Pricing in a Competitive Market with a Common Network Resource

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I. This note is concerned with the economics of a service industry when the services provided include a network function that connects the principals involved in the delivery of the service. For example, a consumer may make a purchase from a merchant with a credit card. The merchant presents the transactional paper (or its electronic equivalent) to his acquiring bank, the acquiring bank transmits this paper through a network to the cardholder's issuing bank, and the issuing bank then bills or debits the cardholder. If the purchase is made in a different currency than the cardholder's home currency, the network may also provide currency exchange. The principals in this example are the cardholders, issuing banks, merchants, and acquiring banks, with a common network resource used to process transactions from acquirers to issuers. This note considers structure and conduct in industries of this type, and implications for consumer welfare. The following assumptions will be made regarding the main features of the type of industry I am considering. For concreteness, the example of credit card services will be used for the language of the assumptions. However, this note is an exercise in economic theory, and does not necessarily represent the structure and conduct this specific industry, nor is it intended to be applicable only to this example.

1. The industry provides domestic and international services. The principles (cardholders, merchants, acquiring banks, and issuing banks) all have the essential features of competitive agents: there are many agents with no concentration of market power, entry barriers are low, the services provided are"commodities" without significant brand differentiation, and there is opportunity through repeated transactions to discover and respond to market price signals. Hereafter, the principals supplying services will be termed the "retailers", and the principals demanding services will be termed the “consumers”. There is a single organization, hereafter called the "association", that provides the network through which services provided by retailers are processed. The association is responsible for handling these transactions, and for building, maintaining, and administering the network, including setting standards and regulations to be met by retailers. This note will not be concerned with other functions an association might perform, such as brand marketing, and recruitment, quality control, and entry control for retailers. The note will consider industries where the services are international and may include currency exchange, as there are specific conduct issues associated with the question of how this exchange is organized and priced.

2. The association is operated as a not-for-profit corporation chartered by the retailers, also called the "members", who elect its board of directors, but who do not otherwise participate in its management. The association has sole control of the network, and has the responsibility within the limits of its not-for-profit status to set prices for various components of transactions among retailers.

3. Retail provision of services is characterized by constant returns to scale. A constellation of services are provided, each with multiple attributes. In the credit card example, issuers may offer cards that vary in credit terms and limits to consumers with different credit ratings, and may set charges in patterns designed to attract different consumer groups. Therefore, issuer credit cards have many of the features of a commodity, but may have limited product differentiation and branding features. Acquirers negotiate terms with merchants that may vary with merchant volume and average transaction size.

4. Provision of network services is characterized by substantial fixed costs (which do, however, depend on network scale in the long run) and relatively low marginal costs whose components and structure depend on the service being provided.

6. Pricing by the association includes a variety of fees, charges, and transfers for the network transactions between retailers. The non-profit status of the association is maintained primarily by periodic adjustments in transactions charges.

II. The question to be discussed is the structure of pricing by the association, and the features of this structure that are in the interests of members and/or in the interests of consumers. I will examine particularly the case where charges for international transactions, composed of transaction fees and a currency conversion surcharge, are higher than the charges for domestic transactions, and are responsible for the recovery of a large share of the fixed costs of the network operation. To investigate the question, I consider the issue of pricing by the association, viewed as a single provider of network services to a competitive retail industry. I maintain the constraint that the association is a non-profit organization, and ask what pattern of pricing for services is optimal for consumers, given that constraint. In order to apply the tools of economic theory, I model this problem to satisfy the assumptions in the previous section. This problem is closely related to what is called the Ramsey pricing problem, extended by Boiteaux to problems with multiple commodities. The primary distinction, which is not essential, is that the network provider is dealing with a competitive retail industry rather than final consumers.

Let $j = 1,2,...,J$ denote the alternative services desired by consumers. In the credit card example, these would include both domestic and international transactions for various purposes, some of which are large (e.g., airline and hotel bills, major goods purchases), and some of which are small (e.g., minor goods purchases). The alternative services to consumers differ, over the relevant price range, in their demand elasticities, primarily because of the availability of ready substitutes. I will

not try to quantify these elasticities, but in the credit card example, common sense suggests that small domestic transactions typically have cash and checks as close substitutes, large domestic transactions have checks as moderately close substitutes, and international transactions have more limited and less convenient opportunities for substitution, from direct currency and traveler check exchanges, and wire transfers. Most services provided by a specific brand of credit card are also provided by alternative credit cards and non-credit-card vehicles, and these may be close substitutes for cardholders (who may carry multiple card brands, change card brands, or use other vehicles such as cash) and issuing banks (who may switch card brands). In the following analysis, I will distinguish two classes of retailers, acquirers and issuers, corresponding to the credit card example. However, this is not essential, and for applications where there is only one class of retailers, one could identify them with "issuers" and eliminate "acquirers". Let m_j denote the marginal cost of providing a unit of service j from the network to retailers, and F denote the fixed costs of the network, including capital costs, administrative overhead, and insurance. If X_j denotes the volume of each service provided, w_j denotes the wholesale prices to issuers, and v_j denotes the wholesale price to acquirers, for service j, then the not-for-profit operating rules of the network provider require

$$(1) \qquad F = \sum_{j=1}^{J} (w_j+v_j-m_j)X_j.$$

Faced with wholesale prices w_j, competitive retailers will market products that are priced to earn at least normal profits, with the pressures of competition and entry pushing market equilibrium to normal profit levels. Let n_j denote the marginal cost to a issuer of providing service j, exclusive of network cost. Let r_j denote the marginal cost to an acquirer of providing service j, exclusive of network cost. Then w_j+n_j is the marginal cost to an issuer for a unit of service j, and v_j+r_j is the marginal cost to an acquirer for a unit of service j.

To represent consumers in a form that permits welfare assessment of alternative pricing structures, assume that they have direct utility functions of the form

$$(2) \qquad u = z + \sum_{j=1}^{J} \frac{(\alpha_j)^{1/\varepsilon_j}(x_j)^{1-1/\varepsilon_j}}{1-1/\varepsilon_j},$$

where x_j is the consumption of service j, and z is the consumption of all goods other than services 1,...J. Maximization of this utility subject to a budget constraint $y = z + \sum_{j=1}^{J} p_j x_j$ is achieved at demands $x_j = \alpha_j (p_j)^{-\varepsilon_j}$, yielding indirect utility of the Almost Ideal Demand System form,

(3) $$u = y - \sum_{j=1}^{J} \alpha_j \frac{(p_j)^{1-\varepsilon_j}}{1-\varepsilon_j} ,$$

where y is income, p_j is the retail price of service j, ε_j is a parameter giving the magnitude of the demand elasticity for the service, and α_j is a parameter giving the scale of demand for the service. For purposes of analysis, I assume that all consumers have the same elasticity of demand ε_j for service j, but that the scales α_j vary over the population.

Consider the effects of retailer competition. I continue to describe the industry in the language of credit card services. Issuers will offer credit cards with some combination of features and charges for services, and consumers will sort themselves out among retailers to find the least cost card for the services they want. The result will be that any credit card offered with charges that are at least as high as marginal cost for each service j will earn at least normal profits, provided that there is positive demand for it. Further, with competition and free entry, a competitor who offers a card with all services priced at marginal cost will draw away all the customers of any rival who prices *all* services at least at marginal cost, and *some* above marginal cost. Consequently, in competition, no firm can survive unless it is either pricing all services at marginal cost, or some services below marginal cost. Finally, consider the outcomes for a firm who attempts the last strategy. This firm will capture only the consumers for which the package of services they desire costs strictly less at the firm's prices than the rival with complete marginal cost pricing. Therefore, the profit of this firm must be strictly less than the zero profit of the complete marginal cost pricing rival. The only exception occurs when the number of different consumer types (characterized by their configurations of α's) is less than the number of services J, as in this case it may be possible to vary some prices in a linear combination without changing the expenditure of any consumer, leaving consumer behavior and firm profit invariant. I will assume that the number of consumer types greatly exceeds the number of services J, so that retail market equilibrium prices will necessarily be equal to retailer marginal costs. Then, competitive market equilibrium will result in each service being priced at its marginal cost to the issuer, w_j+n_j, irrespective of the way a particular issuer's credit card bundles the various services. A similar argument for competitive acquirers establishes that they will price services to merchants so that each service is priced at its marginal cost to the acquirer, v_j+r_j. The full price to consumers is the sum of the acquirers and issuers prices, $P_j = w_j+n_j+v_j+r_j$.

III. Now consider the problem of maximizing consumer welfare through the setting of wholesale prices w_j and v_j, subject to the zero profit constraint. Market demands satisfy $X_j = A_j(P_j)^{-\varepsilon_j}$, where A_j is the sum over all consumers of the α_j parameters. Giving all consumers equal welfare weights for the marginal utility of income, the welfare of consumers is measured by

(4) $$U = Y - \sum_{j=1}^{J} A_j \frac{(P_j)^{1-\varepsilon_j}}{1-\varepsilon_j} ,$$

where Y is autonomous income Y_0 plus the profit from the industry (paid to the consumers in their role as owners of the member firms in this industry),

(5) $$Y = Y_0 + \sum_{j=1}^{J} (w_j+v_j)X_j - F - \sum_{j=1}^{J} m_jX_j + \sum_{j=1}^{J} (P_j-w_j-n_j-v_j-r_j)X_j.$$

$$= Y_0 - F + \sum_{j=1}^{J} (P_j-M_j)X_j.$$

With $M_j = m_j+n_j+r_j$ the full marginal cost. Substituting this expression into the community indirect utility function yields

(6) $$U = Y_0 - F + \sum_{j=1}^{J} (P_j-M_j)A_j (P_j)^{-\varepsilon_j} - \sum_{j=1}^{J} A_j(P_j)^{1-\varepsilon_j} /(1-\varepsilon_j).$$

The budget constraint for the association can be written

(7) $$F = \sum_{j=1}^{J} (w_j+v_j-m_j)X_j \equiv \sum_{j=1}^{J} (P_j-M_j)A_j (P_j)^{-\varepsilon_j} .$$

For consumer welfare, it makes no difference whether a particular marginal cost component is incurred by acquirers, issuers, or the network. It also makes no difference whether the network charges are pushed back through acquirers or forward through issuers.

To maximize consumer welfare subject to the budget constraint, introduce the Lagrangian

(8) $$L = U + \lambda[\sum_{j=1}^{J} (P_j-M_j)A_j(P_j)^{-\varepsilon_j} - F]$$

$$= Y_0 + (1+\lambda)[\sum_{j=1}^{J} (P_j-M_j)A_j(P_j)^{-\varepsilon_j} - F] - \sum_{j=1}^{J} A_j(P_j)^{1-\varepsilon_j} /(1-\varepsilon_j).$$

The first-order-conditions for optimization are

$$(9) \qquad \partial L/\partial P_j = [(1+\lambda)(1-\varepsilon_j)-1]A_j(P_j)^{-\varepsilon_j} + (1+\lambda)\varepsilon_j A_j(P_j)^{-\varepsilon_j}(M_j/P_j) = 0.$$

These conditions are satisfied by markup rates

$$(10) \qquad P_j/M_j = 1/(1 - \kappa/\varepsilon_j),$$

where $\kappa = \lambda/(1+\lambda)$ adjusts so that the budget constraint is met. Thus, services with high elasticities ε_j will be marked up very little over marginal cost, while those with low elasticities will receive the larger markups. If two services have roughly the same demand elasticity, then they will receive approximately the same markup rate. If a service is perfectly elastic, $\varepsilon_j = \infty$, then it is priced at marginal cost. If a service is perfectly inelastic, $\varepsilon_j = 0$, then $\partial L/\partial P_j = \lambda A_j = 0$ requires $\lambda = \kappa = 0$. Each service whose demand is not perfectly inelastic will then be priced at marginal cost. The recovery of fixed cost will be achieved by marking up the perfectly inelastic services above their marginal cost.

These results imply that if the demand for international transactions is substantially less elastic than the demand for domestic transactions, then consumer welfare is maximized by loading fixed cost recovery primarily onto the international transactions. If, in particular, large international transactions are the least elastic, then they would be the most heavily loaded under welfare-maximizing pricing. If small domestic transactions are the most elastic, then they would be the least heavily loaded. From the standpoint of assuming the burden of covering fixed costs, large international transactions are "cross-subsidizing" small domestic transactions, and correspondingly large international business customers with low demand elasticities are "cross-subsidizing" small domestic consumers with high demand elasticities. This pattern of “cross-subsidization” is an essential element of a pricing structure for the association that maximizes consumer welfare.

The preceding analysis does not depend critically on the assumption that the retail segment of the industry is competitive. If retailers were instead monopolistically competitive, with product differentiation or barriers to entry giving them some market power to mark up the prices of service components above their marginal costs to the retailers, then they would mark up most those services that have the least elastic demand. Thus, retailer component pricing would produce price patterns qualitatively similar to Ramsey pricing patterns, but generally higher markups than optimal Ramsey pricing would prescribe. In this circumstance, if the association had the Ramsey objective of consumer welfare maximization, it would in its optimization take into account the indirect effect of its prices on retailer markups, and would adjust its own markup on low elasticity items so that the combined wholesale and retail markup is optimal, subject to the constraints of retailer behavior. The qualitative conclusion that consumer welfare is advanced by loading much of the fixed costs of network operation on the least elastically demanded components remains true. A simple analysis

under the alternative assumption that the retail sector is monopolistic supports this conclusion. Consumer welfare is still given by (6). To carry through the analysis in the constant demand elasticity framework, assume that all services have demand elasticities greater than one in magnitude. The monopolistic retailer maximizes its profit, given wholesale prices, by employing the markup rule

(11) $$P_j = (w_j+v_j+n_j+r_j)/(1-1/\varepsilon_j),$$

which implies that $w_j+v_j-m_j = P_j(1-1/\varepsilon_j) - M_j$. Then, the association's budget constraint in the presence of a monopoly retail sector becomes

(12) $$F = \sum_{j=1}^{J} (P_j (1-1/\varepsilon_j)-M_j)A_j \ (P_j)^{-\varepsilon_j} \ .$$

Setting up a Lagrangian to maximize consumer welfare subject to this budget constraint, as earlier, leads to the result that the optimal markups for the association, given the conduct of the retail sector, satisfy

(13) $$P_j/M_j = 1/(1 - \kappa(2-1/\varepsilon_j)/\varepsilon_j),$$

where $\kappa = \lambda/(1+\lambda)$ is adjusted so that the budget constraint is satisfied. This resembles the optimal markup condition for a competitive retail sector, except for the added term $(2-1/\varepsilon_j)$. Then, for a given value of κ, total markups will be higher under monopoly than under competition, and will be largest on the least elastically demanded services. The effect of the retailer monopoly conduct is to generate larger markups from the association, as the retailer markups reduce demand and require that fixed cost be recovered from lower volumes than in the competitive case. There will also be some shifting of the shares of fixed costs covered to somewhat more elastic services, essentially for the same reason: retailer behavior limits the volumes, and hence the potential network fixed cost recovery, from the least elastic services. Despite these differences, the overall picture is that the largest shares of fixed cost recovery will be bourne by the least elastically demanded services. Intermediate cases between a competitive and a monopolistic retail sector will not alter this qualitative conclusion.

The preceding analysis did not depend in any essential way on the association being the only network providing services versus being in working competition with other networks. Its non-for-profit operating rules limit its behavior in the same way that rivals in working competition with free entry of rival networks would limit its behavior. The effect of market structure at the network level is solely to influence the elasticities of demand that the network faces for its services. If consumers can readily switch networks, then an analysis similar to that used above for marginal cost pricing by retailers can be applied, and used to show that a single network will not be able to increase its wholesale prices for services above those in rival networks. Given the existence of positive fixed costs at the network level, and barriers to entry, workable competitive equilibrium would produce

wholesale price structures that recover fixed costs through some pattern of markups. There is a potential problem of "cream-skimming" by issuers: different networks would set different wholesale pricing structures that all break even for their existing retailer base, but after switching by retailers to networks where their incidence of fixed cost recovery is reduced, the networks will no longer cover costs. In these circumstances, pure competition may break down, with no stable market equilibrium, but workable competition is likely to lead to an equilibrium in which existing networks have comparable pricing structures so that the incentive for retailers to switch networks is removed.

The conclusions of this note do not claim, or require, that the association consciously seeks to maximize consumer welfare. Its objective may, for example, be to maximize total transactions subject to its non-profit operating rule, thereby maximizing (normal) profits of its members. This objective would lead to the same qualitative pricing pattern, with fixed costs most heavily loaded on services where transaction volume is least sensitive to price. Such an objective does not lead to network wholesale prices that solve the Ramsey optimal pricing problem, but it does produce a similar pattern of prices, with fixed cost recovery loaded primarily on the services with the least elastic demand. (The precise Ramsey solution would require quantitative information on elasticities of demand for various services.) However, the results of this note establish clearly that any prescription for pricing that forced recovery of fixed costs through uniform markups closely tied to marginal costs, or through markups that are keyed to the order in which services were introduced into the market, without adjustments for differences in demand elasticities, would harm consumers.