December 2001

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Manish Agrawal
SUNY Buffalo

Rajiv Kishore
SUNY Buffalo

Raghav Rao
SUNY Buffalo

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Manish Agrawal
School of Management
SUNY Buffalo
magrawal@acsu.buffalo.edu

Rajiv Kishore
School of Management
SUNY Buffalo
rkishore@buffalo.edu

H. R. Rao
School of Management
SUNY Buffalo
mgmtrao@acsu.buffalo.edu

Abstract

Transaction cost economics suggests that services should be outsourced when there are a large number of vendors available to provide a service, since this eliminates possibilities of opportunism. However, clients face search costs when there are a large number of vendors to choose from. This paper develops a simulation testbed to analyze the role of intermediaries in reducing search costs for clients.

Keywords: Intermediary, e-commerce, search cost, services, pricing

Introduction

Many studies suggest that Electronic Commerce is an important driver of the economy in recent years. It was estimated (Whinston et al. 2000) that Internet-related growth was 15 times the growth rate for the non-Internet economy. It has also been suggested that only as few as 10% of the organizations in the United Sates have as yet (in 2001) implemented systems to conduct transactions over the Internet.

Organizations may seek the help of service providers to develop their e-commerce capabilities. While choosing a service provider to outsource the development of e-commerce systems, client have to choose from among a number of vendors, the vendor that best meets its needs. This process creates search costs in locating a vendor. Research (Biglaiser 1993; Diamond 1984; Gehrig 1993; Rubinstein and Wolinsky 1987; Spulber 1996) suggests that intermediaries provide value by facilitating search in the market. Qualitatively, this has also been suggested in the IS literature (Bailey and Bakos 1997) for IS service providers. This paper examines the role of intermediaries in outsourcing by examining their role in reducing search costs for clients and vendors. The contributions of this paper are as follows: (1) It synthesizes the literature on Information Services and intermediaries to examine the role of intermediaries for information services under the influence of search costs (2) It develops a model based on general equilibrium theory and a simulation testbed based on the model to analyze the role of intermediaries under the influence of search costs.

For the purpose of this study, outsourced e-commerce service providers are modeled as Application Service Providers (ASPs). These companies rent software applications and related services (Bennett and Timbrell 2000). The unique feature of an ASP is that it is based on a fixed per-time period fee.

The Simulation Methodology

Simulations have been used in management research. For example, Rivkin (Rivkin 2000) uses a simulation to study the impact of the complexity of strategies on their duplication. Rao et. Al have used simulations to study interactions in teams (Rao et al. 1995). An advantage of the methodology is that simulations help isolate the impact of specific constructs under study for detailed study. Also, simulation models may be easily extended to examine more constructs are added to the model.

Our simulation design is based on the vendor selection process described in (Kotler 1991). In this model, the client first goes through a search process, followed by negotiations and the final delivery of services over the contract period. In this research,

the negotiation process is abstracted by splitting the surplus in a transaction between the client and the vendor equally between the parties (Rubinstein and Wolinsky 1987).

Search Costs

When clients use an intermediary, they weigh the costs of using the marketplace against the possible loss of utility from selecting a sub-optimal vendor. We model the role of the intermediary in search as follows:

A distribution of clients seeking information services enters the simulation at time period 0. They are characterized by a type θ_j , which is the price they are willing to pay for the service. Similarly, a distribution of vendors also enters the simulation at time period 0. They are characterized by a quality $q_i \in [0,K]$. Vendors who choose to list with the marketplace pay a listing fee τ_i. The cost for providing the service is $(1/K^2)*q_i^2$. Clients may choose to enter the marketplace, pay a fee P_j to the intermediary, and obtain listings of all the vendors available or search for vendors directly, without the intervention of the intermediary.

Using the intermediary, the client is able to conduct a global search of all vendors listed on the marketplace. When clients do not use the intermediary, they select vendors on their own. However, since organizations have limited resources at their disposal, they can only examine $S \leq N$ vendors in one time period, where N is the number of vendors in the simulation. It compares the best vendor in this sample of S vendors and compares it to the best vendor in the next sample. If the utility from waiting is positive, it waits yet another time period. This continues until time period t_0 when the search does not yield positive utility. In each time period that the client goes without a vendor, it incurs a business loss for lack of availability of the required Information service (fig. 1). Notice that the selected vendor in direct search may not be the globally optimal vendor. It will not be able to choose the globally optimal vendor if it is not among the candidates chosen till time period t_0.

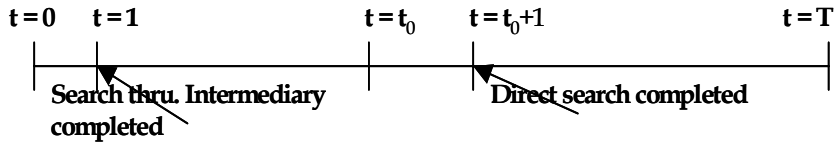

Figure 1. Experimental Design to Search Costs

Assuming a common discount factor δ for clients, vendors and the intermediary, the variables that determine the vendor's operations are:

Quality offered $q_i \in U[0, K]$; Cost $c_i = (1/K^2)*q_i^2 \in [0, 1]$
And for the client (Mussa and Rosen 1978),
Willingness to pay $\theta_j \in U[0, 1]$; Utility from service $q_i = \theta_j * q_i - (\theta_j - c_i)/2$ per time period

In direct search, the vendors incur a cost K_d to locate clients and secure contracts.

When the client participates with the intermediary, its utility is given by:

$$U_{cji} = \sum_{t=1}^{T} \delta^t * (\theta_j * q_i - \frac{(\theta_j - c_i)}{2}) - P_j$$

Sub. To $\theta_j \geq c_i$ (1)

Where the subscript c denotes the client, j identifies the client and i indicates that the transaction is through the intermediary.

A vendor who completes an arrangement with a client derives utility per time period of $(\theta_j - c_i)/2 - c_i - \tau$. The utility for vendor I of participating with the intermediary is given by:

$$U_{vii} = \sum_{t=1}^{T} \delta^t * (\sum_{j} \frac{(\theta_j - c_i)}{2} - c_i) - \tau$$

Following the logic discussed earlier, in direct search, vendor v_2 is selected at time t_0 when:

$U_{t0} > U_{t0+1}$

The clients' utility from direct search is given by

$$U_{cjd} = \sum_{t=t_0}^{T} \delta^t * (\theta_j * q_i - \frac{(\theta_j - c_i)}{2})$$

And the vendor's utility per time period from direct search is $(\theta_j - c_i)/2 - K_d - c_i$, therefore the vendors' net utility from direct transactions is given by:

$$U_{vid} = \sum_{t=0}^{T} \delta^t * (\sum_j \frac{(\theta_j - c_i)}{2} - c_i) - K_d$$

We can now state the intermediary's problem as follows. The only revenues for the intermediary are the participation fee from the clients and listing fees from the vendors.

Max. $N.\tau + \Sigma_j P_j$ (2)

Sub. To participation by clients:

$$\sum_{t=1}^{T} \delta^t * (\theta_j * q_i - \frac{(\theta_j - c_i)}{2}) - P_j \geq \sum_{t=t_0}^{T} \delta^t * (\theta_j * q_i' - \frac{(\theta_j - c_i)}{2})$$

and vendors:

$$\sum_{t=1}^{T} \delta^t * (\sum_j \frac{(\theta_j - c_i)}{2} - c_i) - \tau \geq \sum_{t=0}^{T} \delta^t * (\sum_j \frac{(\theta_j - c_i)}{2} - c_i) - K_d$$

Example

Consider a simple numerical example for the above system. There is a single client of type 0.8 and three vendors of quality 30, 40 and 60 with costs respectively 0.3, 0.4 and 0.6. Assume only one time period and zero discount rate. Thus while participating with the intermediary, the client's utilities are:

$U_{60} = 47.3 - P_j$; $U_{40} = 31.4 - P_j$; $U_{30} = 23.45 - P_j$

Therefore, the client will choose the vendor with quality 60. In direct search, it is easy to check the possible search sequences to see that the vendor with quality 30 will never be selected, vendor 40 has probability 1/3 of being selected and vendor 60 has probability 2/3 of being selected. The expected utility for the client in direct search = 0.67*47.3 + 0.33*31.4 = 42.1. Since this is less than the utility from participating with the intermediary if $P_j \leq 5.2$, the intermediary can charge upto 5.2 units from the client and secure its participation.

Further Research

To analyze the above equation system, we will introduce a random population of clients and vendors in the marketplace. Clients leave the marketplace after they are matched with a vendor by an omniscient agency that allocates the surplus to the intermediary as in the example. This will help determine the fees that may be charged by an intermediary for different categories of clients and vendors. An intermediary can add value in the search process if there are paying clients and vendors that prefer to use its services.

At the conference, we will present the results of our simulations. We expect that we will identify the categories of clients and vendors that prefer to participate with the intermediary and the fee schedules that the intermediary can charge for the different categories of clients and vendors.

The model presented here can be extended to examine the role of intermediaries in monitoring the performance of vendors during service fulfillment. Assuming that monitoring requires a high initial investment, it may be more efficient for an intermediary to make the investment since it is likely to be amortized over a number of clients. Since technology advances rapidly and it is expensive to keep abreast of technological changes (training, R&D and other expenses), vendors have an incentive to shirk adapting to changes in technology, thus lowering the quality of their service over time. An intermediary, representing a large number of clients can effectively enforce quality performance by vendors in addition to investing in the capabilities to detect such deviations. In an extension to the current research, we will examine the role of intermediaries in monitoring and enforcing quality during service fulfillment.

References

Bailey, J. P., and Bakos, Y. (1997). "An exploratory study of the emerging role of electronic intermediaries." *International Journal of Electronic Commerce*, 1, 7-20.

Bennett, C., and Timbrell, G. T. (2000). "Application service providers: Will they succeed?" *Information Systems Frontiers*, 2(2).

Biglaiser, G. (1993). "Middlemen as Experts." *Rand Journal of Economics*, 24(2), 212-223.

Diamond, D. W. (1984). "Financial Intermediation and Delegated Monitoring." *Review of Economic Studies*, 51(July), 393-414.

Gehrig, T. (1993). "Intermediation in Search Markets." *Journal of Economics and Management Strategy*, 2(1), 97-120.

Kotler, P. (1991). *Marketing Management: Analysis, Planning, Implementation and Control*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Mussa, M., and Rosen, S. (1978). "Monopoly and Product Quality." *Journal of Economic Theory*, 18, 301-317.

Rao, H. R., Chaudhury, A., and Chakka, M. (1995). "Modeling Team Processes: Issues and a Specific Example." *ISR*, 1995.

Rivkin, J. W. (2000). "Imitation of complex strategies." *Management Science*, 46(6), 824-844.

Rubinstein, A., and Wolinsky, A. (1987). "Middlemen." *Quarterly Journal of Economics*, 102(August 1987), 581-593.

Spulber, D. F. (1996). "Market Microstructure and Intermediation." *Journal of Economic Perspectives*, 10(3), 135-152.

Whinston, A., Barua, A., Shutter, J., Wilson, B., and Pinnell, J. (2000). "Measuring the Internet economy." CISCO systems, University of Texas.