The Pricing of Interbank Payment Services in a Changing Competitive Environment

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Interbank payment arrangements create a tension between competition and cooperation among participating banks. By providing payment services to a rival's depositors, a bank enhances the value of the rival's deposit services. Hence, the pricing of these interbank services will have an effect on the competition between banks for depositors. This paper discusses the pricing of interbank payment services in an imperfectly competitive banking market. The strategic effects of interbank prices are very different in a segmented market in which there is no direct competition for depositors. Public policy often is more accepting of cooperation among banks in setting interbank prices than in setting the prices of "final goods" like deposits. While such a policy stance makes sense in a setting of segmented markets, the case of direct competition in deposit markets is more complicated. Here, cooperation in the setting of interbank prices could dampen competition in the markets in which banks compete directly.

Key words: Interbank payments; Interconnection pricing

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I. Introduction

In a large, diversified economy, currency is likely to be an inefficient means of making payments. While the use of currency saves sellers the cost of having to assess the creditworthiness of individual buyers, an all-cash economy will be one in which large resource costs are incurred in the handling, carrying, and storing of money. Further, to the extent that participants in the economy need to carry high inventories of currency, it will be difficult and costly to transfer savings between high liquidity/low rate of return instruments and assets that are not used for payments but produce higher yields.

The alternative to currency is credit, which can come in many forms. In most cases, the use of credit instruments as a means of payment for goods and services involves the intermediation of one or more banks. The provision of payment services is, in fact, one of the distinguishing characteristics of banks. A bank-intermediated payment instrument typically amounts to a means of communicating instructions to the buyers' bank to make payment to the seller or the seller's bank. Often, then, we think of payment services as being bundled with the deposit services provided by banks, although this is not always the case. Credit cards, for instance, involve payments by the card-issuing bank at which the card holder need not hold deposits. Still, many payment services do arise naturally as a by-product of deposits being held with a bank. Accordingly, the industrial organization of the payment services industry, and even the characteristics of the payment services provided, will generally depend on the organization of the banking industry itself.

One dimension along which the structure of the banking industry matters for the nature of payment services is the dimension of interbank payments—payments in which the services of more than one bank are required. In an economy where banking is dominated by a very few institutions, there may be relatively many transactions in which both the buyer and the seller have deposits with the same bank. In these cases, interbank payments are not necessary. If, for instance, payment was made with a check, the bank simply debits the buyer's account and credits the seller's. On the other hand, if there are many banks and people frequently engage in transactions with customers of diverse institutions, then many payments will be interbank payments, requiring the coordinated services of both the buyer's and the seller's banks. In these cases, each bank is providing services to both its own and the other bank's depositors. The "interbank" payment services that one bank provides to another's depositors are similar in nature to the interconnection services that allow customers of one communication network to connect with those of a second network.

In an environment in which banks compete for depositors, the terms on which one bank makes interbank services available can be a powerful strategic tool. By making "interconnection" very costly, a bank can dissuade potential depositors from placing deposits with competing banks. Hence, there is a potential tension between competition for depositors and cooperation in interconnection so as to enhance the quality of services provided. An analogous tension exists in the competitive telecommunications markets.

An historical characteristic of banking markets in Japan is market segmentation. This has shown up both across geographic markets and across different types of banking institutions. As late as the 1980s, Ito (1992) describes a banking structure in which direct competition between banks was limited by convention, differences in legal status, and "administrative guidance" from regulators.

In this segmented environment, the terms of interbank payment arrangements could have at most a limited effect on the competition among banks for depositors. The main concern, then, would be the provision of the "public good" represented by a comprehensive interbank network. Conflicts of interest among banks, to the extent that there were any, would be mainly related to differences in the value that different banks placed on having access to such a network. For instance, in a banking system in which local clearinghouses play an important role in payments within a region, a primary role of an interregional network is to connect the various clearinghouses. In Japan, where there have traditionally been both regional and nationwide banks, the value of participating in an interbank, interregional network was likely smaller for the latter than for the former. A large, nationwide bank could use its own internal branch network to make connections among the various clearinghouses. A bank with geographically limited operations, however, could benefit from having access to a national network. Indeed, in the 1940s, when the national clearing system was first established, it was the regional banks that took a great interest in its development, according to Tsurumi (1999).

The approach to the pricing of payment services in Japan tends to involve considerable leadership exercised by the banking associations that run the interbank networks. This approach may have been well suited to the traditional structure of banking in Japan, featuring considerable segmentation of markets. The structure of the Japanese banking system appears to be changing in such a way that there will be less market segmentation and more direct competition among a greater variety of institutions. In this changing environment, the terms of providing and pricing interconnection among banks will potentially take on a new role in competitive behavior of banks and other financial institutions.

The next section of this paper surveys some recent literature on the pricing of interconnection among competing providers of network services. While most of this work has drawn its motivation from issues in telecommunications, there are close parallels with issues involving the pricing of interbank payment services. The following sections address the question of how interbank pricing might respond to a change in the competitive environment in which banks operate. The discussion is first presented in fairly general terms and then in the context of a simple example of a model of bank competition and interconnection.

The main insight drawn from this discussion can be summarized as follows. While cooperation in the setting of interbank prices typically leads to lower interbank prices and greater consumer welfare and profits when deposit markets are segmented, when banks compete directly for deposits cooperation in setting interbank prices can have the effect of dampening competition in the deposit market. This could result in higher interbank prices and reduced consumer welfare. Hence, as banking markets become increasingly competitive, due to technological change and evolving regulation, traditional reliance on cooperative organizations for setting interbank prices may require closer scrutiny.

II. Network Interconnection

Most of the literature on interconnection pricing and its effect on competition between rival networks arises from the telecommunications industry. The typical example given involves the problem of connecting competing providers of long-distance phone service to the local network of one of the providers. One strand of this literature focuses on the "one-sided" interconnection problem in which there is a monopoly provider of local services that faces potential competition in providing other (such as long-distance) services. In this strand of the literature, the key question is the extent to which the access price charged by the incumbent monopolist can and will be used to deter entry. An efficiency standard for such pricing might hold that the access price should accommodate entry if and only if that entry will improve the market's performance in terms of profits plus consumer surplus. If, for instance, post-entry competition can be characterized by Bertrand-like price competition, then entry enhances welfare if the entrant is able to produce the competitive product at a lower marginal cost than can the incumbent.[1]

The present discussion of interbank pricing is more directly related to the "two-way" interconnection problem. In this case, two networks compete for subscribers by charging a combination of subscription fees and prices per unit of network service. The latter can include a price charged by one network to the other network's subscribers (or to the other network itself) when they interconnect. In telecommunications, this might relate to situations in which there are two providers of local service, each with its own (physical) network. Here, the analog to the price for an interbank payment service is the price charged by a network for a message (e.g., phone call) originated on another network.

A pair of papers by Laffont, Rey, and Tirole (1998a, b) examine the effects of interconnection prices on competition between two networks whose services are imperfectly substitutable for one another. They consider fixed (exogenous) interconnection fees and show that setting this fee high dampens firms' incentive to compete for network subscribers by driving down their subscription fees.[2] A high interconnection fee means that a firm is extracting a relatively large price-cost margin from the other firm's subscribers. Hence, the marginal benefit from gaining one more subscriber is less than it would be if there were no interconnection revenue.

Laffont, Rey, and Tirole also consider endogenous interconnection fees, set cooperatively by the two firms. That is, the access, or interconnection fee, is set to maximize joint profits, subject to noncooperative subscription pricing. When

1. For a review of the one-sided problem, see Sidak and Spulber (1997).
2. In Laffont, Rey, and Tirole's framework, the price charged by a network to its own customers consists of a price per call and, perhaps, a subscription fee. It is useful to focus on the subscription fee to highlight the main trade-off presented by interconnection pricing—attracting subscribers versus extracting revenues from nonsubscribers.

their model's parameters are such that equilibrium exists, they find a tendency for negotiated access fees to be strictly greater than the marginal cost of providing access.

The question of noncooperatively set access fees is considered by Economides, Lopomo, and Woroch (1996). In their analysis, the trade-off between attracting subscribers and extracting revenue from nonsubscribers is muted; they analyze a setting in which consumers precommit to a single network provider before firms set their prices. As a result, the strategic interaction in pricing is between one seller's per unit price to its members and the other seller's interconnection price. In this setting, negotiated interconnection prices would tend to be lower than if set noncooperatively.

General conclusions are hard to draw from this literature, since the equilibrium pricing behavior can depend not just on the structure of the model but also on the nature of the pricing game assumed. Still, one can identify some tendencies. When interconnection prices affect the competition for subscribers, then interconnection pricing can be a tool to facilitate collusion, since it dampens the competition for subscribers. An opposing tendency arises from the fact that interconnection is a complementary service to the services provided by one's home network. When rivals price complementary goods noncooperatively, they tend to price those goods higher than they would if they could cooperate. The existence of these two opposing tendencies is exactly the reason why general conclusions are elusive.

III. The Elements of an Interbank Pricing Game

This section describes a model of price competition between two banks facing demands for deposits and interbank payment services. The demand structure specified below can be derived from a more detailed economic environment involving the need for agents to sometimes engage in storage and consumption activities at physically distinct locations.[3] The same general structure would arise in any economic environment in which a diverse set of buyers and sellers of goods and services acquire both deposit and transaction services from potentially competing banks.

Consider a market in which two banks raise deposits that can be used to make payments in the purchase of goods. To be concrete, one might focus on the market for household deposits and the payment services provided by banks to households for making purchases from firms. To do so, and in the interest of simplicity, suppose that firms are exogenously assigned to banks, some with each bank. A consumer's choice of which bank to hold deposits at will affect the set of firms to which it can costlessly make payments. If we assume that consumers are randomly matched with firms for the purpose of making purchases, then each consumer faces some chance that he will need to make a purchase from a firm that does not use his bank. Completion of such transactions will require an interbank transaction, in which the firm's bank credits the firm's account and collects funds from the consumer's bank.

For the purposes of examining interbank pricing and competition, we can capture this market structure with the specification of demand functions for bank services.

3. See Weinberg (2000).

Labeling the banks 0 and 1, let z_i represent the number of depositors attracted by bank i, and let x_i represent the number of interbank transactions entered into by a customer of bank i. These quantities will respond to the prices set by the two banks. Assume that each bank sets two prices, one price for deposit services that also covers all same-bank payments and another price per interbank transaction. Let bank i's price of deposit services be denoted by p_i, and let its price for interbank transactions be given by q_i. More precisely, bank i collects p_i from each consumer that places deposits with it and collects q_i from the other bank's depositors for each purchase they make from firms that use bank i.

In general, we can assume that both the number of depositors a bank attracts and the number of interbank transactions it services will be functions of the full set of prices, (p_0, p_1, q_0, q_1). The demand for deposits at bank 1 (z_1) is decreasing in p_1 and q_0 and either independent of or increasing in p_0 and q_1.[4] An increase in q_0 causes this demand to fall, because this is the price paid by bank 1's depositors when they must make a purchase from a customer of bank 0. The dependence of z_1 on p_0 and q_1 is determined by the degree to which the two banks' markets for deposits are segmented. Segmentation of the markets could be the result of fundamental demand characteristics, such as the degree to which consumers find the deposit services of the two banks to be good substitutes. Market segmentation could also arise from artificial barriers to competition, such as legal rules that limit the set of consumers a particular bank (or type of bank) may serve.

If there are no consumers who could reasonably choose to bank at either bank, then the markets are fully segmented and p_0 and q_1 will have no effect on z_1. If, on the other hand, the two banks compete directly for at least some customers, then z_1 is increasing in p_0 and q_1, which determine the cost of depositing with bank 0.

For a given depositor at bank 1, the demand for interbank transactions depends only on q_0, the price charged for such transactions. The total quantity of interbank transactions on which bank 0 collects q_0 is z_1x_1. The banks' profits can be written as $\Pi_1 = z_1p_1 + z_0x_0(q_1 - c)$ and $\Pi_0 = z_0p_0 + z_1x_1(q_0 - c)$, where c is the cost to the bank of processing and collecting on an interbank payment.[5]

The banks set prices for payment and deposit services to maximize their profits, each taking the other's prices as given. Consider, for instance, bank 1's profit maximization problem. Its first-order conditions are[6]

$$\frac{\partial \Pi_1}{\partial p_1} = z_1 + \frac{\partial z_1}{\partial p_1}p_1 + \frac{\partial z_0}{\partial p_1}x_0(q_1 - c) = 0; \text{ and}$$

$$\frac{\partial \Pi_1}{\partial q_1} = z_0x_0 + \frac{\partial z_1}{\partial q_1}p_1 + \left(\frac{\partial z_0}{\partial q_1}x_0 + \frac{\partial x_0}{\partial q_1}z_0\right)(q_1 - c) = 0.$$

4. The treatment of the demand facing bank 0 is symmetric to that for bank 1.
5. The profit functions reflect the assumption (for simplicity) that variable costs of deposit services are zero.
6. Similar conditions hold for bank 0.

These two equations can be rewritten as

$$1 + \eta^1_{p_1} + \eta^0_{p_1}\frac{z_0 x_0(q_1 - c)}{p_1 z_1} = 0; \text{ and}$$

$$1 + \mu_1(\eta^0_{q_1} + \varepsilon^0_{q_1}) + \eta^1_{q_1}\frac{z_1 p_1}{z_0 x_0 q_1} = 0,$$

where η^i_j is the elasticity of z_i (demand for deposits at bank i) with respect to price j; ε^i_j is the elasticity x_i (demand for interbank payment services from bank i) with respect to price j; and $\mu_i = (q_i - c)/q_i$ is the percent markup of bank i's interbank price over marginal cost.

The conditions above capture the typical result that a profit-maximizing price is inversely related to the relevant (own price) demand elasticities. The first condition indicates that, in addition to the price elasticity of its own deposit demand, a bank's choice of a price for its deposit services also depends on the "cross price" elasticity of the other bank's deposit demand. This dependence arises because the bank earns profits by providing interbank payment services to its rival's depositors. Since deposits at the two banks are substitute services, own price and cross price elasticities have opposite signs, and the effect is to moderate a bank's desire to raise deposit prices, other things equal. Note however, that the magnitude of this effect depends on the relative contributions that payment services and deposit services make to a bank's profits.

A similar interpretation can be given to the second condition above. In setting its price on payment services, a bank takes into consideration both the direct effect on its own sale of payment services and the indirect effect on its sale of deposit services. The latter arises because bank 1's payment services are complementary to bank 0's deposit services, which are substitutes for bank 1's own deposit services. Again, the extent of the indirect effect depends on the relative contributions the two services make to a bank's overall business.

The joint solution of the two banks' problems and the nature of the interaction between prices of interbank payment services and prices of basic deposit services depend on the extent of competition between the banks. In part, the extent of competition is determined by the structure of the banks' external environment. In particular, the degree of integration or segmentation of markets determines whether the banks come into face-to-face competition with each other. This characteristic of the markets is driven by the demand functions, and the degree of segmentation is represented by the values of the elasticities $\eta^i_{p_j}$, for $i \neq j$, and $\eta^i_{q_i}$. These elasticities reflect the responsiveness of a bank's deposits to the other bank's deposit price and to its own interbank payment price. Recall that a bank's interbank price is paid by the other bank's depositors. Hence, q_1 will affect z_1 only if banks 1 and 0 compete directly for customers. When the deposit markets are segmented, $\eta^0_{p_1} = \eta^1_{p_0} = \eta^0_{q_0} = \eta^1_{q_1} = 0$.

When markets are segmented, then the first-order conditions above reduce to

$$\frac{\partial \Pi_1}{\partial p_1} = z_1 + \frac{\partial z_1}{\partial p_1} p_1 = 0; \text{ and}$$

$$\frac{\partial \Pi_1}{\partial q_1} = z_0 x_0 + \left(\frac{\partial z_0}{\partial q_1} x_0 + \frac{\partial x_0}{\partial q_1} z_0 \right) (q_1 - c) = 0.$$

Or, in terms of elasticities,

$$1 + \eta^1_{p_1} = 0; \text{ and}$$

$$1 + \mu_1 (\eta^0_{q_1} + \varepsilon^0_{q_1}) = 0.$$

Note that, even when markets are segmented, one bank's pricing is not entirely independent of the other bank's prices. Each bank's deposit demand depends on its own deposit price and the other bank's payment service (interconnection) price. That is, z_1 depends on p_1 and q_0. Still, under segmented markets, a bank's pricing of its own deposit services does not interact directly with its pricing of interbank payment services.

In the case of segmented markets, one bank's deposit services are complementary to the other bank's interbank payment services. For instance, an increase in q_0, bank 0's payment service price, reduces the value to potential customers of placing deposits at bank 1. This will generally result in lower demand for bank 1 deposits and lower profit-maximizing value of p_1, bank 1's deposit price. At the same time, an increase in p_1 reduces the amount of deposits bank 1 is able to attract and correspondingly reduces the volume of interbank transactions on which bank 0 can extract a fee. This reduction in demand results in a lower optimal choice of q_0.

When two sellers set the prices of complementary goods noncooperatively, the outcome is often characterized as a problem of "double marginalization." In effect, the two goods can be thought of as a single service with two distinct components. If both components were sold by a single seller with market power, that seller would recognize the effect of each component's price on the sale of both components. This interdependence limits the seller's interest in raising prices. When the components are sold separately by different firms, each seller is interested in only its own profits, and ignores the effects of its price on the other seller's sales. Hence, the distortion due to the deviation of price from marginal cost is compounded by the independent profit-maximizing behavior of two sellers with market power. This compound distortion comes at the cost of both combined seller profits and consumer welfare.

If instead of setting all prices noncooperatively, banks set their prices for interbank services through negotiation, they can raise their combined profits by setting interbank prices (q_0 and q_1) lower than their noncooperative levels. This process is formalized by assuming that (q_0 and q_1) are set to maximize joint profits, conditional on the noncooperative determination of (p_0 and p_1). This represents a mixed form of interaction between sellers, colluding on the interbank prices while competing in the pricing of deposit services. For many specifications of the demand structure, the optimal negotiated choice for interbank prices is to set them equal to marginal cost. This eliminates the double marginalization problem, allowing banks to earn their rents from the markup on deposit services.

To see the effect of cooperating in the setting of interbank prices when markets are segmented, consider the first-order condition for choosing q_1 to maximize joint profits $(\Pi_0 + \Pi_1)$. In terms of elasticities,

$$1 + \eta^0_{q_1}\frac{p_0}{q_1} + \mu_1(\eta^0_{q_1} + \varepsilon^0_{q_1}) = 0.$$

Compared to the corresponding noncooperative condition, this cooperative condition has an extra term, $\eta^0_{q_1}(p_0/q_1x_0)$. This extra term reflects the effect of bank 1's choice of interbank price q_1 on bank 0's earnings from deposits priced at p_0. The effect of the added term is to reduce the choice of q_1, other things equal.

In the case of segmented markets, the mechanism for jointly determining interbank prices is not a matter of great importance. Suppose the jointly optimal interbank price is equal to the marginal cost of interbank services. A relatively simple mechanism that will achieve this result is to delegate the choice of a common interbank price to one of the banks. That is, impose symmetry in interbank prices and let the price level be chosen by either of the banks. Suppose this authority is granted to bank 0. Its choice of q_0 does not affect its own profits, but q_1 does. If the demands facing the two banks are symmetric, then bank 0's optimal choice is to set $q_0 = c$, eliminating double marginalization. Bank 1 would make the same choice if it were given the authority to set the q's. Hence, with segmented markets and symmetric demands, delegated setting of reciprocal interbank prices achieves outcomes that minimize the efficiency loss to market power. Indeed, there are some demand specifications for which this result extends to the case of asymmetric demands.

When markets are not segmented, the interaction between deposit prices and payment service prices is more complicated. In this case, the interbank prices, (q_0, q_1) are a strategic tool in competition for market share. In addition to raising revenue for bank 0, q_0 imposes a cost on bank 1's depositors that, other things equal, may induce some consumers to deposit at bank 0 instead. To the extent that bank 0 is able to extract price-cost margins from deposit customers that are large relative to markups on payment services, the bank may find it profitable to use a high interbank price to help attract deposits. It is also not the case that cooperation in setting interbank prices will necessarily improve consumer welfare. This is one of the messages of Laffont, Rey, and Tirole (1998a, b). The interbank price could be a mechanism to facilitate collusion in deposit pricing, by making depositors less likely to switch banks.

It may be reasonable to think of an increase in competition (or more precisely in the potential competitiveness of the market environment) as being captured by a move from a situation of segmented markets to one of a single integrated market. Such a shift could have many causes. Changes in the regulatory or legal environment could bring banks into direct competition that had previously enjoyed protected market segments. Improvements in technology can make it possible for banks to serve expanding sets of customers. For instance, consumer banking may have been traditionally a local business, with people choosing banks based on the convenience of their locations to homes or places of business. Technological advances allow consumers to make banking choices that are less dependent on location.

If we think of increasing competition as a shift from segmented to integrated markets, then the role of interbank prices can be very different in a more competitive environment. With less competition (segmented markets), the interbank price serves mainly as a potential source for double marginalization. Accordingly, cooperation in setting the interbank price is largely beneficial from the point of view of consumer welfare. As markets become more competitive (integrated), the interbank price plays a more complicated strategic role.

Of course, the degree of competition between the two banks also depends in part on the behavior of the banks themselves. Is their pricing competitive, in the sense that price determination can be modeled as the Nash equilibrium of a non-cooperative game? Or is there some amount of cooperation between the banks in their price-setting behavior? This aspect of the degree of competition is more difficult to tie directly to the demand and cost fundamentals of the market. Rather, the ability of banks to collude depends on such factors as the legal environment. In a setting with strict antitrust enforcement, it will be difficult for sellers of a product or service to engage in explicit or open price collusion. Even so, tacit collusion may be possible, in the form of cooperation supported by implicit threats to engage in a price war should any seller cheat on the collusive agreement.[7] The feasibility of such collusion depends on such factors as sellers' ability to monitor each other's behavior.

The foregoing discussion has assumed that banks behave as Nash price-setters. Under that assumption, the degree of competition is determined by the demand characteristics, as discussed above.

Suppose that banks do collude in the setting of prices. Then, prices are set to maximize joint profits, $\Pi_0 + \Pi_1$. In this case, the first-order conditions for (for instance) (p_1, q_1) are

$$\frac{\partial(\Pi_0 + \Pi_1)}{\partial p_1} = z_1 + \frac{\partial z_1}{\partial p_1}[p_1 + x_1(q_0 - c)] + \frac{\partial z_0}{\partial p_1}[p_0 + x_0(q_1 - c)] = 0;$$

and

$$\frac{\partial(\Pi_0 + \Pi_1)}{\partial q_1} = \frac{\partial z_1}{\partial q_1}[p_1 + x_1(q_0 - c)] + \frac{\partial z_0}{\partial q_1}[p_0 + x_0(q_1 - c)]$$

$$+ z_0\left[\frac{\partial x_0}{\partial q_1}(q_1 - c) + x_0\right] = 0.$$

7. See Green and Porter (1984).

As with other conditions stated above, these last two can be expressed in terms of demand elasticities as

$$1 + \eta^1_{p_1}\left[1 + \frac{x_1(q_0 - c)}{p_1}\right] + \eta^0_{p_1}\frac{p_0 z_0 + z_0 x_0(q_1 - c)}{p_1 z_1} = 0; \text{ and}$$

$$1 + \mu_1(\eta^0_{q_1} + \varepsilon^0_{q_1}) + \eta^0_{q_1}\frac{p_0}{x_0 q_1} + \eta^1_{q_1}\frac{z_1 p_1 + z_1 x_1(q_0 - c)}{z_0 x_0 q_1} = 0.$$

For any given configuration of demand, cooperative price-setting tends to result in higher deposit prices (p's) and lower payment services prices (q's), when compared to noncooperative pricing. Payment services are the services that provide interconnection between banks, allowing one bank's customers to use another bank's facilities. The prices charged for these services then are prices charged to another bank's depositors. When prices are set noncooperatively, a bank ignores the effect that raising this price has on its rival's demand and profits. Taking this effect into account causes cooperation to result in a moderation of the desire to raise this price. Hence, when banks collude in the setting of deposit prices, either explicitly or implicitly, the role of the interbank price is more similar to its role in the case of segmented markets.

One additional issue regarding tacit (or implicit) collusion involves the possible role that interbank prices might play in coordinating collusive pricing. Implicit agreements not to engage in aggressive competition in deposit prices need to be monitored, and the monitoring of a rival bank's deposit arrangements with its customers may be difficult. Prices of interbank payment services are likely to be easier to monitor. If, for instance, bank 1 charges a fee to bank 0's depositor, that fee is typically collected through bank 0 (that is, through the interbank clearing and settlement system). Hence, bank 0 will directly observe the fees its customers face from bank 1. This ease in monitoring could give interbank prices a role to play in enforcing broader agreements among banks.

IV. An Example

As in the papers by Laffont, Rey, and Tirole (1998a, b), Economides, Lopomo, and Woroch (1996), and Weinberg (2000), the strategic interaction among banks (or firms in general) in setting interconnection prices can be illustrated through an example in which consumers are assumed to have "home" locations on the "Hotelling" line. That is, each consumer's location is given by a point in the unit interval, $z \in [0, 1]$. There are two banks, located at either end-point of the interval. The cost to a consumer located at z of depositing funds at the bank at 0 (1) is τz ($\tau(1 - z)$). A consumer receives utility W from deposit services and U from payment services. For instance, if the consumer is able to use his deposit balances to make a purchase of goods from a store, then U would represent the net benefit that the consumer receives from such a transaction. Hence, a "payment service" here might be a transfer of funds from the consumer's account to the store's account. Alternatively, a payment service might be the withdrawal of cash at a cash dispensing terminal close to the point at which the consumer will make a purchase.

Consumers face uncertainty about where they will want to consume final goods. This uncertainty translates into uncertainty regarding the bank from which the consumer will need deposit services. With probability ϕ, a consumer needs the services of bank 0. This might be interpreted as wanting to transfer funds to a merchant who banks with bank 0 or as needing to withdraw funds from a machine owned by bank 0. With probability $(1 - \phi)$, the consumer needs the payment services of bank 1.

Bank i bundles deposit services and payment services to its own depositors under a single price p_i and charges q_i for payment services provided to the other bank's depositors. The net benefits a consumer derives from depositing with either bank is given by

$$V_0 = W + U - p_0 - (1 - \phi)q_1 - \tau z; \text{ and}$$

$$V_1 = W + U - p_1 - \phi q_0 - \tau(1 - z).$$

If, for a given z, the greater of V_0 and V_1 is greater than zero, then the consumer deposits with whichever offers the greater value. Let z_i denote the consumer for whom $V_i = 0$. Then, the case of segmented markets, as discussed above, is the case in which $z_0 < z_1$. In this case, there is a set of consumers (those between z_0 and z_1) who do not use banking services. Consumers between zero and z_0 deposit at bank 0, while those between z_1 and one deposit at bank 1. Given this specification of demand, banks' profit functions (when markets are segmented) can be written as[8]

$$\Pi_0 = z_0 p_0 + \phi(1 - z_1)q_0; \text{ and}$$

$$\Pi_1 = (1 - z_1)p_1 + (1 - \phi)z_0 q_1.$$

This specification of segmented markets involves a "gap" in the market for banking services, representing consumers who choose not to deposit their funds in the banking system. While there are, in fact, such "unbanked" consumers in many economies (close to 10 percent of all households in the United States), one does not need to take this specification literally. The choice of interbank prices would be similar in any setting in which a bank's choice of q had no effect on its own deposits. This would be true, for instance, if deposit market segmentation were established by legal or regulatory rules.

Noncooperative price setting by banks in this example leads to the following Nash equilibrium prices: $p_0 = p_1 = (U/3)$; $q_0 = \max[(U/3\phi), U]$; $q_1 = \max[(U/3(1 - \phi)), U]$.

8. For simplicity, this example assumes that the marginal costs of both deposit and payment services are zero. Assuming positive marginal costs would not alter the nature of the strategic interaction among banks. However, assuming a higher marginal cost for interbank payment services than for same-bank services would add an important dimension to the efficiency properties of equilibrium allocations.

The reason interbank prices must be less than U is that consumers can always choose not to use interbank services, forgoing the utility U. With these prices, the market division is given by $z_0 = (1 - z_1) = U/3\tau$, so that the two banks have equal market shares.[9]

When the noncooperative equilibrium has this segmented markets characteristic, cooperation in the setting of interconnection pricing is equivalent to full cooperation in all prices. This is because, with segmented markets, each bank is a local monopolist in its segment of the deposit services market. Still, cooperation turns out to result in a preferred outcome for both banks and consumers. Under this pricing scenario, interbank prices (q_0, q_1) are set equal to marginal cost $(q_0 = q_1 = 0)$, and deposit prices are $p_0 = p_1 = U/2$. Hence, deposit prices go up, while interbank charges go down. The net effect on consumer welfare is positive, as seen by the fact that more consumers choose to use bank services than under noncooperative pricing. With the cooperative prices, market shares are $z_0 = z_1 = U/2\tau$.

Whether the equilibrium features segmented or integrated markets depends, of course, on the parameters of the model. In particular, U gives the value of having access to payment services, and τ gives the consumer's marginal cost of using bank services. As τ gets smaller or U gets bigger, more consumers will seek to use bank services, and eventually, the marginal consumer's decision will be which bank to deposit at rather than whether to deposit at all. When the market becomes integrated in this way, banks' shares of the market are determined by the point (z) at which a consumer is just indifferent between the two banks $(V_0 = V_1)$. Denoting this point by $\hat{z}$, we have

$$\hat{z} = \frac{1}{2} + \frac{1}{\tau}[(p_1 + \phi q_0) - (p_0 + (1 - \phi)q_1)],$$

and banks' profit functions are

$$\Pi_0 = \hat{z}p_0 + \phi(1 - \hat{z})q_0,$$

$$\Pi_1 = (1 - \hat{z})p_1 + (1 - \phi)\hat{z}q_0.$$

Relative to the case of segmented markets, banks now have a heightened incentive to raise the interconnection price. With segmented markets, q_0 has no effect on bank 0's sale of deposit services to its own customers. Here, raising q_0 increases the cost to consumers of depositing with bank 1. When the market is integrated, any loss of depositors by bank 1 is matched by a gain at bank 0. Indeed, in this example the profit maximizing choice for q_0 and q_1 is $q_0 = q_1 = U$. Deposit prices are then $p_0 = 2\tau + \phi U$, and $p_0 = 2\tau + (1 - \phi)U$.

With an integrated market, it is no longer the case that banks can raise their combined profits by agreeing to lower interconnection prices. In particular, each

9. This characterization of the equilibrium assumes that $\tau > (2/3)U$.

bank's profits are lower if interconnection prices are set at marginal cost. On the other hand, if banks collude on both interbank and deposit prices, then joint profits are maximized by setting the interbank prices equal to zero.[10]

V. Conclusion

In many economies, the business of banking is undergoing profound changes. Boundaries between markets, both geographically and in terms of product lines, are being removed by regulatory changes and technological advances. These changes present challenges to traditional ways of handling interbank clearing and settlement arrangements. If the terms for interbank transactions are established by industry-based, collaborative organizations, how will such arrangements respond to the entry of new market participants? This paper has suggested that increasing competition creates a complicated set of incentives for banks with regard to the terms for interbank payment services. Neither competition nor cooperation in setting these prices is guaranteed to always yield desirable results from the point of view of consumer welfare. This does not necessarily imply the need for a regulatory mechanism in determining interbank prices. The development of such a mechanism, managed by a governmental authority, is subject to its own drawbacks including, for instance, the difficulty faced by a regulator in obtaining the information necessary to set interconnection prices. Short of direct regulation, however, there may be a role for careful monitoring of industry practices in interconnection pricing. Such monitoring was, perhaps, less important in an environment with less direct competition among banks. It is somewhat ironic, then, that heightened competition may actually increase concerns for the competitive impacts of interbank payment services pricing.

10. Actually, in this example, where consumers end up using either zero or one units of interbank services, the joint profit-maximizing solution determines only the sums $p_0 + (1 - \phi)q_1$ and $p_1 + \phi q_0$. In an extended example, with downward sloping demand for interbank services, joint maximization would drive the interbank prices to marginal cost.

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