Retail Bank Services Strategy: A Model of Traditional, Electronic, and Mixed Distribution Choices

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ABSTRACT: Design of a retail banking distribution strategy is an important issue in that industry. This paper shows the effect of new electronic distribution technologies such as PC banking on the choice of a bank’s distribution strategy. We present a competitive model of distribution strategy choice, including heterogeneous consumers and banks, that allows a rich variety of customer preference and technology cost parameters. Sensitivity analysis shows how several parameters affect the competitive outcome. This analysis suggests that changing consumer behavior and attitudes, instead of banks’ cost structure with new technologies significantly affects the bank’s distribution strategy choice. If the segment of consumers that prefers PC banking remains small relative to the segment that prefers branches, then there will still be a market for specialized branch banks. Branch banking without PC banking services will be a viable strategy until the segment that prefers PC banking grows larger (amounting to about 40 percent of all transactions). Banks offering both branch and PC banking services can prevent successful and profitable entry by virtual banks (Internet banks offering only PC banking services) as long as the segment of customers that prefer PC banking remains relatively small (less than two-thirds of all transactions). Beyond this fraction, virtual banks will be profitable. This analysis suggests that it may be a long time (if ever) before virtual banks turn a profit.

KEY WORDS AND PHRASES: automated teller machines, ATM, banking industry, branch banking, channel selection, distribution channels, electronic banking, financial services, PC banking, retail banking
Technology and Competition in Retail Banking

Over the past twenty years the retail banking industry has experienced major changes. These changes include increased competition among banks and nonbanks, evolution in customer preferences, and technological advances in bank distribution systems [3]. With deregulation of the financial services sector, nonbanks can now compete with banks, and banks can provide services in formerly prohibited geographical areas. The rise of PCs has created a group of customers with the ability and desire to conduct remote transactions. Technological advances have shifted retail banking’s historical reliance on branches. Many banks have expressed a desire to reduce the number of bank branches and shift transactions to lower-cost electronic channels [12, 15]. Further, the advent of “pure” virtual banks—banks with no branches or ATMs—has called into question the importance of bank branches, even driving some to predict that branches will one day be virtually eliminated from retail banking distribution [7]. Others have suggested that banks will have to offer the full range of technology choices, including branches, to customers, or be forced out of the market [3].

This paper examines a retail bank’s choice of distribution strategy in light of the major competitive and consumer changes in the marketplace. The paper applies an economic model of a competitive market for retail banking services to generate insights into the following relevant questions: Is the cost structure of electronic distribution systems sufficient to justify “pure” virtual banks? What is the effect of changing customer preferences and other market parameters on the equilibrium mix of banks? Does technology choice affect a retail bank’s ability to compete? In short, our answers are: probably not, virtual banks will not be successful until a large fraction of consumers prefers PC banking over branches; changing customer preference will result in fewer branch banks and more banks offering branch and PC banking services; and yes, technology will be increasingly important for banks to compete. As our purpose is to model competition between retail banks, any reference to a bank is meant to be a retail bank, not a commercial or investment bank.

Our goal is to model competition between banks and nonbank financial services firms in order to predict the probable “winners and losers” in the market. The model employed captures a rich variety of influential market parameters, both from the consumer side and the producer side. For simplicity we assume two different customer segments, each with preferences for technologies and the price and convenience of services. Consumers differ in their attitudes toward transaction technology. In practice, many customers may be averse to dealing with tellers and prefer the efficiency of an ATM or PC banking system, but other customers are wary of remote technology and prefer the secure feeling of interacting with a teller. In this study we allow two customer segments corresponding to those consumers preferring branches and those consumers preferring electronic distribution. On the producer side, retail banks can choose between various distribution technologies to capture transactions, including branches, ATMs, and PC banking systems. Further, the model incorporates both fixed and variable costs of providing banking service. The model is developed under sufficient conditions to guarantee the existence of a competitive entry equilibrium. A com-
petitive entry equilibrium requires customers to maximize their utility, banks to maximize their profits, total supply to equal demand, and potential bank entrants to earn zero profit once entry occurs.

We found major results that we describe next. Depending on the mix of customer segments, there are three separate strategies that can competitively dominate all others. These strategies are the only ones observed in equilibrium: (1) a branch banking strategy serving only the segment of customers that prefer branch transactions, (2) a PC banking strategy serving only the segment that prefers electronic transactions, and (3) a combined strategy using branches and PC banking that serves each segment using its preferred channel. These strategies dominate systems using only branches to serve both segments, and systems using ATM systems without branches (either a bank’s own or ones from another bank). Thus a bank that wishes to serve both segments needs a branch system as well a PC banking system. A bank that wishes to serve the branch banking preferring segment must have branches, and a bank that wishes to serve the segment preferring electronic distribution must have a PC banking system.

Currently, the electronic channel segment is very small—fewer than seven percent of households with PCs have PC banking accounts. If the segment of consumers that prefers PC banking remains small relative to the segment that prefers branches, then there will still be a market for specialized branch banks. If this segment is small, banks offering both branches and PC banking services can prohibit successful entry by virtual banks (banks that do not have their own branches). However, if the customers who prefer electronic transactions grow at the expense of the other segment, as some have suggested, the model predicts that branch banks, and some banks offering both branches and PC banking services, will exit the market in favor of virtual banks. Before a virtual bank profitably survives, however, this segment must generate about two-thirds of market transactions.

Further analysis shows that the equilibrium results are relatively insensitive to the fixed and variable costs of technology. The results generally suggest that changing consumer behavior, rather than bank cost structure, drives changes in retail bank competitive strategies at equilibrium, and that virtual banking strategies are unlikely to succeed.

While there are other papers in the literature with related modeling approaches, no other papers address the banking distribution strategy question. The closest paper [2] models competition between retailers and a direct marketer. The retailers have a physical outlet, and the direct marketer uses catalogs. That paper identifies the prices and market shares that result and demonstrates the conditions under which a direct marketer can successfully compete against the retailers. However it considers only a single customer segment with inelastic demand, and the firms are either of one type or another.

Lederer and Li [11] model time-based competition with heterogeneous firms and customer segments. Their paper is relevant to our current effort in that it models competition when customer tastes can be described with a hedonic pricing model in which the costs and benefits of attributes add to the customer’s cost. Also related is
De Vany and Saving [6], who address the determination of quality in an equilibrium model and consider the relationship of social welfare and market equilibrium. However, their approach considers only a single product and firm type. Hence, they do not address a changing mix of firms in equilibrium.

Prasad and Harker [14] address the question of pricing PC banking services considering the existence of network externalities. However, they do not address the issue of strategic choice of distribution technology or equilibrium. Several articles in the industry literature discuss the nature of branches and locations in a marketing framework. Other articles discuss strategic branch location focusing on qualitative aspects, such as sharing facilities with supermarkets or warehouse stores [1, 9, 16, 17]. Although others discuss the trade-offs and strategies involved in choosing a distribution strategy, none applies an analytical approach [3, 15]. Finally, there are some mathematical models of locating bank branches in a market. Most of these models address the optimal location of branches based on demographic information, but do not address the trade-off between alternative service delivery systems [5, 8, 10, 13].

Model of Retail Banking Market

Next, we present a model of the market for retail banking services with heterogeneous consumers and banks. The purpose of the model is to study competition between competing banks who choose prices for services, distribution technologies, and volumes of customers served. Our model captures many aspects of competition. Banks compete by providing retail banking transactions to spatially dispersed consumers for a fee, and these transactions can be provided through different distribution technologies, for example, branches and PC banking. Banks may differ in their choice of distribution strategy. Consumers differ in their sensitivity to price, preference for distribution technology, and average distance from a retail bank. Market demand for transactions is a decreasing function of consumer costs, including price and convenience costs. Banks differ in cost structure and distribution technology choices. To assist the reader, Table 1 lists and describes the major variables and parameters defined in this paper.

Competition between banks is modeled following a variation of the “perfect competition” model. That is, banks are “price takers.” But our model differs in several important ways: we consider the fixed costs of entry to a market and allow banks to enter and exit. Also, customers evaluate purchases on the total cost of goods, where total cost includes the price and convenience or quality of the item. How we model competition is deferred to in the next section. We begin by considering banks’ decisions.

We allow banks to choose one or several ways to collect and distribute transactions. Formally, the set of distribution technologies are in the set $K = \{B \text{ (branch banking)}, PC \text{ (home PC banking)}, ATM \text{ (owned ATMs)}, OATM \text{ (other banks’ ATMs)}\}$.

For ease of analysis we assume that the technologies are generally standardized so that any banks choosing a particular technology have the same cost structure for that technology. Branches represent the “classical” bank outlet, either the usual indepen-
Table 1. Summary of Notation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Remarks</th>
<th>Meaning of Notation</th>
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<tbody>
<tr>
<td><strong>Indices</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$K = {B, PC, ATM, OATM}$</td>
<td>Indices to indicate technology</td>
<td>Set of distribution technologies: branches, PC banking, a bank's own ATM, using other banks’ ATMs, respectively.</td>
</tr>
<tr>
<td>$k$</td>
<td>Generic index for technology</td>
<td></td>
</tr>
<tr>
<td>$J = {b, e}$</td>
<td>Indices used to indicate segment</td>
<td>Set of consumer segments: branch preferring customers and electronic distribution-preferring customers, respectively.</td>
</tr>
<tr>
<td>$j$</td>
<td>Generic index for segment</td>
<td></td>
</tr>
<tr>
<td>$I$</td>
<td></td>
<td>Set of firm strategies: what subset of distribution technologies a bank has (a subset of $J \times K$).</td>
</tr>
<tr>
<td>$i$</td>
<td>Generic index for strategy</td>
<td></td>
</tr>
<tr>
<td><strong>Cost parameters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$h_{jk}$</td>
<td></td>
<td>Disutility imposed on customer segment $j$ by a transaction through technology $k$ ($$/transaction)</td>
</tr>
<tr>
<td>$\beta_j$</td>
<td>Coefficient of segment $j$’s disutility due to distance ($$/mile)</td>
<td></td>
</tr>
<tr>
<td>$F_k$</td>
<td>Yearly fixed cost of placing an outlet using technology $k$ in the market region, $k = {B, ATM}$ ($$/year)</td>
<td></td>
</tr>
<tr>
<td>$G_i$</td>
<td>Yearly fixed cost of maintaining a network of strategy $i$ ($$/year)</td>
<td></td>
</tr>
<tr>
<td>$c_k$</td>
<td>Coefficient of variable cost per transaction’s linear term ($$/transaction)</td>
<td></td>
</tr>
<tr>
<td>$d_{jk}$</td>
<td>Coefficient of the variable cost per transaction’s quadratic term ($$/transaction^2)</td>
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(continued)
Table 1. Summary of Notation (continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Remarks</th>
<th>Meaning of Notation</th>
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<tbody>
<tr>
<td><strong>Banks decisions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$n_k$</td>
<td>This is exogenously held fixed in this paper</td>
<td>Number of outlets of distribution technology $k$</td>
</tr>
<tr>
<td>$\rho_j; \bar{\rho}$</td>
<td>Price per transaction charged to segment $j$ ($$$), vector of these prices for all segments ($$$)</td>
<td>Full price includes price, travel costs, and disutility due to technology type</td>
</tr>
<tr>
<td>$\bar{P}; \bar{P}$</td>
<td>Full price per transaction charged to segment $j$, vector of these prices for all segments ($$$)</td>
<td></td>
</tr>
<tr>
<td>$m_i; \bar{m}$</td>
<td>Number of firms using strategy $i$. The vector of firms' strategy choices.</td>
<td></td>
</tr>
<tr>
<td>$\tau_{jk}; \bar{\tau}_i$</td>
<td>Number of transactions supplied by a bank using strategy $i$, serving customer segment $j$ with distribution technology $k$. The vector of transactions by strategy for strategy $i$.</td>
<td></td>
</tr>
<tr>
<td><strong>Demand function</strong></td>
<td></td>
<td></td>
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<tr>
<td>$d_j(\bar{P}); \bar{d}(\bar{P})$</td>
<td>Demand by segment $j$ given full price vector $\bar{P}$. Vector of demand for each customer segment given price vector $\bar{P}$.</td>
<td></td>
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</table>
dent facility or the smaller facility placed in grocery stores. We assume that a branch has an attached ATM to reduce congestion and offer longer service hours. In either case, the primary forms of customer contact in a branch are tellers, account representatives, or ATMs. This is what we mean by the “B” technology. Banks can also try to use ATMs (or highly automated kiosks) to serve customers as a substitute for branches. The “ATM” technology is an automated distribution system that completely replaces branches. “OATM” is a distribution technology where other banks’ ATMs similarly substitute for a branch system. Finally, PC banking systems offer the convenience of conducting basic bill-paying and account-management transactions from home, as well as other transactions, such as trading stocks, purchasing insurance, ordering postage stamps, and applying for loans. Each technology affects customers and banks in different ways, through disutility and cost.

Each retail bank competes in the market by choosing a distribution strategy, defined by technology choice, transaction volumes, and prices for services.

The next subsections study modeling details about customers and banks, respectively.

Customers

Customers demand retail bank transactions whose volume depends on the full cost of conducting a transaction. Full costs are imposed on customers in three ways: price, technology preferences, and distance traveled to conduct a transaction. In practice, retail banks charge prices in different ways, many of them indirect. Examples of the ways that retail banks charge prices include fees for a specific service, minimum account balances, periodic fees, and deals for packages of services. The model employed in this paper approximates the multiple pricing methods used in practice by a per-transaction pricing approach to avoid additional complexity.

Consumers differ in their attitudes toward transaction technology. This is a major source of segmentation of customers. We denote two respective customer segments by \( J = \{ e, b \} \), where \( b \) is a branch-prefering segment, and \( e \) is an electronic channel-prefering segment. (Sometimes we refer to the respective segments as \( e \)’s and \( b \)’s ). These preferences are modeled as an additional cost per transaction, due to disutility, imposed on the customer. Denote the disutility imposed on customer segment \( j \) by a transaction through technology \( k \) as \( h_{jk} \). Assume that each customer segment has a “preferred” distribution technology. For the preferred technology \( h_{ja} = 0 \), and for all other technologies \( h_{ja} \geq 0 \).

Consumers are sensitive to the distance they must travel to conduct a transaction. Since banks place multiple locations throughout a region, and consumers travel randomly within the region, it is reasonable to assume that customers do not measure their distance to a single retail bank outlet in evaluating their banking relationship. The model assumes that customers are sensitive to a measure of distance related to their average distance to a bank outlet. Assume that the bank uses technology \( k \) to serve segment \( j \), and that the bank places \( n_k \) outlets using technology \( k \) in the market (\( k = \) branches, own ATMS or other’s ATMs). For segment \( j \) served by technology \( k \), assume
that customer disutility for a single transaction due to travel is in the form $\beta/n_k$, where $\beta_j$ is a scaling parameter for customer segment $j$ using distribution channel $k$.

Customer demand depends on the total cost and value of the banking relationship. The total cost to the consumer of a banking relationship is a function of price, disutility, and convenience costs of transactions. Let $p_j$ denote the price per transaction a retail bank using technology $k$ charges customer segment $j$. Under these conditions, customer segment $j$ incurs a full price given by Equation (1)

$$P_j = p_j + \sum_{j \in J} \left( h_{jk} + \frac{\beta_j}{n_k} \right)$$

We assume that customers buy service from the bank offering the lowest average full price per transaction and that the volume of transactions depends on the full price. The number of transactions demanded by each customer segment is given by a differentiable, strictly decreasing function of full price. We write the function that maps the least full prices for each segment to the volume demanded by that segment by the vector valued function

$$\ddot{d}(\vec{P}) = \left\{ d_j(\vec{P}) \right\}_{j \in J}.$$

We assume that a bank can set a price to each segment it serves, and that a bank uses, at most, one channel to serve each segment. Although this implies that banks can price discriminate among customer segments, it can be shown that in a competitive entry equilibrium, customer self-selection can be assured. Although it appears that a bank can choose different prices for each segment and can force customers in each segment to use the channel the bank has selected, customers will in fact willingly choose the channel the bank picks in equilibrium. This is shown in Lederer and Li [11] and Byers and Lederer [4].

**Banks**

The defining characteristic of a retail bank in our model is its distribution “strategy.” A strategy is defined as a function that maps each customer segment in $J$ into a technology chosen from the set of available distribution technologies $K$ that will be used to serve that segment. Consider the set of all ordered pairs of elements in $J$ and $K$:

$$I = \left\{ (j,k) \mid j \in J, k \in K \cup \emptyset \right\},$$

where $\emptyset$ is the null net. A strategy, $i$, is a subset of the set of all pairs of segments-technologies $I$, ($i \subset I$), that maps a single $j$ into at most one $k$.

We use the following notation for a bank’s distribution “strategy,” which are simply sets of pairs of segments and technologies. In strategy $((b,B))$, the branch segment is served with branches. Strategy $((e,PC))$ is a strategy in which the e segment is served by PC banking, and the bank does not have any physical outlets. Strategy $((b,B)(e,B))$
is a hybrid strategy in which both segments are served by branches. Strategy
((b, B)(e, PC)) is one in which the b segment is served by branches, and the e segment
is served by PC banking. In a real sense, ((b, ATM)(e, E)) is an “electronic distribution
strategy,” where ATMs substitute for branches. Strategy ((b, OATM)(e, PC)) is one in
which a bank does not even own the ATMs with which it serves b customers with.
Strategies ((e, PC)) and ((b, OATM)(e, PC)) are “virtual strategies” in which banks pro-
vide banking services without any owned branches or ATMs. Although other strate-
gies are technically possible, they seem to be less realistic alternatives. We allow
these other combinations to arise in our analysis, though.

In defining set I, we allow a customer segment to be mapped into the null set,
meaning that this segment is not served. By definition, a retail bank that offers a
branch network with ATMs attached serving e and b customers employs a different
strategy than one offering branches serving b’s and ATMs serving e’s. Each bank
using strategy i provides a transaction volume for each technology-customer pair,
(j, k). Denote the volume decision variable by \( t_{ijk} \). Let

\[
\tilde{\mathbf{t}}_i = (t_{ijk})_{j \in J, k \in K}
\]

denote the vector of production volumes for banks using strategy i.

Banks can enter this market, so that the number and strategy choices of banks in the
market are endogenously determined. We refer to \( \tilde{m} \) as the vector of “strategy types
in the market.” Understand that \( \tilde{m} \) is a vector in \( R^{|I|} \) and the ith entry of \( \tilde{m} \), \( m_i \), is the
number of banks using strategy i in the market. To avoid problems associated with the
constraint of an integer number of firms, we allow \( \tilde{m} \) to be any nonnegative real-
valued vector. This is clearly an approximation that will not be serious when many
firms compete for customers. Further, assume that all banks using strategy i are iden-
tical, that is, they have the same cost structure and attractiveness to customers.

To complete the specification, the cost structure of the distribution technologies
must be described. Each distribution technology involves fixed and variable costs and
exhibits diseconomies of scale in variable costs because it becomes inefficient if the
volume of transactions processed is too large. Each technology has a fixed cost \( G_k \), a
variable technology cost of serving \( \tau \) transactions through technology \( k \), \( c_k \tau \), and a
variable customer cost of serving \( \tau \) customers of type \( j \) through technology \( k \), \( d_{jk} \tau^2 \).
This fixed cost also includes the cost of entering a market. The linear variable cost
reflects the purely operational cost of processing a transaction through technology \( k \).
The quadratic term represents the cost incurred by the retail bank for providing in-
centives and support to induce customer segment \( j \) to transact using technology \( k \).
This quadratic form reflects diseconomies of scale in attracting and maintaining cus-
momers, both in terms of support capacity and providing incentives to customers to
bring more transaction volume to the retail bank. Further, the diseconomy is a tech-
ical necessity of the model since without it there would be no competition in the mar-
ket. The only equilibrium result would be monopoly, which is not observed in practice.
Despite consolidation, there are nevertheless many competitors in banking markets.
Although any strictly increasing, strictly convex function would reflect the diseconomy
of scale, the model assumes a quadratic function for simplicity. If a retail bank chooses a strategy with branches, then it is assumed that ATMs are offered at the branches only. Each bank employing strategy \( k \) chooses a number of locations, \( n_k \), at a cost of \( F_k \) dollars per outlet. Write the vector of the number of outlets as \( \vec{n} \), where \( \vec{n} \in \mathbb{R}^K \).

The number of branches and ATMs for each strategy is fixed: the number of outlets for strategy \( k \) is exogenously specified by \( n_k \). This is done for simplicity and tractability. 1

Each bank using strategy \( i \), maximizes its profit by choosing a transaction volume for each customer segment and technology, \( \tau_{ijk} \), subject to its full price being fixed. Profit is denoted \( \pi_i \) and is given in Equation (2).

\[
\pi_i = \sum_{j \in J} \sum_{k \in K} P_j \tau_{ijk} - \sum_{j \in J} \sum_{k \in K} c_k \left( \sum_{j \in J} \tau_{ijk} \right) - \sum_{j \in J} \sum_{k \in K} d_{jk} \tau_{ijk} - \sum_{k \in K} (n_k F_k + G_k). \tag{2}
\]

Here the profit associated with strategy \( i \) for a bank is computed by finding the entire revenue, and reducing it by the sum of all variable costs and fixed costs. It follows that, given a market full price \( P_j \), the price a bank using strategy type \( i \) can charge for a transaction is given in Equation (1). Substituting Equation (1) into Equation (2) yields the profit function for a bank using strategy type \( i \), given in Equation (3),

\[
\pi_i \left( \vec{P}, \vec{n}, \tau \right) = \sum_{j \in J} \sum_{k \in K} P_j \tau_{ijk} - \sum_{j \in J} \sum_{k \in K} \frac{\beta_j \tau_{ijk}}{n_k} - \sum_{j \in J} \sum_{k \in K} h_{ijk} \tau_{ijk} - \sum_{k \in K} c_k \tau_{ijk} - \sum_{j \in J} \sum_{k \in K} d_{jk} \tau_{ijk} - \sum_{k \in K} (n_k F_k + G_k). \tag{3}
\]

Here the profit is the sum of the product of full price and production for all segments using all channels less the sum of total customers disutility of travel plus inconvenience costs related to non-preferred channels plus total variable and fixed costs.

A bank’s profit optimization problem as a function of the \( \tau \) variables is given in Equation (4),

\[
\pi_i^* (\vec{P}) = \max_{\vec{\tau}} \pi_i \left( \vec{P}, \vec{n}, \tau \right)
\]

\[
\pi_i^* (\vec{P}) = \sum_{j \in J} \sum_{k \in K} P_j \tau_{ijk} - \sum_{j \in J} \sum_{k \in K} \frac{\beta_j \tau_{ijk}}{n_k} - \sum_{j \in J} \sum_{k \in K} h_{ijk} \tau_{ijk} - \sum_{k \in K} c_k \tau_{ijk} - \sum_{j \in J} \sum_{k \in K} d_{jk} \tau_{ijk} - \sum_{k \in K} (G_k + n_k F_k), \tag{4}
\]

such that \( \tau_{ijk} \geq 0, \forall j \in J, k \in K \).

The objective function in the bank’s optimization problem is concave. For convenience, call function \( C_i \),
strategy $i$’s “full cost.” The full cost of strategy $i$ is the sum of the total cost of a firm using strategy $i$ and this firm’s customers’ total “hedonic costs” (preference related costs). Equation (4) says that strategy $i$’s profit is its total full revenue (which is the full price times volume for all production), minus its full cost.

Given market full prices, $\bar{P}$, each bank using strategy $i$ seeks to provide the quantity and mix of transactions to maximize its profits. The supply function for a bank using strategy $i$ is the vector,

$$\tilde{s}_i(\bar{P}) \in R_{JxK}^I,$$

which maximizes strategy $i$’s profit. (The supply function is a vector that potentially allows a distribution channel to serve multiple customer segments.) Specifically, for a bank using strategy $i$ we can write this mathematically as

$$\tilde{s}_i(\bar{P}) = \left( \operatorname{argmax}_{\xi \geq 0} \left( \pi_i (\tilde{\xi}_i, \bar{P}) \right) \right)_{j \in J}.$$

Denote the aggregate supply function for mix of strategy types $\bar{m}$, $\bar{m} \cdot 0$, as

$$S(\bar{P}, \bar{m}) \in R_{\bar{I}}^I$$

by

$$\tilde{S}_j(\bar{P}, \bar{m}) = \left( \sum_{i \in I, k \in K} m_{ijk} \tilde{s}_i(\bar{P}) \right) \text{ for all } j \in J.$$

This vector is the total supply by all firms to each segment. Now that the consumers and the banks have been defined, it remains to discuss how those two interact in the market setting. In the next section, we discuss their interaction by examining the notion of competition and equilibrium in the markets.

**Competition in the Retail Banking Market**

We analyze competition between retail banks as a perfectly competitive market. This assumption may be justified as follows. There are many consumers in the market and an individual household has no power to affect market prices offered by banks. Similarly, we assume that the market will support many competing banks, and
that none of which views itself as having the power to affect market prices. This is clearly an approximation, but one that fits the empirical facts of the banking industry—it is highly competitive. Also, we assume that there are fixed costs to entering the market, thus banks must consider whether entry into a new market will be profitable. This set of assumptions follows the classical analysis of "perfect competition," except that customers are concerned with "full prices," not just the real price paid. The fact that customers are concerned about full prices does not affect the analysis of a competitive equilibrium as is shown in De Vany and Saving [6].

Given a vector of strategy types in the market, \( \tilde{m} \), a competitive entry equilibrium is defined as a vector of full prices and a vector of transaction-volume decisions, such that each bank maximizes its profit earning at least zero profits, aggregate supply equals demand, and profitable entry into the market is not possible.

Definition. A competitive entry equilibrium is defined to be a vector of full prices \( \tilde{P} \), a vector of transaction volume decisions by strategy type, \( (\tilde{\tau}_{ij}^*)_{i \in I} \), and a vector of strategy types, \( \tilde{m}^* \), such that \( \tilde{\tau}_{ij}^* = s_i(\tilde{P}) \) for all strategies \( i \in I \) and

\[
\hat{S}(\tilde{P}, \tilde{m}) = \left( \sum_{i \in I, k \in K} m_{ik} \tilde{\tau}_{ijk} \right)_{j \in J} = \hat{d}(\tilde{P}) \text{ and } \pi_i(\tilde{\tau}_{ij}^*) = 0
\]

for all strategies \( i \in I \).

Under the assumptions presented, a unique competitive entry equilibrium exists. Proof of the existence and uniqueness is found in Byers and Lederer [4]. A major result of equilibrium analysis is that in equilibrium, the market’s full prices must be equal to the active strategy’s marginal full costs (that is, the derivative of Equation (5) with respect to output). This is shown in De Vany and Saving [6], and is an analog of the traditional perfect competition model where prices equal marginal costs. Why this is so is clear by a simple argument. If the full price for some segment is above (below) marginal full cost, then profitable entry (exit) by some banks is possible. We cannot be in a competitive entry equilibrium without this condition.

By a similar argument, an active strategy’s marginal full cost must be least among all firms to serve all segments that it actually serves. We also conclude that all active firms earn zero profits in equilibrium, else profitable entry is possible. These are important efficiency properties that we will exploit when computing and characterizing equilibrium outcomes.

Using the competitive entry equilibrium, the next section will address the behavior of specific bank strategies, patterned after strategies employed by banks in the U.S. market, in equilibrium by conducting sensitivity analysis.

Analysis of the Equilibrium

This section presents an analysis of the market equilibrium for realistic values of parameters and a sensitivity analysis of several parameters. The sensitivity analysis will examine the effect on equilibrium of changing customer demands, variable costs,
and fixed costs of PC banking systems. The analysis suggests that the relative size of customer segments, as opposed to cost structure or total demand, induces the most significant strategy shifts of competing banks.

Our method of analysis is to first characterize the output of firms earning zero profits in equilibrium, and then find the mix of these firms that will equate supply and demand when full prices are set to marginal full cost. Note the following condition on a firm’s production decisions in equilibrium: each firm earns zero profits. Suppose strategy type \( i \) uses technology \( k(j) \) to serve market segment \( j \). Thus the equilibrium production decisions must obey the following:

\[
\pi_i \left( \bar{P}, n, \tau_j \right) = \sum_{j \in J} P_j \tau_{ijk}(j) - \sum_{j \in J} \sum_{k \in K} \frac{\beta_j \tau_{ijk}(j)}{n_k} - \sum_{j \in J} \frac{h_{ijk}(j) \tau_{ijk}(j)}{c_k(j) \tau_{ijk}(j)} - \sum_{j \in J} d_{jk}(j) \tau_{ijk}(j) - \sum_{j \in J} \left( n_{j}(j) F_{k}(j) + G_k(j) \right) = 0,
\]

(8)

where

\[ \bar{P} = \tilde{\nabla} \left( \tau_{i,1,j(1)}, \tau_{i,2,j(2)} \right) C(\tilde{\tau}) \]

and

\[ \left( \tilde{\tau}_{i,1,j(1)}, \tilde{\tau}_{i,2,j(2)} \right) \]

is the vector of production that \( i \) supplies to the two segments. Equation (8) simplifies to:

\[
\sum_{k \in K} \left( n_{k} F_{k} + G_k \right) - \sum_{j \in J} \sum_{k \in K} d_{jk} \tau_{ijk}^2 = 0.
\]

(9)

Production satisfying Equation (9) can be mapped into marginal full costs for \( e \) and \( b \), by

\[
MC_j(\tau_i) = \sum_{k \in K} \frac{dC_i(\tau_i)}{d\tau_{ijk}} \text{ for } j \in J.
\]

(10)

To complete the analysis we must specify a demand function for the segments as a function of full prices. For simplicity we choose a linear separable demand function:

\[
D_j(P_j) = A_j - B_j P_j \text{ for } j \in \{e, b\}.
\]

(11)

Parameters \( A_i \) and \( B_j \) are the intercept and slope of segment \( j \)'s demand function. Table 2 reports parameters used for an example we will study.

The entries in Table 2 are estimates taken from industry publications. Retail banks are generally unwilling to provide detailed cost information, so we created the previous data using industry averages from publications such as American Banker. The
Table 2. Parameter Values Used in Sensitivity Analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Point Estimate (Base Value)</th>
<th>Parameter</th>
<th>Point Estimate (Base Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable Costs: linear terms</strong></td>
<td></td>
<td><strong>Variable Costs: quadratic terms</strong></td>
<td></td>
</tr>
<tr>
<td>$c_B$: Branch</td>
<td>$0.75$ per transaction</td>
<td>$d_B$: b customer at Branch</td>
<td>$6 \times 10^{-7}$</td>
</tr>
<tr>
<td>$c_{ATM}$: ATM</td>
<td>$0.50$ per transaction</td>
<td>$d_{ATM}$: b customer at ATM</td>
<td>$9 \times 10^{-7}$</td>
</tr>
<tr>
<td>$c_{PC}$: PC</td>
<td>$0.3$ per transaction</td>
<td>$d_{PC}$: e customer at Branch</td>
<td>$8 \times 10^{-7}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$d_{ePC}$: e customer at PC</td>
<td>$6 \times 10^{-7}$</td>
</tr>
<tr>
<td><strong>Customer travel costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_B$: B customer sensitivity</td>
<td>$1.5$ per mile</td>
<td>$\beta_e$: E customer sensitivity</td>
<td>$2.25$ per mile</td>
</tr>
<tr>
<td>to traveling to a branch/ATM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Customer Disutility</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$h_B$: b customer at Branch</td>
<td>$0$</td>
<td>$h_{ATM}$: b customer at ATM</td>
<td>$3.20$</td>
</tr>
<tr>
<td>$h_{eB}$: e customer at Branch</td>
<td>$1.75$</td>
<td>$h_{eATM}$: e customer at ATM</td>
<td>$0.60$</td>
</tr>
<tr>
<td>$h_{ePC}$: e customer at PC</td>
<td>$0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yearly Fixed Costs of Strategies (amortized over 10 years)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_B$: Branch Placement (with ATMs)</td>
<td>$50,000$ per branch</td>
<td>$G_B$: Branch Network (with ATMs)</td>
<td>$2,110,000$</td>
</tr>
<tr>
<td>$F_{ATM}$: stand along ATM placement</td>
<td>$10,000$ per kiosk</td>
<td>$G_{ATM}$: stand along ATM Network</td>
<td>$1,800,000$</td>
</tr>
<tr>
<td>$G_{PC}$: PC banking system</td>
<td>$1,550,000$</td>
<td>$G_{PCB}$: Branch Network with PC banking</td>
<td>$2,160,000$</td>
</tr>
<tr>
<td><strong>Assumptions on $n_k$</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of branches ($k=B$)</td>
<td>10</td>
<td>Total number of OATMs in market ($k=OATM$)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Demand Parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$A_B$</td>
<td>$25,000,000$</td>
<td>$B_B$</td>
<td>1</td>
</tr>
<tr>
<td>$A_e$</td>
<td>$3,000,000$</td>
<td>$B_e$</td>
<td>3</td>
</tr>
</tbody>
</table>
quadratic coefficients were chosen empirically to generate solutions that approximate observed total transaction volume and number of competing banks for an average market of an approximate spatial radius of 15 miles. It is assumed that customers incur travel costs at a rate of $0.65 and $0.95 per mile for customer segments, respectively. Figure 1 reports the marginal full costs corresponding to solutions to Equation (9) for the values of Table 2 for a selection of relevant strategies. The strategies are denoted in the form \((e,k)(b,k)\), with \(k\) belonging to set \(K\). When the null technology is selected, we omit the segment.

In equilibrium, only a firm on the frontier of lowest marginal full costs will survive. In Figure 1, the efficient frontier is given by the heavy line that indicates the strategy type and the marginal full costs of output to both segments. Each point on this frontier corresponds to a zero profit firm producing output at a mix given by the corresponding solution to Equation (9). This trade-off considers the variable and fixed cost of each strategy, as well as the diseconomies of scale of operations.

Figure 1 provides much insight as to the strategies that arise in equilibrium. Strategy \(((e,PC)(b,ATM))\) is dominated by strategy \(((e,PC)(b,OATM))\), that is, an electronic distribution strategy where \(b\)'s are served by ATMs (and \(e\)'s are served by PC banking) is dominated by one where \(b\)'s are served by others' ATMs (and \(e\)'s are served by PC banking). We can call this type of strategy a “virtual bank,” since it has \(b\) customers but no branches of its own. This observation suggests that ATMs alone will not be a viable strategy to serve either segment. It is important to note that the traditional branch strategy \(((e,B)(b,B))\) is dominated by a split strategy where \(e\)'s are
served by PC banking and b’s are served by a branch system, ((e,PC)(b,B)). Strategy ((e,PC)(b,OATM)) is itself dominated by ((e,PC)(b,B)). Thus, the only strategy that serves both markets that can arise in equilibrium is ((e,PC)(b,B)). Also observe that the highest marginal full cost for serving b’s is constrained by the marginal full cost of the strategy ((b,B)). This marginal full cost is \( \overline{mc_b} \). The highest marginal full cost for serving e’s is constrained by strategy ((e,PC)), and this marginal full cost is \( \overline{mc_e} \).

Point P in the figure corresponds to production by a firm using the strategy ((e,PC)(b,B)). Point P’ is at the intersection of two strategies: ((e,PC)(b,B)) and ((e,PC)). The mixes of transactions produced for the two strategies are different: ((e,PC)(b,B)) serves both, while at ((e,PC)) serves only e’s. For any equilibrium, there are at most two different strategies observable in the market: either ((b,B)) and ((e,PC)(b,B)), or ((e,PC)) and ((e,PC)(b,B)). Thus, this model shows that there won’t be a proliferation of strategies. In fact, at any time, at most two profitable strategies will be observed.

Points P’ and P” are defined by the parameters of the example. At P’, the marginal full cost for producing service to e must be the same for strategies ((e,PC)) and ((e,PC)(b,B)) and is \( \overline{mc_e} \). The production rate of any firm using strategy ((e,PC)) will solve Equation (9), yielding

\[
\tau_{eE}^o = \frac{G_{PC}}{d_{ePC}},
\]

thus,

\[
\overline{mc_e} = c_E + h_{ePC} + 2d_{ePC}\tau_{ePC}^o = c_E + h_{ePC} + 2\sqrt{d_{ePC}G_{PC}}
\]

and the output rates for e are the same for both strategies that coincide at P’. (For simplicity we omit the “i” subscript on variables \( \tau \) in this section and include designation of the bank’s method for serving the appropriate segment instead.) Since Equation (9) holds at ((e,PC)(b,B)), it follows that

\[
n_BF_B + G_{PCB} = d_{ePC}\tau_{ePC}^2 + d_B\tau_{bB}^2.
\]

thus,

\[
\tau_{bB}^o = \frac{n_BF_B + G_{PCB} - d_{ePC}\tau_{ePC}^2}{d_B} = \frac{n_BF_B + G_{PCB} - G_{PC}}{d_B},
\]

and

\[
\overline{mc_b} = c_B + h_{bB} + 2d_{bB}\tau_{bB}^o = c_B + h_{bB} + 2\sqrt{d_{bB}}\left(n_BF_B + G_{PCB} - G_{PC}\right).
\]

We adopt the superscript “o” because these production volumes result in zero profit.
The important conclusion is that for strategy ((e,E)(b,B)), the ratio of production of \( b \) to total production at \( P^\prime \) is just

\[
\frac{\tau^o_{bb}}{\tau^o_{bb} + \tau^o_{ePC}} = \frac{\sqrt{\frac{n_B F_B + G_{l(e,E), (b,B)} - G_{l(e,E)}}{d_B}}}{\sqrt{\frac{n_B F_B + G_{PC} - G_{PC}}{d_B}} + \sqrt{\frac{G_{PC}}{d_{ePC}}}}.
\] (12)

Similarly, at point \( P^\ast \) for strategy ((e,E)(b,B)), the ratio of production of \( b \) to total production is

\[
\frac{\tau^o_{bb}}{\tau^o_{bb} + \tau^o_{ePC}} = \frac{\sqrt{\frac{n_B F_B + G_B}{d_B}}}{\sqrt{\frac{n_B F_B + G_{PC} - G_B}{d_B}} + \sqrt{\frac{G_{PC} - G_B}{d_{ePC}}}}.
\] (13)

We have shown that at point \( P^\prime \) (\( P^\ast \)), strategy ((e,PC)(b,B)) serves both segments in the ratio of \( b \)'s to total supply of Equations (12) and (13). Thus at point \( P^\prime \) a range of ratios of segment \( b \) supply to total supply from zero percent to the fraction Equation (12) are feasible because there can be any arbitrary mix of strategies (e, PC) and ((e,PC)(b,B)), which share the same marginal full cost. Thus, by adjusting the number of banks of each of those types, any ratio from zero percent to the value of Equation (12) can be produced. Using similar arguments, at point \( P^\ast \), any ratio from Equation (13) to 100 percent can be produced. Figure 2 describes the ratio of total production of \( b \) to total production of all as a function of \( MC_{b} \). Demand generated by the marginal full costs found on the efficient frontier of Figure 1 is computed as a function of the marginal full costs on the efficient frontier. The ratio of demand by segment \( b \) to total demand as a function of \( MC_{b} \) is found in Figure 2. The competitive entry equilibrium will use a combination of strategy types of sufficient number to provide the market with its demanded services at the corresponding marginal full costs. The equilibrium market prices are the marginal full costs for \( e \) and \( b \) that equate the production mix and the demand mix.

To find the equilibrium production rates and mix of firms, we need only find the point on the efficient frontier, where the ratio of demands for the two segments equals the ratio of production. At this point, supply can be made equal to demand, firms earn zero profits, and price equals marginal full cost for both segments. This will be the unique competitive equilibrium.

**Sensitivity Analysis: Changing Segment Sizes**

Next, we study the effect of changing segment size on the equilibrium. The previous analysis leads to the following insights: The mix of bank strategies used is a function...
of the relative size of the two segments, and not its absolute size. Scaling up demand in the two segments in a way that preserves the demand ratios leaves the equilibrium choices of strategies and the production decision for individual banks unchanged. We will conclude that when demand for the \( e \)-segment rises relative to the \( b \)-segment, some pure branch banks will be forced from the market, and some will adopt PC banking in addition to branches.

If the size of the segment that prefers e-banking rises, this will cause a shift in the demand ratio function downward. For example, Figure 2 shows a shift in the demand ratio with a corresponding shift in equilibrium full prices from \( P^1_b \) to \( P^2_b \). Clearly the full market price for \( b \)-segment falls, with the full market price for the \( e \)-segment rising to \( mc_e \) from some lower value. The actual market prices for \( b \) rises, and for \( e \) falls. This is direct from Equation (1). The optimum mix of bank strategies shifts as well. For the downward shift in the demand of \( b \) ratio to total demand shown in

---

**Figure 2.** Finding the competitive entry equilibrium by tracing the marginal cost of serving branch-preferring customers from the efficient frontier. The increasing curve is the ratio of total production of branch transactions to total production, and the decreasing curve is the ratio of total demand for branch transactions to total demand as a function of the marginal full cost of serving the branch-preferring segment. Note that two examples of the demand ratio are indicated. The competitive entry equilibrium corresponds to the point of intersection of the respective demand curve with the supply ratio curve. Also, the figure illustrates the change in equilibrium when the variable cost of PC banking transactions falls. The solid lines represent the initial demand ratio and the dashed demand ratio curve corresponds to lower variable cost of PC banking. Note that as the equilibrium marginal full cost for branch transactions shifts, then the market full price falls, from \( P^1_b \) to \( P^2_b \), but the equilibrium ratio of demand from the branch-preferring segment (and production for this segment) to total demand (and total production) does not change very much.
Figure 3. Number of banks by strategy as a function of the size of the two segments. The number of banks for the three types is plotted as a function of the y-intercept of the demand functions for the two segments ($A_e$ and $A_b$, respectively). The figure shows that the number of branch banks that serve $b$ segments will decline, and the number of banks offering a combination of branch banking and PC banking will rise, as the relative size of the $b$ segment falls. When the $e$ segment is about $12/28 \approx 0.4$ of the whole market, only banks offering branch and PC banking will survive. As the $e$ segment becomes larger then $18/28 \approx 0.64$ of the whole market, banks offering PC banking alone will become viable. Note that as the relative size of the $b$ segment falls, the total number of banks will fall, and then begin to rise.

Figure 2, there is entry of banks using the strategy $(e,PC)$. The market now supports these banks, as well as some using strategy $((e,PC)(b,B))$. We note that as the relative size of the $e$ market rises, there will be some banks serving just the $e$ segment, and some banks providing service to both segments using strategy $((e,PC)(b,B))$. Thus, two types of banks have PC banking: ones with branches and ones without branches that serve just the $e$ segment. Note that as long as there are some $b$ customers, the model shows that a bank using the two-channel strategy will exist in equilibrium.

Figure 3 shows how the mix of strategies changes as a function of segment sizes, as driven by the y-intercept of the segment demand functions. When the market is mostly $b$ customers, most banks use the $(b,B)$ strategy, with a few using $((e,E)(b,B))$ to serve both $e$'s and $b$'s. As $b$ segment members shift to the $e$ segment, the $((b,B))$ strategy disappears—it isn’t profitable to use a “branch” strategy. Instead, all banks serve both segments with $((e,E)(b,B))$. As the size of the $e$ segment grows even larger, the strategy $((e,PC))$ begins to dominate the market. The $e$ segment needs to be about twice the size (as measured by transactions generated) of the $b$ segment to allow profitable entry of this strategy. When (if ever) this will occur is unknown.

Note, we predict consolidation of the banking market as branch banks are forced out, but that the number of competing banks increases when about half of the total customer transactions are $e$’s.

Sensitivity Analysis: Changing Fixed Costs of PC Banking

Suppose the fixed cost to provide PC banking services fall. In Figure 4, this results in a shift to the origin of the marginal full-cost curves for all strategies that employ PC
banking. For example, Figure 4 shows the effect of reducing PC banking fixed cost by $1 million. We show that such a change results in some branch banks adopting PC banking in addition to branches.

The strategies that arise in equilibrium change—now only strategies \((e,PC)\) and \((e,E)(b,B)\) arise. Even when the relative size of the \(e\) segment is small compared with the \(b\) segment, “branch” banks cannot compete with banks offering branches and PC banking. When the \(e\) segment is relatively large, a PC bank serving \(e\)’s can compete with a \((e,E)(b,B)\) bank. For strategy \((e,E)(b,B)\), and any value of \(mc_e\), the ratio of \(b\) transactions to total transactions can be shown to be:

\[
\frac{\tau^o_{bb} + \tau^o_{PC}}{mc_b - c_B - h_B} = \frac{mc_b - c_B - h_B}{2d_{hB}} + \frac{1}{d_{PC_E}} \sqrt{h_AF_B + G_{PC}} - \frac{(mc_b - c_B - h_B)^2}{4d_{hB}}.
\]

If the fixed cost of PC banking declines, then for any value of \(mc_e\), the full price of \(e\) transactions falls, and the ratio of \(b\) transactions to total transactions declines. This causes the equilibrium value of \(mc_e\) to increase, thus the real price for transactions of
type $b$ rises. It is not hard to show that the equilibrium full price for $e$ falls, as does its "real" price.

Equilibrium mix of bank strategies changes as the fixed cost of PC banking falls. Not surprisingly, the number of banks increase as the fixed costs fall. If the initial full price equilibrium is at point $P'$ before the PC fixed cost fall, all banks using strategy $((b,B))$ are forced to adopt strategy $((e,PC)(b,B))$, and there is additional entry by banks with this strategy. That is, branch banks are replaced by banks using both branches and PC banking. If the initial full-price equilibrium is at point $P''$, then some new banks enter using the strategy $((e,PC))$ and some $((e,PC)(b,B))$ convert to this strategy.

Sensitivity Analysis: Changing Variable Costs of PC Banking

Suppose the variable cost to provide PC banking services falls. In Figure 5, this results in a shift to the downward of the marginal full-cost curves for all strategies that employ PC banking. Figure 5 shows the effect of reducing the variable cost of PC banking from $0.30 to $0.10 per transaction—the $0.30 figure was used in the example of Figure 1. We show that if variable cost drops enough, all branch banks will be forced to offer PC banking.

Figure 5. Marginal full costs for the strategies when the variable cost of a PC banking transaction is low.
The equilibrium will change because the ratio of $b$ demand to total demand curve will shift to the left. Figure 2 shows how the equilibrium shifts. Although the market price for $b$ transactions falls (as does the price for $e$ transactions), the actual equilibrium demand/production mix does not change much, and, for this example, the strategies chosen do not change at all. Clearly, the strategies can change when variable cost of PC banking falls. If the initial equilibrium was point $P'$ with some firms adopting both strategies found here, $((b,B))$ and $((e,PC)(eB))$, a slight reduction of variable cost will force some banks using only branch banking to exit the market. A larger change causes all branch banks to abandon their strategy.

This section has shown how to analyze the effect of parameter changes on the equilibrium. We demonstrated that a very important driver of technology choice and transactions mix is the relative size of the $e$ and $b$ segments. When the fixed cost of PC banking systems falls (such as by outsourcing this system), or when the variable cost of PC banking falls, “pure” branch banks will be forced out of the market. These branch banks will either adopt a PC banking strategy or exit the market. We showed, however, that the change in relative size of the $e$ and $b$ segments is a much more important driver of transactions mix than changes in technology cost. Unless the relative market size of the $e$ segment rises to be the dominant segment, virtual banks will fail.

**Conclusion**

Retail Banking Distribution Strategy is an important issue in the banking industry, and this paper shows the effect of key banking parameters on the equilibrium choice of that strategy. The model is very useful in that it admits a rich mix of real-world features such as heterogeneous consumers and banks. Sensitivity analysis shows how several parameters affect the equilibrium outcome and illustrates that the relative size of the customer segments drives the choice of distribution strategy. For example, we show that unless the segment, which prefers electronic transactions becomes much larger than it is today, pure virtual Internet banks will not succeed.

These results suggest that changing consumer behavior and attitudes, instead of banks’ cost structure, affects significant changes in distribution strategy. If the segment of consumers that prefer PC banking remains small relative to the segment that prefers branches, then there will still be a market for specialized branch banks, and banks offering both branches and PC banking services can prohibit successful entry by virtual banks (banks that do not have their own branches). However, if the segment that prefers electronic distribution over branches grows at the expense of the branch preferring segment, as some have predicted, the model shows that branch banks and some banks offering both branches and PC banking services will exit the market in favor of virtual banks. Virtual banks will be profitable only when the electronic-prefering segment is approximately twice the size of the branch-prefering segment.

The current analysis is illuminating, but leaves room for further work. Endogenous choice of the number of branches has been ignored here, but has been considered in
Byers and Lederer [4]. One promising addition to the model would be to create classes of transactions. For example, it is currently not possible to withdraw cash from a PC banking system, and, despite technological advances, it may never be a viable possibility. It would make sense then to create a class of transactions that must be conducted through an ATM or branch. This change may increase the persistence of strategies that include branches and may provide additional importance to the ATM/PC strategy. A finer segmentation of the consumers in the market may also provide additional insights into the equilibrium. Finally, other work has established the existence of network effects on consumer acceptance of retail banking technology [14], incorporating those effects into an equilibrium model may provide additional insight.

Acknowledgment: The authors acknowledge the helpful comments of Associate Editor Robert Kauffman and the anonymous referees.

NOTE

1. In analysis of the problem where branch and ATM numbers are chosen endogenously and competitively, similar results are obtained. The interested reader is directed to Byers and Lederer [4] for an analysis of this problem.

REFERENCES


