

Sequential Decisions for Location and Service Intensity by Professional Service Firms with Geographically Dispersed Clients

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The issues of inseparability, the difficulty of knowledge transfer, and the limited number of service providers requires professional service firms(PSFs) to develop unique service delivery systems to serve geographically dispersed clients. This study examined service location and intensity decisions for a multi-location service delivery system, in other words, this study examined two inter-related questions; 1) how they chose locations in which to practice that lay outside the urban areas where their home offices resided, and 2) how much resources they allocated to the selected location. These two sequential questions are investigated with a generalized Tobit model.

This research tested hypotheses using a unique data set of medical oncology specialty group practices in the state of Iowa in the U.S. for the period 1989-2001. This study focused on the service delivery decisions made by these specialized physicians regarding practicing in rural areas near the urban center where they are located. Specifically, this study examined their decisions regarding the locations and intensity of service via visiting consulting clinics(VCC) in rural hospitals.

This study found that the practice locations in a given year were determined by the benefits of the location as well as the opportunity costs to serve that location. Furthermore, past experience played an important role in the choices made by these professional service firms. However, the data showed that the number of incumbent competitors does not affect PSF's location decision.

With respect to the level of resource allocation(service intensity) to these locations, the decisions by the PSFs in the sample of this study were driven by many of the same factors as their choices to practice there in the first place. Locations with larger client bases and lower opportunity costs enjoyed higher levels of service intensity. The PSFs also allocated more resources to locations that were not overly attracted to competitors. Although the number of competitors did not affect the choice decision, the service intensity of the incumbent competitors affects the focal PSF's service intensity. In other words, once a PSF decides to enter the market the PSF tends to provides high level of service intensity when the competitors are allocating more resources.

Keywords : Service marketing, Service delivery, Professional Service, Healthcare, Location Model

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I. INTRODUCTION

Growth is a key goal of most service firms. One strategy that many firms use to achieve their growth objectives is geographic expansion. Geographic expansion is particularly important for small and medium-sized service firms whose business scope has been geographically confined (Barringer and Greening 1998). Two different modes of geographic expansion exist: international expansion and domestic expansion. Current trends toward globalization in the service sector have motivated a number of researchers to examine how service providers choose to enter new international markets (Erramilli and Rao 1993; Ekeledo and Sivakumar 1998, Lu and Bea-mish 2001). In addition, researchers have renewed their interest in the challenges facing professional service providers as they enter unfamiliar foreign markets (Beaverstock 2004). However, in reality, most professional service firms (PSFs) serve a localized, geographically bounded set of clients. For example, the primary focus of expansion by U.S. law firms has been entry into new domestic markets (Hitt et al. 2001).

That PSFs focus on domestic expansion is due, in part, to their nature. The professional workforce is one of the most important assets of the PSF, and successful growth of a PSF depends on recruiting and retaining those professionals (Barringer and Greening

1998; Greenwood et al. 2005). However, unlike other service providers, professional service providers are bounded by the regulations associated with licensure in professional services. For example, an accountant who attains a CPA designation in one state usually must limit his or her practice to that state. To serve clients in other states, the accountant would have to obtain further certification.

When a PSF decides to expand its business geographically, the key issue is delivering the service to clients in each geographic market. As service firms have begun to cover multiple geographic markets, academics have started to pay more attention to the problems of designing and operating service delivery systems (Hitt and Frey 2003; Ho and Zheng 2004).

This study examined the decisions made by a set of PSFs regarding their service delivery to geographically dispersed clients. This study differs from prior research in important ways. First, much of the research on location decisions for professional services has focused on choosing a single, optimal location (Becker et al. 1997; Paul 1997). Second, those studies that have examined PSFs with multiple locations have focused either on “hard” services, which can be created in one location and delivered in another (e.g. computer software programming), or on decisions about the opening of branch offices that are

replications of the home office. This study, however, concentrated on a “soft” service that has a highly restricted number of providers and requires a very high degree of personal interaction between the professional and the client (e.g. medical service). Therefore, to serve a geographically dispersed population, these providers have to create a multi-location service delivery model. Third, prior research examined the service location decision alone. To our knowledge, no studies have considered the determinants of service intensity (i.e., the level of service provided at each geographic location) for professional service providers. Given the inseparable nature of professional services (see discussion of this topic in the next section), PSFs have limited resources to dedicate to various service locations. Consequently, service intensity decisions are equally important and interesting to study.

This study focused on medical oncology specialty practices in Iowa. In this state, as in most of the U.S., specialist physicians serve a geographically dispersed population of patients from a few, widely separated urban centers. This study examined the decisions made by these PSFs with respect to the locations and intensity of their delivery of specialized medical services between 1989 and 2001.

The next section discusses the important features of PSFs that affect their delivery

system decisions. The section also provides a short overview of alternative topologies of service delivery systems for geographically dispersed populations. This section is followed by study hypotheses and empirical results. The last section discusses findings of this study and directions for future research.

II. BACKGROUND

Service providers face a range of issues with respect to production and distribution. PSFs have a unique set of challenges that complicate their decision making regarding service delivery system design. The major factors contributing to the complexity of these decisions are: 1) the inseparability of professional services; 2) the difficulty in transferring professional knowledge; and 3) the limited number of professional service providers. These characteristics argue for a specialized approach to designing a delivery channel to provide professional services for geographically dispersed customers.

1. Inseparability of Professional Services

Many services are separable, meaning that the production of the service and its consumption can be separated in space and time (Sampson and Snipe 1985). TV news and computer software are examples of se-

parable services. Like most tangible goods, separable services may be designed, manufactured, and stocked in a location and be delivered and consumed later in different locations. However, a large number of services are produced at or near the temporal and spatial point of purchase.

While inseparability is one of the defining characteristics of services that distinguish them from products (Zeithaml et al. 1985), the degree of inseparability is much greater, in general, for professional services. To understand the importance of inseparability to the nature of professional services, consider the following criteria developed by Gummerson (1978) to distinguish professional services from other products and services:

- The service should be provided by qualified personnel, be advisory, and be focused on problem solving.
- The professional should have an identity (i.e., be known in the market for his/her specialties under a specific name such as “architect” or “lawyer”).
- The service should be an assignment given from the buyer to the seller.
- The professional should be independent of suppliers of other services or goods.

Among the above characteristics of professional services, “given assignment” raises the first important issue with respect to

service delivery decisions for geographically dispersed clients.

The relationship between a professional service provider and a client is an “assignment” to solve specific problems for a particular client. In that sense, the level of customization in the professional service is higher than in many other services. The fact that professional service focuses on more personalized problem solving necessitates a higher amount of personal interaction between a PSF and a given client. The amount and type of interaction depend on the extent to which the professional must be physically present to deliver the service. As Alreck (1994) states, “One of the most distinct features of service marketing is that it brings customers and service providers into direct interpersonal contact with one another more often and more intensely than the relationship between the producers or sellers and the buyers of goods. Providing professional services brings the professional and the client into even closer and more prolonged contact.”

One way that a PSF could serve a geographically dispersed set of clients would be to utilize some types of intermediate agent as a substitute for face-to-face contact. Unfortunately, the nature of knowledge in the professional service deters the use of intermediary agents.

2. Nature of Knowledge in Professional Services

The survival of a PSF depends on its storehouse of tacit knowledge. Polanyi (1967) defined tacit knowledge as being acquired experientially and transferred by demonstration, by personal instruction, and by the provision of expert service. Therefore, tacit knowledge cannot be easily transferred to others by codifying or teaching. The cost and time to transfer the tacit knowledge relate to the magnitude of “tacitness” of the knowledge. The more difficult to code and teach the knowledge, the longer the time it takes to transfer.

Tacitness of knowledge is an important factor in the market entry mode choice for all types of service providers. According to Erramilli and Rao(1993), professional skills and knowledge can be acquired only through years of education and training. Because the knowledge and skill cannot be easily acquired by any intermediary, the service firm that is based on professional skills prefers the full control mode to the shared control mode when entering a new market.

The success of professional service providers is built on tacit knowledge, which cannot be easily delivered to customers through an intermediate agent. Thus, the question that arises is: Can a PSF establish wholly owned branch firms in the local market? The limited

supply of professional service providers makes this option infeasible.

Limited Supply of Professional Service Providers

PSFs cannot establish wholly owned subsidiaries in each and every local market. The demand for the professional service would not be large enough to provide the income necessary to compensate the professional service providers for their rare and valuable knowledge. In addition, it is quite challenging to deploy professionals into each local office. The workforce itself is a PSF’s most important resource(Hitt et al. 2001). The professionals generate, embody, and translate the knowledge inherent in the firm’s output. They develop relationships with clients who are critical for sustaining the flow of remunerative work. At the same time, there is a shortage of individual professional service providers by the nature of the professional service.

Professionalization is “the collective struggle of members of an occupation to define the condition and methods of their work, to control the production of producers”(DiMaggio and Powell 1982). This collective struggle protects the knowledge and certifies the training in the professional service. Consequently, this process filters people who want to work in the profession through

specific qualification processes, such as license exams. The only people who pass such a screening can acquire the required “identity.”

The limited supply of professionals, the difficulty of transferring professional knowledge, and the degree of interaction needed between the professional service provider and customers create the need for a unique delivery system to provide service to geographically dispersed clients. The next section examines how PSFs have organized such service delivery systems.

3. Professional Service Distribution Channels

There are two basic forms of professional service distribution channels: centralized and decentralized. In the centralized approach, a PSF locates in densely populated areas which have sufficient numbers of potential clients to meet the firm’s revenue requirements. Since the PSF usually has only one location to provide its service, the location in terms of demand and distance to clients is critical for the service delivery. Interestingly, a survey of PSF’s by Mersha, Adlakha and O’Brien(1989) found that less than 25% used a formal quantitative approach to identify favorable locations for their practices. For an example of a scoring model incorporating both qualitative and quantitative factors to

evaluate alternative locations, see Mersha and Adlakha(1991).

This approach allows a PSF to focus on serving customers who reside near the service provider’s location. However it is not effective for the PSF to expand its service coverage especially for the soft services. While PSF can expand its promotion coverage to surrounding areas, actual service delivery between service providers and clients heavily depends on clients’ willingness to travel to the service provider’s location.

One alternative to a single centralized location is the geographic propagation of self-contained sites. The PSF locates identical or highly similar facilities at more than one geographically dispersed location, i.e. wherever sufficient levels of demand exist. These multiple locations may be operated under common ownership or under separate entities like a franchise system. While this model is best known in services such as retailing (chain stores) and food service(restaurant chains), it has been successfully used in public accounting in international expansion (Laird, Kirsch and Evans 2003) and in the area of consumer tax services, e.g. H&R Block. However, the professional services where this alternative will be a successful option are likely to be less capital intensive and be associated with clients who require more standardized services. PSF may have problems to implement this approach when

the local demand is not large enough, or when recruiting and staffing professionals for each location is not easy.

The final distribution option that is a focus of this paper is a hybrid model combining advantages of centralized approach and self contained approach. Under this approach, the PSF maintains a centralized location but its professionals also travel periodically to other geographically dispersed sites. The topology of this service delivery system is a star-shaped “hub-and-spoke” system. This service channel is best known in the airline industry where regional carriers provide service from smaller airports to centralized hubs. At these hubs airports, national carriers aggregate passengers using larger aircraft for direct flights between large cities(for a more detailed description, see Kanafani and Ghobial 1985).

In the professional services setting, a PSF in a centralized location chooses other locations to visit on a periodic basis in nearby geographic areas. These are usually generalist providers located in geographic areas too small to support a specialized PSF. For example, law firms specializing in criminal defense cases often choose a centralized location such as a county seat in order to have ready access to the court. These specialist law firms consult with civil attorneys in smaller nearby towns and cities to gain access to clients requiring their specialty

services.

In the medical field, specialist physicians in urban areas periodically travel to provide services to patients in adjacent rural area. In some situations, the service may be rendered at the rural site, such as a rural hospital. In other instances, the client must eventually travel to the centralized location if specialized equipment is involved in the treatment regimen. This particular geographic service delivery system is known in the medical field as a “visiting consulting clinic.”

The actual clinic consists of a specialist physician traveling from an urban area to a rural hospital to provide a limited range of outpatient diagnostic and therapeutic care to patients(Tracy, Saltzman, and Wakefield 1996; Wakefield, Tracy, and Einhellig 1997). The specialists also consult with local physicians during these visits. In addition to providing on-site care, these specialists expect to influence future referrals of more complex cases(e.g., surgery or radiation) for treatment in an urban hospital with which they are affiliated.

4. Location Choice for Professional Service Distribution Channels

The main issue in the above three service distribution channels is selecting the best location for the service providers. There is a long tradition of modeling the location

selection in marketing and operations research disciplines. Location selection problems for first two forms have been modeled by spatial interaction models. The most common formula of spatial interaction model is the “gravity model.” Following Isaac Newton’s law of gravitations, Reilly(1931) recognized and formulated the tradeoff relationship between the cost of travel and the attractiveness of alternative shopping opportunity. Reilly’s law states that “the probability that a consumer patronizes a shop is proportional to its attractiveness and inversely proportional to a power of distance to it”(Reilly 1931). Huff(1964) also developed a similar gravity model. Unlike Reilly’s model, Huff’s incorporated Luce choice axiom in the gravity mode(Luce 1959). Using this axiom, Huff’s model recognized that not everyone in the trading area(or service area) would travel to the stores. Instead, the model measures the probability that a customer is likely to shop at a store in one(designated or specific) location rather than travel to a different store. The probability is equal to the ratio of the utility of that store to the sum of utilities of all stores considered by customers. However, the main criticism against the Huff model is its over-simplification as the original Huff model considered only two variables, distance and size, to calculate the utility of stores.

Nakanish and Cooper(1974) revised and

extended the original Huff model to explicitly incorporate other competitive attributes of stores such as store image and assortments. This more general form of the gravity model is named by authors as multiplicative competitive interaction(MCI) model. Accuracy of the calibrated parameter was another criticism against Huff model, but Nakanish and Cooper(1974) showed that MCI model can be calibrated using a least square procedure.

While the single location problem is the main focus of the original Huff model and the MCI model, multiple location selection problems are also solved by several forms of location-allocation models(for a review, please see Drezner 1995) and MULTILOC (Achabal et. al, 1982).

This study deals with the hybrid form of service distribution. The specialist physician chooses to practice in more than one rural area in addition to the “home” urban market. The specialist physicians in urban areas periodically travel to provide services to patients in adjacent rural areas. Thus, our approach differs from previous location selection models in that 1) we consider the distance between service provider’s origin and the target locations, not the distance between customers and the target locations, and 2) we also model subsequent service intensity decisions as well as location selection decisions.

The travel distance is a very important

consideration in the previous models. However, the previous models focus on the distance between customer's location and possible facility sites as their main decision is to choose the right location to set up rather long-lasting facilities which are close to their customers. Moreover, in the previous model, the facilities in the target location operate mostly within that specific location. The hybrid form, however, as seen in figure 3, requires professional service providers travel between the origin and the target location. With high opportunity cost that the professional service providers need to bear, the travel distance between the target location and the origin of the professional service becomes critical factor to consider for the location decision in the hybrid form.¹⁾

Another important decision that service provider needs to make is a service intensity decision. Since a service provider with finite resources serves multiple locations, the professional service providers need to decide how much resource they allocate to adjust the service intensity for the given location. This study will examine the factors which affect location decision and/or resource allocation at the same time. In other words, this research aims to answer two key que

stions regarding service delivery decisions for these specialist physician practices: 1) Which location(s) should be chosen? and 2) What should be the intensity of service provided to these locations?

The next section develops a set of hypotheses regarding the determinants of location choices and service intensity decisions in hub-and-spoke-type service delivery systems for professional services.

III. LOCATION CHOICES AND SERVICE INTENSITY DECISIONS

For a PSF, choosing to practice in person in a set of locations outside a central, urban setting entails two inter-related decisions: location choice and resource allocation. In other words, the PSF makes decisions regarding the geographic scope and intensity of its service delivery system.

Some locations will be more attractive to a given PSF than others. Because the purpose of the relationship is to gain access to potential clients, those locations that have a larger client base will be more attractive. At the same time, a PSF should consider the potential reward for practicing in a given

1) Due to lack of data, we could not explicitly incorporate the distance between customers and the target location. With the small county level data we use, we assume that customers in the county are willing to travel to any location in the county for the important medical service.

location. The level of service should be more intense for those locations likely to provide more clients to the PSF. Therefore, this study expects that locations with larger client bases are more likely to be chosen by the PSF and be served more intensively. This leads to first two hypotheses:

H1: A PSF is more likely to choose a location that has a larger client base.

H2: Given that a PSF has chosen its locations, its level of service intensity will be higher for locations having larger client bases.

These hypotheses are concerned with the size of the benefits of a given location. However, resource dependence theory(Pfeffer and Salancik 1978) suggests that the stability of resource flows is of comparable concern for the firm. Due to its desire for stable resource flows, a firm will find a location with which it has previous experience more attractive.

Once a PSF chooses a location, it invests financial and human capital to initially cultivate the location. The PSF needs to set up facilities in the new location, study the local market, and establish relationships with new clients. The financial and human capital invested in the new location represent sunk costs, and these costs play a crucial role in the firm's decision in favor of continuing

with the status quo and against market exit(Phillips and Mason 1997; Karakaya 2000).

In the organizational learning literature, Baum et al.(2000) indicated that organizations tend to exploit current routines that provide more certain reward rather than explore new routines that are risky and uncertain. Concerns regarding the stability of resource flows, sunk costs, and loss aversion(Kahneman and Tversky 1979) lead to the third hypothesis.

H3: A PSF is more likely to choose a location that it had chosen in the previous year.

Gundlach et al.(1995) argued that commitments to relationships become meaningful over the passage of time. This suggests that the intensity level of service that a PSF commits to a given location will set expectations for the future. A PSF's failure to continue or even increase its level of service intensity might be judged negatively as opportunistic if not unethical behavior. This leads to the fourth hypothesis:

H4: Given that a PSF has chosen its locations, the level of service intensity in the current year will be positively related to the service intensity level in the previous year.

Location and service intensity decisions are a balance between expected benefits and costs. For the PSF, its major costs for choosing a new location to practice are opportunity costs. The time spent traveling to the new location decreases the resources available to serve clients in the home market, and these cannot be recovered.

If variations across locations exist, a PSF will be more likely to choose a location, all else being equal, with lower opportunity costs. Furthermore, a PSF will provide a less intensive level of service to a location with a high level of opportunity costs. This study based these predictions on the influence of risk aversion on managerial decision making. The outcome of the investment in time for developing a practice in a new location is relatively unknown at first. In contrast, opportunity costs can be known and, therefore, are quantifiable. Under risk aversion, a PSF will seek to reduce known outflows in the presence of uncertain returns. This leads to the next two hypotheses:

H5: A PSF is more likely to choose a location with low opportunity costs.

H6: Given that a PSF has chosen its locations, it will more intensively serve those locations with lower opportunity costs.

In managing its portfolio of practice

locations, a PSF must consider the actions of its competitors (i.e., PSFs able to supply the same services). Multiple PSFs interested in and able to provide services may exist in a given location. Consequently, the presence of a competing PSF would make that location less desirable because there are too few potential clients to justify the presence of more than one PSF. This leads to the next hypothesis:

H7: A PSF is less likely to choose a location in which competitors have already established themselves.

If more than one PSF is competing to serve a given location, the clientele of that area is in a powerful position. Such clients “can create advantages for themselves by playing one off against the other and brokering tension between the other players. These advantages can translate into concrete benefits in the form of favorable terms in their exchange relationships” (Gulati 1998, p. 297). In other words, clients in this location can leverage their position to their benefit. Therefore, to avoid being out-manuevered, a PSF will increase the intensity of service at locations that are already being intensively served by competitors. Thus, the next hypothesis of this study is:

H8: Given that a PSF has chosen its

locations, it will serve a location more intensively if its competitors also served that same market intensively in the previous year.

Up to this point, this study has focused on the attractiveness of a location to the PSF seeking new places to practice. However, an equally important issue is how attracted the clients in a given location are to one's competitors. Clients from a location where the PSF is currently practicing may prefer to do business with a competing PSF. For example, a competitor located closer might be able to provide a more intensive level of service. The presence of a competitor that is very attractive to clients in a given location makes that location less desirable overall because of the possibility that the competitor might supplant the PSF in that location. Such a possibility motivates the next hypothesis:

H9: A PSF is less likely to choose a location if clients in that location are highly attracted to a competitor.

The resources committed by the PSF in serving a given location are non-transferable(Heide and John 1988); they represent an unrecoverable cost in lost opportunities to serve other locations or clients in the PSF's home market. If clients in a given location are very attracted to a competitor and decide

to work with the competitor, the PSF will have no opportunity to recover the resources it has already committed. Therefore, all else being equal, this study expected that a PSF would have a lower level of service intensity in locations where clients may be strongly attracted to a competitor. This leads to the final hypothesis.

H10: Given that a PSF has chosen its location, its level of service intensity will be lower in locations where clients are highly attracted to competitors.

IV. EMPIRICAL STUDY

1. Setting

The setting for the empirical study of this research was the market for specialized physician services, specifically medical oncologists, in Iowa. This study focused on the service delivery decisions made by these specialized physicians regarding practicing in rural areas near the urban center where they are located. Specifically, this study examined their decisions regarding the locations and intensity of service via visiting consulting clinics(VCC) in rural hospitals.

This service delivery system has a number of advantages for the participants(Tracy et

al. 1996; Wakefield et al. 1997). For the specialists, a VCC assists in retaining and enhancing its referral base. These referrals improve relations with the urban hospitals where they practice. For the rural hospital, hosting a VCC increases the availability of needed specialty services, reduces professional isolation for its staff, and heightens its local reputation as a medical care provider. There are further benefits to patients who can access specialty care in their own communities.

A specialist physician often conducts VCCs in multiple rural hospitals. At the same time, a rural hospital may host VCCs from specialist physicians who are competitors (i.e., in the same specialty). The arrangements supporting the VCCs are reviewed regularly (at least yearly), and either party can terminate the relationship.

The primary data for this study came from the Visiting Medical Consultant Database maintained by the Office of Statewide Clinical Programs, which is housed in the Carver Medical School of the University of Iowa. This database collects data continuously as new VCCs are formed. In addition, a yearly telephone census of all hospitals in the state ensures that all data are being captured at least on a yearly basis. In addition to the location of the VCC, the database includes the name and location of the participating specialist physicians and their group practice

affiliation and location. Statewide data collection began in 1989. This is the only database of its kind in the U.S.

This study focused on the service delivery decisions made by medical oncology group practices, all of which are based in urban areas. This study chose oncology due to the increasing demand for services in rural areas where the population is rapidly aging and advances in high-technology treatment options require specialized facilities and training. Most of these resources, however, are concentrated in urban areas.

Overall, the number of medical oncology group practices participating in VCCs grew from 14 in 1989 to 17 by 2001. At the same time, the number of total VCC arrangements more than doubled from 41 in 1989 to 91 by 2001. These medical oncology group practices are all located in 18 urban areas within the state and in urban areas located within adjoining states. The pool of potential locations consists of 116 hospitals in rural areas. These hospitals are generally small; more than 85% have fewer than 100 beds. They have limited medical staffs and less access to medical technology than hospitals in nearby urban centers.

The data used in this study span the period from 1989 to 2001. Although VCCs did exist before 1989, no statewide data from before this time are available. This is a common problem with longitudinal data. However,

because the VCC arrangements are reviewed and renewed at least on a yearly basis, the effect of missing initial period data is lessened.

2. Measures

2.1 Dependent variables

The two dependent variables of interest were choice and level of service intensity. A choice of a given location by a given firm is considered to occur if there is a VCC in operation during a given year. Due to frequent reviews, the status of these relationships can change from year to year.

This study measured the level of service intensity by the number of visits to a particular location a given urban specialty practice made in an average month. This measure reflects a significant, non-transferable, non-recoverable investment by the urban specialty practice in the patients associated with that location.

2.3 Independent variables: Client Base

The benefits of a VCC for an urban specialist come from treatments at the rural location(i.e., the site of the VCC) as well as from referrals for more complex care to be provided in an urban setting. The size of the client base associated with a location is determined by the number patients who are

in need of specialty care.

In Iowa(as in most of the country), the majority of patients treated in a rural hospital live in the same county in which the hospital is located. Therefore, this study used county population size as a measure of size of the client base associated with a given location.

2.4 Opportunity costs

Specialty medical care is an inseparable service — it requires the physical presence of the provider(Erramilli and Rao 1993). Such services have also been referred to as “soft” services, as opposed to “hard” services such as advertising or equipment leasing whose expansion to new markets has more in common with manufactured goods(Ekeledo and Sivakumar 1998). If the physicians should travel to remote areas to deliver the service, they need to forego the opportunity to treat the patient in their own location. Therefore, the opportunity costs for the urban specialty practices are a result of the time spent by physicians traveling to and from the rural locations.

In Iowa, there is an absence of significant geographic impediments, such as rivers and mountains, and the presence of a well-developed road system(Wakefield et al. 1997). These conditions ensure relatively straight forward travel between urban centers and rural hospitals. Therefore, this study used

the Euclidean distance (in miles) between the centroid of the area in which an urban specialty practice is located and the location of the rural hospital. (In other settings, such as travel within large urban areas, estimates of drive times should be used).

2.5 Prior experience

A prior relationship between a given firm and a particular location was determined by the presence of VCC relationship in the previous year. Therefore, if a VCC was present, this variable had a value of 1; otherwise it was zero.

2.6 Previous level of service intensity

This variable was the number of visits from a given specialist practice to a given location in the previous period. If no VCC existed in the immediate prior period, this variable had the value of zero.

2.7 Presence of competitors

The value of this variable in a given time period was determined by the number of competitors who participated in a VCC in a given location in the immediate prior year. It was zero otherwise.

2.8 Competitors' service intensity

This variable was determined for each pairing of urban specialty clinic and rural location separately. For a given year, it was the total number of days in the past year that a VCC was held in an average month at a given location by competitors.

2.9 Attraction of location to competitors

In addition to providing care on-site, the urban specialists participating in a VCC also provide more complex care to a rural location's patients, albeit at a better equipped urban hospital. All else being equal, the specialist practice located in the closest urban area is the most attractive to patients of a given rural area.

Proximity is very attractive to patients from a rural location, because it would mean reduced travel time and costs if more advanced care were required in a better equipped urban hospital. In addition, local primary care physicians in the rural area would find it easier to visit and monitor their patients if they were being treated in a nearby urban area.

For these reasons, this study modeled the attraction of a location to a competitor (another urban specialty practice) as the distance between the location (i.e., rural hospital) and the closest urban specialty practice that is not the focal firm. This distance may be more or less than the

Table 1: Variable descriptions

	Dependent Variable	Definition	Operationalization	
Choice Model	<i>Choice_{pat}</i>	Firm p practices in location q at time t	= 1, if an urban practice p has a VCC relationship with rural hospital q at time t ; = 0, otherwise	
	Independent Variables			Sample Mean (Std. Dev.)
	<i>Client Base</i>	Client base at location q	Population of the county where the rural hospital is located	7704 (6435,72)
	<i>Past experience</i>	Practiced in same location in prior year	$INERT_t = 1$ if urban specialist p practiced in location q in year $t-1$, otherwise, 0	0.135 (0.34)
	<i>Opportunity costs</i>	Opportunity costs for firm p with respect to location q	Euclidian distance between centroid of urban specialist p 's county and address of location q .	64.2 (23.43)
	<i>Competitors</i>	Number of competitors practicing in location q	Sum of competitors practicing in location q in year $t-1$	0.429 (0.587)
	<i>Attraction of Competitors</i>	Attractiveness of location q to most attractive competitor	Euclidian distance between location q and city centroid of competitor from closest city that is not the urban practice's origin.	26,71 (11,68)
		Dependent Variable	Definition	Operationalization
Service Intensity	<i>Service Intensity_{pat}</i>	Level of service intensity offered by firm p at location q at time t	Monthly visit frequency from an urban specialty practice p to location q at time t	
	Independent Variables			Sample Mean (Std. Dev.)
	<i>Client Base</i>	Client base at location q	Population of the county where the rural hospital is located	7704 (6435,72)
	<i>Past service intensity</i>	Previous level of service intensity	Previous year's monthly visit frequency	0.22 (0.64)
	<i>Opportunity costs</i>	Opportunity costs for firm p with respect to location q	Euclidian distance between centroid of urban specialist p 's county and address of location q .	64.2 (23.43)
	<i>Competitor Service Intensity</i>	Competitors' total service intensity at location q	Previous year's total number of monthly visits from competitors at location q	0.743 (1,16)
	<i>Attraction of Competitors</i>	Attractiveness of location q to most attractive competitor	Euclidian distance between location q and city centroid of competitor from closest city that is not the urban practice's origin.	26,71 (11,68)

Table 2–A : Correlation matrix for the choice model

	1	2	3	4	5	6
<i>Choice</i>	1,00	–	–	–	–	–
<i>Client Base</i>	0,06	1,00	–	–	–	–
<i>Past experience</i>	0,89	0,06	1,00	–	–	–
<i>Opportunity costs</i>	–0,27	–0,06	–0,25	1,00	–	–
<i>Competitors</i>	–0,10	0,13	–0,11	0,07	1,00	–
<i>Attraction of Competitors</i>	0,20	–0,07	0,18	0,08	0,06	1,00

Table 2–B: Correlation matrix for the service intensity model

	1	2	3	4	5	6
<i>Service Intensity</i>	1,00	–	–	–	–	–
<i>Client Base</i>	0,14	1,00	–	–	–	–
<i>Past service intensity</i>	0,88	0,13	1,00	–	–	–
<i>Opportunity costs</i>	–0,25	–0,06	–0,24	1,00	–	–
<i>Competitor Service Intensity</i>	–0,08	0,37	–0,09	0,06	1,00	–
<i>Attraction of Competitors</i>	0,12	–0,07	0,11	0,08	0,00	1,00

distance between a given urban specialty practice and a specific rural location,

In Tables 1 and 2, this paper presents the variable descriptions and sample statistics.

3. Model Formulation

3.1 Choice model

The dependent variable for choice is the existence of a VCC between a PSF(urban specialty practice) and a rural location. If Z_{pqt} denotes the dependent variable, the existence of a relationship between firm p

and a location q at time t can be written as:

$$Z_{pqt} = \begin{cases} 1, & \text{if firm p participates in a VCC at} \\ & \text{location } q \text{ at time } t \\ 0, & \text{otherwise.} \end{cases}$$

If Z_{pqt}^* is continuous latent utility for firm p's choice of location q at time t, the latent utility can be represented as a combination of a deterministic component and a random component as follows:

$$z_{pqt}^* = \sum_k \alpha_k \omega_{kpqt} + \varepsilon_{pqt} \quad (1)$$

$$z_{pqt} = 0 \quad \text{if} \quad z_{pqt}^* \leq 0 ;$$

$$z_{pqt} = 1 \quad \text{if} \quad z_{pqt}^* > 0 ,$$

where Z_{pqt} is a binary observed choice of firm p of location q at time t and Z_{pqt}^* is a continuous latent variable that represents utility of firm p 's choice of location q at time t .

The term $\omega_{k_{pqt}}$ is the k^{th} covariate (e.g., client base, opportunity costs, etc.) that depends on firm p , location q , and time t ; α_k is the coefficient to be estimated for the k^{th} covariate and ϵ is a random error component. We observe z , a binary variable that is a realization of a latent continuous variable z^* , having a normally distributed error ϵ .

3.2 Service intensity model

The dependent variable in the service intensity model, y_{pqt} , is the average number of visits by firm p to location q at time t . As in the choice model, we can use the latent variable for the service intensity of firm p at location q at time t , y_{pqt}^* . This latent variable can be observed as y_{pqt} only if firm p chooses location q at time t ($z_{pqt}=1$). Then, the relationship between the level of service intensity and covariates is presented as equation (2). In this model, the variable z_{pqt} serves as a selection variable for the variable y^* .

$$y_{pqt}^* = \sum_j \beta_j x_{j_{pqt}} + \mu_{pqt} \quad (2)$$

$$y_{pqt} = y_{pqt}^* \quad \text{if} \quad z_{pqt}=1;$$

$$y_{pqt} = \text{not observed} \quad \text{if} \quad z_{pqt}=0.$$

Therefore, we observe y_{pqt} , which is the observed realization of a second latent variable y_{pqt}^* , which has normally distributed independent error μ , with mean zero and constant variance $\sigma^2\mu$.

The term $x_{k_{pqt}}$ is the j^{th} covariate (e.g., client base, opportunity costs, etc.) that depends on firm p , location q , and time t ; β_j is coefficient to be estimated for the j^{th} covariate and ϵ is a random error component.

3.3 Estimation

The service intensity model (equation (2)), cannot be estimated by using a simple linear model due to two interrelated problems. First, a firm's service intensity at a given location cannot be observed unless the firm chooses that location. Second, the error in the service intensity model is correlated with the errors in the choice model.

In the model, as shown in equations (1) and (2), we have two dependent variables: z for the choice and y for the service intensity. The independent variables in the choice equation and service intensity equation may

overlap or may be completely different. Thus, the sample selection model can have a different censoring variable(z) and a censored variable(y). An appropriate model for this situation is known as the “generalized Tobit model”(Amemiya 1984).

For mathematical convenience, a normal distribution is assumed for both errors in the choice model and the service intensity model, and the two errors are assumed to have correlation ρ . Thus, the joint distribution of the two errors follows a bivariate normal distribution as follows:

$$(\varepsilon, \mu) = N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\varepsilon^2 & \rho \sigma_{\varepsilon\mu} \\ \rho \sigma_{\varepsilon\mu} & \sigma_\mu^2 \end{bmatrix}\right). \quad (3)$$

The log-likelihood function included the above information to estimate the choice model and the service intensity model simultaneously. Constructing the likelihood function for the sample selection model is quite complicated. However, as shown by Amemiya(1984), the final form of the log-likelihood function for the sample selection model is

$$\begin{aligned} LL = & \sum_0 \log(1 - \Phi(1 - \omega_i \alpha)) + \sum_1 \log \Phi \left[\frac{\omega_i \alpha + \rho \frac{y_i - X_i \beta}{\sigma_\mu}}{(1 - \rho^2)^{1/2}} \right] + \\ & \sum_1 \log \frac{1}{\sqrt{2\pi} \sigma_\varepsilon} - \sum_1 \frac{1}{2\sigma_\mu^2} (y_i - X_i \beta)^2 \end{aligned} \quad (4)$$

where Φ is the normal probability density function.

For the parameter estimation, this study used the maximum likelihood(ML) estimation with the log-likelihood function above.

3.4 Sampling

The unit of analysis in this research was the urban group practice. To generate the set of location choices for a given practice in a given year, the empirical study could have considered all 100+ rural hospitals. However, the data showed that almost no VCCs offered by urban practices occurred in rural locations more than 100 miles away. Given that virtually all travel by urban specialists to the rural locations was by car, it was reasonable to constrain the choice set to those locations within a 100 mile radius of the urban practice. In practice, the average round-trip for a specialist was 2 hours (Wakefield et al. 1997).

This study also estimated this model using a synthetic retrospective sample. This entailed drawing a sample of non-chosen locations equal to the number of locations chosen by a given firm in a particular year. The results were comparable to those reported here and are available from the authors.

Due to the lagged nature of some of explanatory variables, this empirical study restricted the analysis to VCCs that occurred

between 1990 and 2001. There were a total of 879 different VCC arrangements between medical oncologists and rural hospitals during that time period.

V. RESULTS

Table 3 shows results from three different estimations. The first result was from the full maximum likelihood(FIML) estimation discussed in the previous section. For the sake of comparison, we presented two other results; one result from Heckman's two step estimation(Heckman 1979) and another from multiple regression only with observed service intensity(service intensity of selected location). As you see in the table 3, the results from the two benchmark models are quite different from that of the FIML estimation especially for the effect of opportunity cost, competitor, competitor's service intensity and the constant.

FIML is a preferred estimation method over the regression only with observed service intensity model because the correlation(ρ) of two error terms(ϵ from the choice model and μ from the service intensity model) is not equal to zero($\rho=0.64$, $\chi^2 = 178.13$, d.f. = 1, $p < 0.001$). In this case, the regression only with observed service intensity produces biased values for the constant and the slopes (Green 1997). FIML is also preferred over

Heckman's two step estimation because the estimates of constant and slopes from the two step estimation are not asymptotically efficient. Moreover, the normality assumption is necessary for consistency, so the estimator is not as robust as FIML(Breen 1996). We will discuss only the results from FIML estimation in the next section for these reasons.

1. Hypothesis Testing

The degree of support for the hypotheses in this study was indicated by the direction and magnitude(significance) of the coefficients in the choice and service intensity models as reported in Table 3.

1.1 *Hypotheses 1 and 2: Client base*

The coefficient for the measure of the size of the potential client base was positive and significant in the choice equation($p = 0.035$) and in the service intensity equation($p < 0.01$). These results indicate that, when choosing locations, PSFs are more likely to choose those with larger client bases. In their decisions with respect to service intensity, the PSFs in the sample of this study provided higher levels of service to locations with larger client bases. Therefore, this study found strong support for Hypotheses 1 and 2.

Table 3: Estimation results

Model	Variable	FIML		Heckman's two step		Service intensity only		Expected Sign
		Coefficient	p	Coefficient	p	Coefficient	p	
<i>Choice_{pat}</i>	<i>Client Base</i>	1,11E-05	0,035	1,04E-05	0,054			+ (H1)
	<i>Past experience</i>	3,44	0,001	3,5	0,001			+ (H3)
	<i>Opportunity costs</i>	-0,01	0,001	-0,01	0,001			- (H5)
	<i>Competitors</i>	0,002	0,973	0,036	0,574			- (H7)
	<i>Attraction of Competitors</i>	0,02	0,001	0,02	0,001			+ (H9)
	<i>Constant</i>	-1,96	0,001	-1,94	0,001			
<i>Service Intensity_{pat}</i>	<i>Client Base</i>	3,21E-05	0,001	2,87E-05	0,001	3,86E-05	0,001	+ (L2)
	<i>Past service intensity</i>	0,69	0,001	0,77	0,001	0,53	0,001	+ (L4)
	<i>Opportunity costs</i>	-0,002	0,009	-0,002	0,001	-5,32E-04	0,541	- (L6)
	<i>Competitor Service Intensity</i>	0,07	0,001	0,07	0,001	0,065	0,006	+ (L8)
	<i>Attraction of Competitors</i>	0,003	0,041	0,004	0,003	-0,001	0,468	+ (L10)
	<i>Constant</i>	0,28	0,001	0,12	0,121	0,63	0,001	
	<i>Inverse Mill's ratio</i>			0,52	0,001			
	Correlation between errors of the choice and service intensity models	$\rho = 0,64$ $\chi^2=239,53, d.f.=1, p<0,00$		$\rho = 0,86$ N.A				
Overall Model Fit	<i>Wald</i> $\chi^2=1516,93$, $d.f.=5, p<0,00$		<i>Wald</i> $\chi^2=1564,03$, $d.f.=8, p<0,00$		<i>F</i> (5,870)=204,96 $R^2=0,54, p<0,000$			

1.2 Hypotheses 3 and 4: Prior relationships

In choosing its locations to practice in a given year, the PSFs in this study were significantly more likely to choose locations in which they had practiced previously ($p < 0,01$).

In addition, the current level of service intensity in a given location was positively related to the service intensity in the prior year ($p < 0,01$). For every VCC in the sample, this study compared the average number of visits in a given year with the average number of visits in the previous year. The

current level was significantly higher (paired t-test $t = 4,70, p < 0,01$). Furthermore, the current number of visits increased or stayed the same in 98,66% of the observations. These results provided strong support for Hypotheses 3 and 4.

1.3 Hypotheses 5 and 6: Opportunity costs

Opportunity costs, as measured by the distance between an urban practice and the rural hospitals where they offer a VCC, had a significant impact on which locations were chosen. As this distance rose, the probability

of being selected fell significantly ($p < 0.01$). Moreover, the service intensity was significantly lower as these opportunity costs increased ($p < 0.01$). The data in this study provided strong support for both Hypotheses 5 and 6.

1.4 *Hypotheses 7 and 8: Presence and service intensity levels of competitors*

This study expected that the number of competitors already practicing in a given location would decrease a PSF's likelihood of choosing that location. This study found that the number of existing VCC relationships in a given location did not significantly affect the likelihood that a given PSF would select that location. Therefore, this study did not find support for Hypothesis 7.

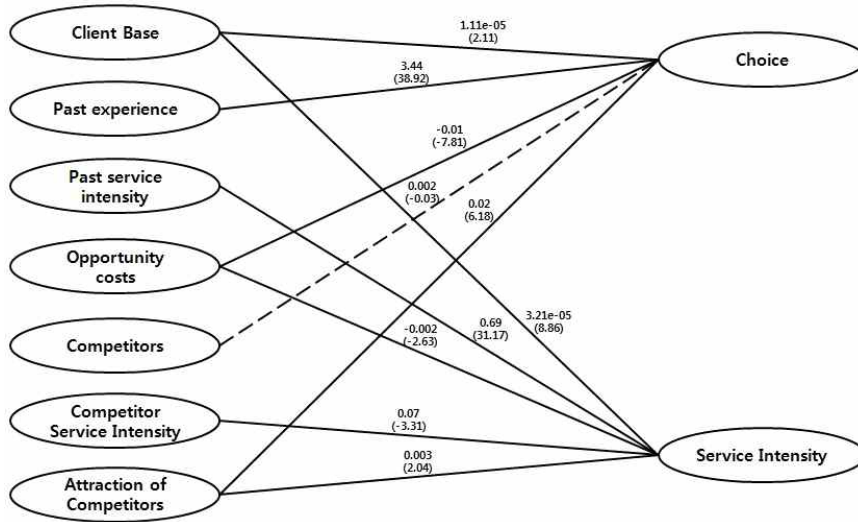
It appears that rural hospitals in locations that have attracted competing PSFs use their position to their advantage. The service intensity provided by competitors had a significant positive effect on the service intensity of the focal PSF ($p < 0.01$). A comparison of the 11 rural locations in 2001 with multiple VCCs showed that they attracted a higher overall number of visits (per month) from urban specialists (3.64) compared to those 49 hospitals with exclusive relationships (1.63, t value = 5.61, $p < 0.01$). Therefore, this study found strong support for Hypothesis 8.

1.5 *Hypotheses 9 and 10: Attraction of location to competitors*

The distance from the nearest competitor to a target location was positively related to the likelihood of that location ($p < 0.01$). One potential reason for this outcome is institutional pressure (DiMaggio and Powell 1983) within the community of specialty physicians. Beginning to practice in a rural location through a VCC that is too close to other competitors may be considered too aggressive. Such an "ungentlemanly" action might result in an unseemly reputation among members of the profession. In addition, competitors may retaliate very effectively based on geographic proximity. This leads an urban specialty practice to choose a rural location that is located farther from competitors' locations.

The effect of a location's attraction to a competitor had a significant negative impact on service intensity decisions as well ($p < 0.04$). In the context of this study, this result makes a great deal of sense. The resources allocated to a VCC represent opportunity costs that cannot be recovered if a competitor decides to enter the market. Therefore, it makes sense for a firm to invest comparatively more in a location that is not attracted to nearby competitors.

The estimation results are also summarized in the figure 2.



Note: Numbers on arrows are coefficients with t values in parentheses.

Figure 2: Estimation results

VI. DISCUSSION AND CONCLUSIONS

The constraint on the supply of professional service providers along with the inseparability of the service motivated this study of service delivery systems for PSFs with geographically dispersed clients. This study examined the scope and intensity decisions made over a 13 year period by specialist physicians. This study examined how they chose locations in which to practice that lay outside the urban areas where their home offices resided. This study found that the practice locations in a given year were determined by the benefits of the location as well as the opportunity costs to serve that location. Furthermore, past experience played an important role in the choices

made by these professional service firms.

With respect to the level of service intensity offered to these locations, the decisions by the PSFs in the sample of this study were driven by many of the same factors as their choices to practice there in the first place. Locations with larger client bases and lower opportunity costs enjoyed higher levels of service intensity. The PSFs also allocated more resources to locations that were not overly attracted to competitors.

To our knowledge, this is the first study that examined these two critical service delivery decisions for a large sample of professional service firms over time. Unlike many other studies, this study had information on all of the possible locations, including their relative advantages and

shortcomings. At the same time, the measure of service intensity in this study was robust, especially compared to survey-based measures used in related B2B research(e.g., Sarkar et al. 2001).

Much of the research on location decisions and other issues surrounding the service delivery systems of professional service providers either concentrate on the problems of the solo practitioner(Becker et al. 1997) or on the global players such as Big 6 accounting firms(Laird et al. 2003). In reality, most professional service organizations, especially in medicine and law, lie between these two extremes. Some of the service delivery challenges faced by these organizations are not necessarily amenable to technological innovations, while others continue to require face-to-face, human interaction. More research is needed in this great middle area to determine how such PSFs make their service delivery decisions and the implications of their choices, before researchers can turn to the question of optimization.

Also, due to the data availability issue, this research could not investigated the influence of distance between the location and customers, distance between the focal service firms location and competitor's location, and the effectiveness of location selection. More research can be done in this area with more informative data.

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지역적으로 분산되어 있는 소비자들을 대상으로 한 전문 서비스 회사의 지역 선정과 서비스 강도 결정에 대한 연구

남 인 우*

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프로페셔널 서비스를 제공하는 회사들은 그 서비스의 특성상 서비스 공급자의 수가 적고, 서비스를 타인에게 교육시키기가 힘들며 서비스 전달과정에 직접적으로 관여해야 할 필요성이 크다. 이러한 상황에서 회사가 넓은 지역에 서비스를 제공하려 한다면 상품의 유통과는 다른 형식의 서비스 유통망을 필요로 하게 된다. 본 연구는 프로페셔널 서비스 회사가 복수의 지역에 동시에 서비스를 공급하려고 할 때 어떤 지역을 선택하고 그 선택한 지역에 얼마만큼의 서비스를 할당하는가는 문제에 어떠한 변수들이 영향을 끼치는가 하는 것을 토빗(Tobit) 모형을 통해서 조사하였다.

본 연구의 데이터로는 1989년과 2001년 사이에 미국의 암전문의들이 Visiting Consultant Clinic(VCC)라는 시스템을 통하여 전문의들 자신이 위치한 도시지역에서 떨어진 넓은 시골 지역에 서비스를 제공하는 행위가 데이터로 사용되었다.

본 연구의 결과에 의하면 서비스회사가 서비스를 제공할 지역을 결정하는 것과 그 지역에 대한 서비스 강도에 관한 결정은 비슷한 요소들에 의해서 영향을 받는데 얻을 수 있는 이익이 크고 기회비용이 적게 소요되는 곳을 우선적으로 선택할 뿐만 아니라 그러한 지역에 서비스 강도를 더 증가시키는 것이 밝혀졌다. 또한 서비스회사는 이전에 서비스를 제공한 지역에서 지속적으로 사업을 유지하는 경향이 강했으며 과거의 서비스 강도가 현재의 서비스 강도에도 영향을 미치는 것으로 나타났다.

주목할 점은 서비스 회사가 지역선택과 서비스 강도를 결정하는데 있어서의 경쟁자의 영향이다. 서비스 회사가 진입하려고 하는 새로운 시장에서 경쟁자의 숫자는 진입결정에 별 영향을 미치지 않는 반면 진입 결정을 한 후 서비스 강도를 결정하는데 있어서는 기존의 경쟁자들의 서비스강도에 영향을 받는 것으로 나타났다. 즉 경쟁자의 서비스 강도에 자신의 서비스 강도를 맞추는 경향이 있음을 밝혀졌다. 또한 경쟁자들이 위치한 본거지에 너무 가까운 지역에 대해서는 지역선택의 확률도 떨어지고 서비스 강도 역시 다른 지역에 비하여 작음이 밝혀졌다.

이 연구는 기존의 연구들이 단일 위치 선정을 중심으로 위치선정에만 초점을 맞춘 것에 비해 복수의 지역을 동시에 서비스 하는 상황에서 위치 선정만이 아니라 그 이후의 서비스 강도에 대한 결정을 동시에 고려한 모델을 수립하였다는 것에 학문적인 공헌을 하고 있다고 믿는다.

주제어 : 서비스마케팅, 서비스 공급, 전문서비스, 의로서비스, 입지모형

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