which integrated firms sell both components of the system.[10] The compatibility issue then becomes whether Firm A's components will function with Firm B's complementary components, and vice versa. Transactions of this sort, in which consumers purchase components from different firms are known as "mix and match" transactions. While much of the theoretical literature considers cases of absolute compatibility or incompatibility, a related literature examines cases of partial compatibility, where for example consumers can attain compatibility by paying an "adaptor fee" enabling them to use incompatible software. The intuitions we highlight below are generally robust to whether compatibility is absolute or adaptor-based.

The most general result of these models is that holding prices constant, incompatibility reduces consumers' willingness to pay. The strength of this effect depends on the degree to which consumers want to "mix and match" components from different sellers. If demand for such transactions is zero, incompatibility leaves consumers unchanged, but if demand for mix and match transactions is high, incompatibility reduces aggregate willingness to pay. These effects may vary by firm; firms with high demand for mix and match transactions will experience a larger reduction in willingness to pay. In our sample, we would expect this implication to be reflected by a fall in prices as surcharging becomes prevalent. Banks with low ATM density are those whose customers would have the highest demand for "mix and match" transactions in which they would use the machine of another bank, implying that banks with low density would experience the greatest fall in willingness to pay.[11]

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[10]Chou and Shy [1989], Church and Gandal [1989], and Matutes and Regibeau [1989] consider cases where network components are sold separately. Economides and Salop (1992) provide a comparison of market structures characterized by different forms of integration and ownership among component producers. Matutes and Regibeau (1992) examine a case where firms produce both components of the network, but may bundle them together.

[11]This abstracts from the selection effect that would lead customers with inherently high "mix and match" demand to migrate toward banks with large ATM fleets. Such a selection bias will reduced the observed

A second result of the network literature is that incompatibility strengthens the link between the quality of one component and prices for the other. In our setting, we can see this intuition by considering an environment with no ATM fees. In that case customers would attach little or no value to a bank's ATM density. Once incompatibility exists, however, the ATM density becomes important.

A final effect that we examine is that incompatibility shifts relative competitive advantage. While it may reduce willingness to pay for all firms, it will harm some more than others. This might cause customers to migrate toward firms who suffer relatively less under incompatibility. These firms will tend to be those with high quality or market power in one component of the network. In our case, this would be reflected in an increased ability of banks with high ATM density to attract customers after the advent of surcharging, because they become relatively more attractive—particularly to customers with high "mix and match" demand.

The fact that ATM and banking behavior involves travel is also important. Most models of ATM/banking competition portray consumers as facing travel costs to use ATMs. This influences, for example, the marginal decision regarding whether to use a close foreign ATM (which carries fees) or a more distant own ATM. In general, we would expect that the implications discussed above would be stronger for consumers facing high travel costs. At zero travel costs, for example, consumers would never use a foreign ATM or pay fees as long as their home bank had one ATM somewhere.

While quantifying travel costs is difficult, it is widely accepted that areas with high population density have significantly higher travel costs than non-dense rural areas. To account for this, in the empirical work below we present results for subsamples of high and low population density. This turns out to be quite important.

There are limitations to our approach. Broadly speaking, these limitations are related to the partial equilibrium framework implicit in our discussion above. This framework takes a number of features of competition as relatively exogenous; we discuss the implications of our approach below.

A first limitation of our approach is that it abstracts from the compatibility choice at the firm level. Firms clearly choose the level of incompatibility, meaning that it is jointly determined with other features of competitive equilibrium. In our case, we can make an argument that the shift is more exogenous than most for two reasons. One reason is that

difference between banks with high and low ATM density.

firms were constrained prior to 1996 by the by-laws of the largest networks from surcharging. The advent of surcharging after 1996 therefore resulted from the removal of a constraint, rather than a shift in strategic behavior. A second reason for at least weak exogeneity of incompatibility is that we examine how surcharging by a firm's competitors affect its pricing, rather than how its own surcharging affects its own pricing. Of course, in concentrated local banking markets such decisions are interrelated, but the relationship is less direct.

A second limitation of our partial equilibrium approach is that it takes firms' characteristics as given—most notably their software quality, as measured by the size of their ATM fleet. There is little question that the advent of surcharging changed the business model for ATM operations and accelerated the deployment of ATMs; this will become apparent when we discuss the descriptive statistics below. However, for our purposes the deployment decision is not the margin of interest. We are interested in measuring how changes in deployment affect pricing for deposit accounts under both compatibility and incompatibility. In future work we plan to examine how incompatibility affects the deployment decision, but for now we leave that issue aside.

A further constraint on our study here is that it largely ignores the implications of incompatibility for strategic pricing among firms. Our approach is consumer-oriented; we estimate the effects of incompatibility on willingness to pay and customer migration. These exercises are surely clouded by supply-side influences. For example, a substantial body of work exists examining the effects of incompatibility on the intensity of price competition. This work yields mixed results, with some studies finding that incompatibility reduces the intensity of price competition and others finding that it increases the intensity of price competition. While our reduced form approach below can not explicitly separate these effects on prices from those following from willingness to pay, we discuss our results below with an eye toward the interaction between the shift to incompatibility and a shift in strategic behavior.

Finally, our work does not address the policy questions associated with incompatibility in general, and ATM fees in particular. A general result of the theoretical literature on incompatibility is that markets may display "too much" incompatibility from a social welfare perspective. In ATM markets, this argument has been made implicitly (though rarely in the language of the network economics literature) by those who attack ATM fees as "too high." We plan to explore these issues more fully in further work; that work will employ a structural techniques more appropriate for the sort of welfare calculations inherent in these

policy debates.

4 Empirical Specifications and Tests

In this section we describe the hedonic price regressions that we use to measure the impact of ATMs on deposit account pricing. We then describe the reduced form regressions relating bank characteristics to movements in market share.

4.1 Hedonic Pricing Models

A wide literature has used hedonic methods to estimate the relationship between product characteristics and willingness to pay, as reflected in prices.[12] This is also the approach taken in some other studies of compatibility. In our case, we observe characteristics of deposit account bundles offered at the bank/year level; we denote these characteristics by X_{it}. The hedonic pricing model is specified as:

$$p_{it} = X_{it}\beta + \alpha_i + \gamma_t + \varepsilon_{it}$$

where the coefficients β represent the incremental contributions of each characteristic to willingness to pay, and α_i and γ_t are fixed bank and year effects.

A given bank's bundle consists of two types of characteristics, corresponding to different components of the network. The first type is a characteristic associated with the deposit account. For example, banks vary in their quality of customer service. Some of these characteristics will be absorbed into the fixed bank effects, since they do not vary over time.[13]

The second type of characteristic valued by consumers is that associated with the ATM services attached to their deposit account. Because traveling to ATMs to get cash is time-consuming, consumers value having access to close ATMs when they experience an unanticipated need for cash. ATMs therefore increase willingness to pay by reducing expected

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[12]The pioneering work of Rosen (1974) is often cited as justification for hedonic models measuring willingness to pay. The limitations of hedonic models have also been studied, most notably that the parameter estimates do not represent the primitives of consumers' willingness to pay. See, for example Pakes (2003).

[13]We can still learn something about their contribution to the hedonic price by regressing the fixed effects on these fixed bank characteristics; we outline this technique and its results in Appendix B. Chamberlain (1982).

travel costs to use an ATM. Absent ATM fees, we would expect consumers to value all ATMs roughly equally (since possessing a card grants them access to all ATMs in their region); any increase in the overall density of ATMs in their market should increase their willingness to pay for a deposit account. In general, we would expect that consumers would make some assessment of their likely use of ATMs and use that to calculate their expected costs of ATM usage (in time and money). This estimate would affect their willingness to pay for the ATM card (and other services attached to the deposit account).

This implies that in the absence of incompatibility, prices should be related to bank characteristics, own ATM density and competitors' ATM density:

$$\ln(p_{it}) = \beta_1 BankChar_{it} + \beta_2 \ln(OwnDens_{it}) + \beta_3 \ln(CompDens_{it}) + \alpha_i + \gamma_t + \varepsilon_{it}$$

We measure density as machines per square mile over all counties in which the bank operates. We use logs to reflect the fact that each additional machine reduces the expected travel distance to use an ATM by a successively smaller amount.

Our measure of deposit account prices divides annual income associated with deposit accounts by year-end balances in these accounts:

$$p_{it} = \frac{FeeInc_{it}}{Deposits_{it}}$$

This measure reflects the annual price per dollar of deposit account balances.[14] The fee income measure includes revenue from monthly account fees, fees on bounced checks, per-check transaction charges, extra fees for returned checks, and in rare cases fees for the use of tellers' services. It also includes "foreign fee" income; we discuss the implications of this below. It does not include income from surcharges, as surcharge revenue is collected from non-customers and therefore falls into a separate revenue category.

One important measurement issue associated with our price measure is that the income and deposit variables include not only demand (checking) deposit balances but also balances for other types of deposits such as money markets and CDs. for the numerator this is not much of an issue, as these other types of account rarely carry fees. However, the denominator overstates balances. In most cases, demand deposit balances average roughly 10 percent of total deposits. Econometrically, the measurement error in our denominator need not pose a problem if it is orthogonal to our right-hand side. However, the measurement error does

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[14]See the Data Appendix for more detail on the construction of this variable.

change the economic interpretation of our coefficients. We note this when we discussing the data and empirical results.

Another issue associated with our price measure is that it includes revenue from foreign fees. On one level this seems methodologically correct since foreign fees are part of the price of the bank's own deposit account bundle. However, foreign fees also influence the *marginal* cost to a consumer of using another bank's ATM. for this reason foreign fees influence incompatibility. To handle this issue, we construct two measures of incompatibility, one that depends only on competitors' surcharging and one that also depends on foreign fees. We now discuss the construction of these variables.

4.2 Modeling Incompatibility

Incompatibility has two effects in the hedonic model. The primary effect of incompatibility is that it reduces the value of competitors' software. This should be reflected in a reduction on the influence of competitors' software on willingness to pay. A secondary effect of incompatibility is that it should increase the marginal impact of own software quality on willingness to pay. This is because consumers can substitute less effectively under incompatibility, strengthening the direct link between quality and prices.

We measure incompatibility in three ways. First, because the primary change in compatibility was discrete following regulatory changes, we construct a dummy variable equal to one if the state in which a bank has primary operations allows surcharging.[15] This variable is equal to one for all observations after 1996, and also equal to one for any bank operating in a state that overrode the surcharge ban prior to 1997.

The second way we measure incompatibility is by quantifying the expected surcharge a consumer must pay for using another bank's ATM. This measure is:

$$E\left[Surcharge_{it}\right] = \sum_{-i} w_{-it} Surcharge_{-it}$$

The expected surcharge is the average of surcharges at other banks' ATMs, where the weights are the shares of total ATMs held in the market by the other banks. The motivation for this specification is an assumption that consumers know something about the distribution of ATMs and ATM fees in their local market, but do not have perfect knowledge regarding

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[15]We define the state of "primary operations" as that in which the bank holds the greatest dollar value of deposits.

either specific fees at each ATM or the locations in which they will experience an unanticipated need for cash. Because we possess surcharge data for only the largest ATM issuers in each market, constructing this expectation requires making an assumption about the surcharging behavior of smaller issuers. We outline these assumptions and discuss robustness in the Data Appendix.

As mentioned in the previous section, we also construct an incompatibility measure that depends on the bank's own foreign fees:

$$E\left[ForeignCost_{it}\right] = ForFee_{it} + \sum_{-i} w_{-it} Surcharge_{-it}$$

Using this measure will bias the coefficient on this variable when it is on the right-hand side of the hedonic regression, because higher fees *per se* lead to higher prices when our price measure includes foreign fee income. This limits our ability to interpret these coefficients.

We incorporate the effects of incompatibility by interacting the incompatibility measure with ATM characteristics. This yields the following specifications, where $Incompat_{it}$ refers generically to any of the three measures above:

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\begin{aligned}
p_{it} =\ & \beta_1 BankChar_{it} + \beta_2 \ln(OwnDens_{it}) + \beta_3 \ln(CompDens_{it}) + \\
& \beta_4 Incompat_{it} \ln(OwnDens_{it}) + \beta_5 Incompat_{it} \ln(CompDens_{it}) + \alpha_i + \gamma_t + \varepsilon_{it}
\end{aligned}
$$

4.3   Market Share Regressions

As a further test of the relationship between incompatibility and market outcomes, we specify a reduced form relationship between market share and bank-level characteristics. This allows us to estimate whether the increase in incompatibility following surcharging changed the relationship between ATM-related characteristics and market share. We begin with the following relationship:

$$DepShare_{it} = \beta_1 ATMShare_{it} + \beta_2 BankChars_{it} + \delta_i + \eta_t + \varepsilon_{it}$$

The dependent variable in these regressions is the bank's share of the local deposit markets in which it competes. The bank characteristics include the bank's share of branches in its local markets, as well as its average salaries per employee and employees per branch. The ATM share variable measures the bank's share of total ATMs in its local markets. The specifications also include fixed year and bank effects.

The specification above omits prices, which would clearly influence market share but are also endogenous. for the purposes of comparison, we also estimate fuller specifications that include prices on the right-hand side:

$$DepShare_{it} = \beta_1 ATMShare_{it} + \beta_2 BankChars_{it} + \beta_3 p_{it} + \delta_i + \eta_t + \varepsilon_{it}$$

We incorporate the effects of incompatibility by interacting the ATM share variable with our incompatibility measures as defined above. The specifications are:

$$DepShare_{it} = \beta_1 ATMShare_{it} + \beta_2 Incompat_{it} \times ATMShare_{it} + \beta_2 BankChars_{it} + \delta_i + \eta_t + \varepsilon_{it}$$

$$DepShare_{it} = \beta_1 ATMShare_{it} + \beta_2 Incompat_{it} \times ATMShare_{it} + \beta_3 BankChars_{it} + \beta_4 p_{it} + \delta_i + \eta_t + \varepsilon_{it}$$

4.4 Econometric Issues

The most serious econometric concern with our specifications above is endogeneity. We would expect that a bank's ATM density or share and deposit fees might be determined jointly as part of a bank's overall business strategy, or both affected by unobservable variables. Branch density/share and our other bank-level characteristics might also be endogenous for similar reasons. If banks set fees strategically, we might also expect competitors' surcharging to be related to a bank's ATM density or deposit fees.

The endogeneity problem seems likely to be most acute in the market share regressions, which also have prices on the right-hand side. In these regressions we instrument for prices using a bank-level measure of costs, the loan loss ratio.[16] It is more difficult to think of an appropriate instrument for ATM density. In cases where it is difficult to conceive of appropriate instruments, our approach is to make clear that we are not identifying causal links between the right-hand side variables and our dependent variables. Our empirical tests simply seek to identify *shifts* in the correlations between our right-hand and dependent variables; we estimate the extent to which these shifts are linked to incompatibility.

A second difficulty with our data is that some right-hand side variables are measured with error (see the Data Appendix for a full discussion of this issue). We attempt to account for this by modifying our estimated standard errors.

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[16]We construct the loan loss ratio by dividing the bank's annualized loan losses by its year-end aggregate loan balances.

5   Data and Descriptive Statistics

Table 1 present descriptive statistics for our sample. The Data Appendix outlines definition and measurement issues for these variables. We take our data from a variety of sources. The ATM-related characteristics come from the Card Industry Directory, an annual trade publication listing data on ATM fleets and fees for the largest three hundred ATM issuers. Many of those issuers are multi-bank holding companies; this gives us data for roughly 4500 bank/years over the sample period 1994-1999.

In most cases we report median values for our data, because the data are highly skewed. One source of skewness is bank size; for example, while the median bank size (in deposits) is $326 million, the mean is $2.3 billion. The tenth and ninetieth percentiles are $58 million and $5.8 billion. Another source of skewness is geographic diversity, realized largely through differences in branches and ATMs per square mile. The only variables for which we report means are those that are not skewed: deposit fees, ATM fees and our analogous measures for competitors, salary per employee and employees per branch.

The top rows show data by year regarding deposits, branches and ATMs, as well as market share data for each of these three variables. These share variables remain roughly constant over our sample, despite a steady increase in median bank size. This reflects changes in the composition of our sample; during the late 1990s, banks consolidated but primarily across markets rather than within them. Thus, the typical bank became larger but did not expand within-market shares. Our competitor-based variables show that ATM deployment grew faster than branch density. Overall, deposit fees remained constant for the sample overall, as did foreign fees. Surcharges became quite prevalent between 1997 and 1999, which nearly doubled a customer's expected costs for using a foreign ATM. Salary per employees and employees per branch remained essentially constant.

While the data in Table 1 would suggest that little changed after the advent of surcharging, a closer look at the data reveal otherwise. In order to clarify the issue, we present data in Table 2 that are stratified in two ways. First, we separate banks into those operating in areas of high population density from those operating in areas of low population density. We also separate large and small banks, based on local ATM share. We categorize as "high density" any bank operating in areas with an average population density above the sample median, and the remainder as operating in "low density" areas. We further segment these subsamples, treating as "large" any bank in the subsample with a share of the local ATM market larger than the median (for that subsample).

These data show a clear pattern in which the greatest changes following the advent of surcharging occurred by large banks in dense areas. In these markets, large banks become larger and small banks become smaller, as measured by deposit share. There is little analogous movement in branch density, which changes little for either size category. The most dramatic changes are in ATM density, which doubles for large high-density banks but is unchanged for smaller high-density banks. This is associated with equally dramatic changes in prices. Large banks charge significantly higher ATM fees. They also charge higher deposit fees. More importantly, this deposit fee gap grows significantly after the advent of surcharging, from $0.60 in 1995 to $1.66 in 1999.

There is little evidence of such change in low density areas. While there are differences between large and small banks, they are not nearly so dramatic. Nor do they change very much after the advent of surcharging.

The overall pattern illuminated by these data are that surcharging is coincident with substantial changes in high-density (i.e. urban) banking markets, but little change in rural banking markets. In these high-density markets, large banks increase the size of their fleets. Large banks are no more likely to impose high surcharges than small banks in these markets, but they have begun to charge significantly higher deposit fees. They also have begun attracting deposit market share, apparently at the expense of smaller banks.

6   Results

Table 3 presents the results of our hedonic regressions examining the relationship between incompatibility, bank/ATM characteristics and pricing. In general our results show an intuitive relationship between bank characteristics and prices.[17] In each of the specifications, both salary per employee and employees per branch are positively related to prices. In a somewhat puzzling development, there appears to be no systematic relationship between branch density and prices (mention Dick paper, note that she does not have ATM density...).

Our baseline specification in column 1 omits the incompatibility measures, restricting the relationship between ATMs and prices to be identical across all regimes of compatibility. In this baseline specification we observe a positive relationship between own ATM density and prices, but no statistically significant relationship between competitors' ATM density and prices. A one percent increase in own ATM density increases willingness to pay by .028

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[17]Note that the bank-level fixed effects capture bank characteristics that do not vary over time.

percent. While this is a small elasticity, it is economically significant when we consider the fact that in our sample, some banks increase their ATM density by as much as three hundred percent.

The next three models include the density/incompatibility interaction terms. In each case, the results suggest that incompatibility strengthens the relationship between own ATMs and deposit account prices. The results are robust to the incompatibility measure, although they are slightly weaker for the surcharge dummy measure than the others. This is not surprising given that this is a weaker proxy for incompatibility, and also given that incompatibility may have not existed prior to 1997 even where surcharging was permitted by law. The economic significance of the coefficients are large; they suggest that the relationship between own ATMs and prices may have been as much as twice as large under incompatibility.

Including the interaction terms makes the coefficient on competitors' density statistically significant, and while it is predictably less than that on own density it is also economically significant. More importantly, the coefficients on the interaction terms suggest that incompatibility reduces the relationship between competitors' ATM density and prices. This is consistent with our expectations. The magnitude of the results implies that by 1999 the relationship between competitors' ATMs and own deposit prices had essentially disappeared.

The last two columns split the sample based on the population density of the markets in which the bank operates, at the median density. The first column (Model 5) shows results for banks in low density markets, while the second column (Model 6) shows results for the banks in high density markets. We use the expected surcharge measure, although the results are similar using either of the other two.

These results corroborate the pattern discussed in the descriptive statistics above. All of the relevant relationships—between own or competitors' density and prices, and between incompatibility and prices—are much stronger in high-density markets than in low density markets. In fact, they are nearly nonexistent in these low-density areas.

Table 4 present results from our market share regressions. As might be expected, there is an extremely strong relationship between branch share and deposit share—nearly one to one, and estimated very precisely. Salaries per employee and employees per branch have the expected signs, although the salary variable is only significant in one model. The price variable is negative and significant when it is included, although the coefficients on the other variables do not change much depending on whether it is included. We again present specifications for all three of our incompatibility measures.

The results show a positive and statistically significant relationship between ATM share and deposit share. They also show that this relationship is stronger under incompatibility. This result holds regardless of the incompatibility measure that we use. In the last two columns, we again stratify the sample based on density, with similar results. The relationships between ATM share and deposit share, and the effects of incompatibility, are much stronger for banks operating in high density areas.

7 Discussion and Conclusion

This pattern of results suggests that the interplay between compatibility and pricing is important, and that links between pricing and quality for different products linked by indirect network effects can be quite strong. This is particularly useful to know since many previous studies of network markets have examined only one component and essentially ignored the other.

It is important to be circumspect about the policy implications of these findings. While they do seem to indicate a competitive advantage by large banks, this competitive advantage might be welfare-enhancing if it reflects increased quality. It appears that large banks dramatically increase the quality of their software, by increasing the density of their ATM deployment. This could easily explain the shifts in deposit pricing and market share.

A Data Appendix: Sources and Variable Construction

A.1 Primary Data Sources

We take our data from four principal sources. The first is the Card Industry Directory, an annual trade publication listing detailed data on ATM and debit card issuers. The Card Industry Directory contains data for the largest 300 ATM card issuers, who collectively own roughly XX percent of the nation's ATM fleet during our sample period. These issuers are most often commercial banks, although some are bank holding companies, credit unions or thrifts. The sample period covered in our data set runs from 1994 to 2002. Data are measured on January 1 of each year.

We also take data from the FDIC Reports of Condition and Income, or Call Reports. The Call Report data are collected quarterly by the FDIC for every commercial bank in the

country. The Call Reports contain detailed balance sheet and income data for each bank. They also indicate which bank holding company owns the bank. Thus, if the Card Industry Directory contains a listing regarding ATM issuance for a bank holding company, we can match that data with the corresponding data for each bank owned by the holding company. The Call Reports do not contain data for credit unions or thrifts; we drop them from the sample.

We supplement the above with data from the FDIC Summary of Deposits Database (SOD). The SOD lists the location of branches for every bank and thrift in the country. It also lists the deposits held at each branch. It does not contain data on branch location for credit unions. We assume that each credit union has one branch, located in its home county, and that all of that credit union's deposits are held at that branch. This assumption is unlikely to affect our results. SOD data are collected each June.

A.2 An Observation in Our Data

By cross-referencing the data sets above, we obtain observations at the issuer level describing each issuer's balance sheet activity and ATM activity. We also use the geographic data from the SOD to derive information about the market(s) in which the issuer competes. Because the data are measured at different times, we must establish a concordance between the dates in the different data sets. We establish the concordance based on the fact that our analysis includes deposit prices and quantities as LHS variables, and ATM-related variables as RHS variables. While these are jointly determined, to mitigate the endogeneity problem we match ATM-related data for each January with six-month ahead data from the other data sets. Thus an observation from 1994 contains ATM-related data from January 1994, while all other data are from June 1994. We describe these data below.

A.2.1 Pricing for Accounts and ATMs

For each issuer, we observe its income associated with deposit accounts over the year preceding the observation date. The primary component of such income is income from monthly service charges on deposit accounts. It also includes foreign fee income paid by its customers stemming from the use of other issuers' ATMs. It also includes a variety of other fees such as NSF fees for bounced checks and other penalty fees on deposit accounts. If the issuer is a bank holding company, we sum its deposit fee income for all banks in the holding company.

To develop our measure of prices, we divide income on deposit accounts by the end-of-year dollar value of deposits (in thousands). This price measure therefore represents the average fees paid per dollar of deposits; this is a measure of the opportunity cost of holding dollars in a checking account. This measure omits the additional opportunity cost of holding deposits in checking, which is the forgone savings interest income. However, it is likely that the measurement error associated with omitting this component of "prices" is similar across banks, and within banks over time.[18]

Another issue associated with using this price measure is that banks typically offer consumers account options with lower explicit fees in exchange for maintaining higher minimum balances. If banks differ systematically in the composition of their customer bases, we will understate fees at banks with high deposits per customer (assuming those customers sort into accounts designed for them).

A practical difficulty with using this measure of fees is that the numerator is a flow measure over the previous year, while the denominator is a stock measure at end-of-year. This creates measurement error for banks with large deposit acquisitions or divestitures during the year. Indeed, there are a significant number of observations with implausibly small or large fee measures. To check that these were outliers stemming from measurement error, we measured the year-to-year percentage change in deposits for observations with exceedingly small or high fee measures; we found that in most cases such observations were for banks that experienced extremely large changes in deposits (more than fifty percent in absolute value). We drop these observations. In unreported specifications we also include these observations but truncate the fee variable at "reasonable" values, with little difference in the qualitative results.

For each issuer in the Card Industry Directory, we also observe its foreign ATM fee and surcharge at the beginning of the year for the observation. In some cases, the bank lists a range for these fees. In that case, we use the highest fee reported. In the empirical work, this tends to understate the true relationship between fees and our other variables of interest.

A.3   Deposits, Market Share and Other Issuer-Level Variables

A.3.1   Market Share Variables

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[18]Large banks tend to pay lower interest than smaller banks. This may refect quality differences or market power. If savings rate differences stem from market power and consumers face switching costs, we will slightly overstate the price difference between large and small banks using our fee income variable.

For each issuer, we observe its total deposits, ATMs and branches. We also observe the distribution of its deposits and branches across individual counties. We also observe the issuer's market share within each county, in terms of both branches and deposits. Thus, for each county in which an issuer operates, we know its share of all branches/deposits in that county. For example, for branches we construct:

$$\omega_{ijt} = \frac{branches_{ijt}}{\sum_{k \in j} branches_{ijt}}$$

We also know the share of its total branches/deposits allocated to that county. For branches we construct:

$$\alpha_{ijt} = \frac{branches_{ijt}}{\sum_{k \in i} branches_{ijt}}$$

This information allows us to construct a number of issuer-level variables. First, we can measure the issuer's weighted deposit/branch market share across all counties by constructing a weighted average of its market share in individual counties:

$$WtMktShr_{it} = \sum_j \omega_{ijt} \alpha_{ijt}$$

Constructing an estimate of the issuer's ATM market share weighted across all the counties in which it operates introduces two difficulties we do not face with the branch/deposit data. First, for a given issuer we do not observe the actual distribution of ATMs across counties. We deal with this by assuming that the issuer's share of ATMs in each county is equal to its share of branches in that county. In other words, we estimate

$$ATM_{ijt} = \alpha_{ijt} ATM_{it}$$

This implies that the issuer maintains a constant ratio of ATMs per branch in all geographic regions. While this may not be true in practice, our empirical results derive from within-issuer changes in ATM deployment. Our imputation method then reduces to an assumption that changes in issuers' deployment strategies are reflected equally in all counties.

A second difficulty with our ATM data is that we only observe ATM deployments for the largest 300 issuers. This creates a problem because estimating the issuer's share of total ATMs within a particular county requires knowing the total number of competitors' ATMs in that county. Therefore we must estimate the number of ATMs deployed by other FIs within

the county. In order to estimate the number of ATMs deployed by other FIs, we estimate a within-sample regression of ATMs on branches, year dummies and year/branch interaction terms. To control for the fact that larger FIs have a greater ratio of ATMs to branches, we also interact the branch variables with the log of issuer size (in deposits). We then construct fitted values of ATMs for each FI for which we do not have ATM data. In order to check the sensibility of this procedure, we compared the fitted total number of ATMs from this procedure to aggregate data on ATM deployment. The figures match fairly closely.

A final point regarding the measurement of ATM share is that it omits ATMs deployed by Independent Service Operators (ISOs). This introduces measurement error, and may bias our measures of competitors' ATM density.

A.3.2 Density and Demographic Variables

We also estimate the density of each issuer's branches and ATMs per square mile. We construct these estimates by aggregating the square mileage of every county in which the issuer operates. We then divide the issuer's total ATMs and branches by this figure.

We also possess population density and income data for each county in which an issuer operates. To aggregate these data up to the issuer level, we construct weighted averages based on the issuer's share of its total deposits in each county.

B   Second-Stage Hedonics

A number of bank-level characteristics are fixed at the bank level over time. This precludes their inclusion in the hedonic regressions, which also include bank fixed effects. However, we can learn something about the value of these other characteristics by examining their relationship to the fixed effects.

Starting with our estimates $\widehat{\alpha}_i$ of the bank fixed effects, we construct the vector Π_i of time-invariant bank characteristics. The first set of such characteristics describes the product offerings of each bank; there are dummies equal to one if the bank offers a credit card, money market accounts, or brokerage services. We also include a dummy if the bank has branches in multiple counties, and a dummy equal to one if the bank is part of a larger bank holding company. We further interact the bank holding company with a dummy indicating that the bank is "small," having deposits of less that $250 million. Presumably, if there are unmeasurable benefits to being part of a bank holding company because the holding

company provides ancillary services or confers higher quality, small banks would stand to gain the most.

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C Tables and Figures

Table 1. Descriptive Statistics

Variable	1994	1995	1996	1997	1998	1999
Deposits/bank ($millions)	264	302	322	412	490	509
Deposit share	0.15	0.15	0.15	0.15	0.15	0.13
Branches/bank	6	7	7	7	8	7
Branches/square mile	0.008	0.008	0.008	0.008	0.009	0.008
Branch share	0.13	0.13	0.13	0.12	0.11	0.10
ATMs/bank	7	8	10	11	14	14
ATMs/square mile	0.008	0.010	0.010	0.012	0.013	0.013
ATM share	0.13	0.13	0.14	0.14	0.12	0.12
Competitors' ATMs/square mile	0.07	0.09	0.10	0.13	0.19	0.22
Competitors' branches/square mile	0.08	0.09	0.11	0.12	0.15	0.16
Deposit fees ($ per $1000 of deposits)	2.48	2.50	2.50	2.31	2.39	2.45
Foreign fee ($)	1.20	1.31	1.31	1.19	1.23	1.16
Surcharge ($)	n/a	n/a	n/a	0.67	0.91	0.95
Expected competitors' surcharge ($)	n/a	n/a	n/a	0.53	0.73	0.88
Salary per employee ($1000)	16	16	17	18	19	20
Employees per branch	17	16	16	16	16	15

Sources: Federal Reserve *Reports of Condition and Income* (Call Reports),
years; FDIC *Summary of Deposits*, various years; *Card Industry Directory*,
various years.

Table 2. Summary Statistics by ATM Share and Population Density

Variable		1994	1995	1996	1997	1998	1999
Deposit share:	large bank, high density	0.192	0.199	0.188	0.202	0.206	0.208
	small bank, high density	0.040	0.038	0.034	0.032	0.031	0.029
	large bank, low density	0.296	0.292	0.285	0.315	0.326	0.320
	small bank, low density	0.143	0.148	0.153	0.151	0.173	0.152
Branches/	large bank, high density	0.037	0.036	0.038	0.042	0.035	0.039
square mile:	small bank, high density	0.012	0.012	0.012	0.011	0.013	0.012
	large bank, low density	0.007	0.008	0.008	0.008	0.009	0.012
	small bank, low density	0.004	0.004	0.004	0.006	0.005	0.005
ATMs/	large bank, high density	0.043	0.047	0.054	0.066	0.084	0.091
square mile:	small bank, high density	0.010	0.011	0.009	0.012	0.014	0.013
	large bank, low density	0.007	0.009	0.010	0.010	0.012	0.012
	small bank, low density	0.003	0.004	0.004	0.005	0.004	0.004
Deposit fees:	large bank, high density	2.87	2.89	2.89	3.01	3.29	3.29
	small bank, high density	2.37	2.32	2.15	2.06	1.91	1.82
	large bank, low density	2.46	2.72	2.87	2.92	2.54	2.73
	small bank, low density	2.51	2.40	2.40	2.42	2.28	2.43
Surcharge:	large bank, high density	n/a	n/a	n/a	0.82	1.11	1.18
	small bank, high density	n/a	n/a	n/a	0.47	0.95	0.91
	large bank, low density	n/a	n/a	n/a	0.92	1.27	1.25
	small bank, low density	n/a	n/a	n/a	0.84	1.10	1.05
Foreign fee:	large bank, high density	1.33	1.37	1.43	1.35	1.37	1.29
	small bank, high density	1.12	1.23	1.20	1.04	1.08	1.01
	large bank, low density	1.31	1.45	1.51	1.32	1.48	1.40
	small bank, low density	1.19	1.36	1.28	1.18	1.24	1.16

Table 3. Hedonic Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
ln(own ATM density)	0.028**	0.027**	0.022*	0.005	0.030*	0.020
	(0.013)	(0.013)	(0.013)	(0.013)	(0.018)	(0.014)
ln(own ATM density)		0.009***				
×surcharge dummy		(0.003)				
ln(own ATM density)			0.024***		0.002	0.029***
×E(surcharge)			(0.006)		(0.008)	(0.006)
ln(own ATM density)				0.020***		
×foreign ATM cost				(0.004)		
ln(competitors' ATM density)	0.003	0.011	0.019*	0.048***	−0.004	0.029**
	(0.009)	(0.010)	(0.010)	(0.012)	(0.014)	(0.012)
ln(competitors' ATM density)		−0.016***				
×surcharge dummy		(0.004)				
ln(competitors' ATM density)			−0.031***		0.001	−0.035**
×E(surcharge)			(0.006)		(0.010)	(0.009)
ln(competitors' ATM density)				−0.031***		
×foreign ATM cost				(0.005)		
ln(own branch density)	−0.018	−0.016	−0.019	−0.019	−0.004	−0.031
	(0.018)	(0.018)	(0.018)	(0.018)	(0.024)	(0.020)
ln(employees per branch)	0.039**	0.042**	0.038**	0.039**	0.001	0.088***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.002)	(0.020)
ln(salary per employee)	0.206***	0.205***	0.210***	0.210***	0.088***	0.186***
	(0.032)	(0.032)	(0.032)	(0.032)	(0.024)	(0.032)

Notes: Dependent variable is ln(Deposit Fees).

All specifications include fixed year and bank effects.

Number of observations is 4203.

* - significant at 10 percent or better

** - significant at five percent or better

*** - significant at one percent or better

Table 4. Market Share Regressions

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
ATM share	0.041***	0.043***	0.032**	0.032**	0.013	0.043***
	(0.012)	(0.012)	(0.013)	(0.013)	(0.017)	(0.017)
ATM share×E(surcharge)			0.011*	0.016**	0.015**	0.040***
			(0.007)	(0.007)	(0.007)	(0.010)
Branch share	0.766***	0.765***	0.772***	0.774***	0.759***	0.778***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.023)	(0.024)
ln(employees per branch)	0.022***	0.024***	0.022***	0.024***	0.029***	0.020***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
ln(salaries per employee)	0.011**	0.018***	0.011**	0.017***	0.017***	0.019***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
ln(deposit fees)		−0.025***		−0.026***	−0.021***	−0.029***
		(0.003)		(0.003)	(0.004)	(0.003)

Notes: Dependent variable is ln(Deposit share). All specifications include fixed year
and bank effects. Number of observations is 4160.

* - significant at 10 percent or better

** - significant at five percent or better

*** - significant at one percent or better

Table B1. Second stage hedonics with time-invariant characteristics.

Variable	Model 1
Multi-county bank dummy	0.113***
	(0.038)
Offers credit card	-0.063
	(0.046)
Offers money market	0.285
	(0.218)
Offers brokerage services	0.065*
	(0.040)
Part of BHC	0.527***
	(0.070)
Part of BHC	0.152*
×small bank	(0.082)
constant	-0.796***
	(0.223)
n	1397
R^2	0.05

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