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Optimal Growth Strategies for Service Organizations*

Service organizations usually grow by opening branches in new locations. However, location strategy has been oversimplified by model builders. In practice optimal strategy depends upon evaluating three effects: the primary effect of the sales potential of a new location, the secondary effects on sales of neighboring company outlets, and the effect on overall network costs. A model is presented which incorporates these three dimensions of the decision maker's problem and its implications for growth strategy are illustrated for a large retail chain.

I. Introduction

Service organizations now represent the dominant employer of labor in the U.S. and other developed nations as well as the most rapidly expanding segment of GNP. For such organizations managing growth is a central problem. Unlike a manufacturing business, a service organization cannot grow by concentrating production in one or a few centers and developing mass distribution systems to reach its consumers. Most services are essentially immobile, and to grow the business usually has to develop a network of branches (shops, banks, gas stations, etc.) which "produce" where the customers are located. Developing such a network presents unique problems of choosing an optimal location strategy which realistically incorporates the marketing opportunities and resource constraints facing the organization. (For a useful review, see Eiglier and Langeard 1977.)

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This study examines optimal network strategy for a profit-oriented service organization with a realistic economic structure and set of financial constraints. Unlike most recent work in this area, which focuses on estimation, the present study examines some substantive issues concerned with problem structure. It is shown that there are three components to consider in designing a location strategy. First, a new branch has a primary effect consisting of the turnover it generates; next is the secondary effect made up of the complementary or substitution effects on the performance of the other branches within the network; last are cost effects of the new branch on total network costs. Previous studies have concentrated overwhelmingly on statistical estimation of the first effect. We suggest this can lead to an incorrect ordering of the potential of alternative locations.

The next section briefly reviews the literature in this area and notes the limitations of existing approaches to the problem. A case study is used to illustrate a more general model which leads to decision rules that are rather different from those of conventional models but quite similar to those employed in practice by many leading service organizations.

II. Review of the Literature

Among service organizations, retail and bank branch networks have received most attention in the literature. It is not uncommon to find such businesses with over a thousand branches. In these sectors branch strategy and management is a key determinant of market growth and profit performance. As one retailing study concluded, with good locations a retailer can expand despite merchandising deficiencies. A poor location, on the other hand, is a crippling handicap for even the most competent retailer (Davidson, Doody, and Sweeney 1975, p. 481). At the same time, the cost of running and financing a branch network is a major constraint to profitability and growth. Not only do property assets form a major part of capital employed (e.g., Thorpe [1974] found leading supermarket chains have 74% of their assets in property), but the effectiveness of property expenditure varies enormously, with retailers' turnover per dollar invested varying from \$3 to \$30.

Two types of location models appear in the literature. By far the most numerous are the microlocation models which seek to determine the potential attractiveness of a specific branch location. More recently there has been a development of macrolocation models which evaluate the results of different regional concentration strategies. These models focus on the demand interdependencies or secondary effects which may exist between a company's branches within a region.

Microlocation Models and the Problem of Interdependencies

Four types of micromodels for estimating location potential can be distinguished: checklist, analogue, gravitational, and statistical (Kotler 1971). Management in banks and retail chains has always employed intuitive checklists of key factors required for a good location. Many such lists have been published by management consultants and real estate professionals. Nelson's comprehensive checklist, for example, cites eight sets of variables to examine when appraising a location. *Analogue* methods seek a more rigorous approach to quantifying the sales potential of a site. Applebaum (1966) has shown how sales for a new location may be estimated by evaluating how similar stores within the group draw expenditure from the population within their trading areas. The accuracy of this method relies significantly on a chain having a sufficient number of analogous branches to calibrate the drawing power of a new one reliably (Kotler 1971). The projections of the *gravitational* model developed by Huff (1964) building on the earlier concepts of Reilly (1931) and Converse (1945) use size of the site and the distance from various neighborhoods to the proposed location. Hlavac and Little (1966) and Stanley and Sewall (1978) have added more variables (store image, advertising, etc.) in attempting to increase the predictive power of gravitational models. Further extensions based on Luce's (1977) strict utility model have focused on logit and probit estimation techniques to analyze location problems (e.g., Gautschi 1981). Finally, there have been many *statistical* models which have used ad hoc hypotheses or search techniques to select variables and their effects on sales have been estimated by regression analysis (e.g., Davies 1973; Clawson 1974). Like analogue methods, they rely on the company having a sufficiently large network of branches to estimate the parameters reliably.

All these models are subject to certain shortcomings. Checklists are unreliable in complex multibranch situations and lack predictive power and means of validation. Analogue and basic gravitational models omit key variables known to have a significant impact on locational performance. Until the recent linear estimation procedure proposed by Nakanishi and Cooper (1974) and the more sophisticated techniques such as logit, generalization of these models was inhibited by problems of parameterization and estimation. Virtually all statistical models have failed to validate their results and so have questionable reliability (see Doyle 1973). But aside from technical weaknesses, all these models suffer a major conceptual weakness in failing to account for interdependencies between branches in the network. It is assumed that individual outlets are independent and that the task is to select the location with the maximum individual sales potential. In practice, however, in evaluating a new location not only its site potential or *primary* effect must be estimated but also its effects on the demand and cost structures of other branches in the network. As is shown below, these secondary and cost effects can even outweigh the primary results of opening a new branch.

Secondary effects arise from concentrating additional outlets in a specific region. Synergy may occur from several sources. Montgomery and Urban (1969) suggest a customer is more likely to obtain a credit card from a company with many branches in his area. More outlets may also mean greater promotional impact in that shoppers see the company's offer as a leading brand. Economies may also arise in regional TV and newspaper advertising which are not specific to an individual outlet but support any number of corporate branches in the region. Finally, multiple outlets in a region mean the customer can remain loyal, he is not forced to try competitor offerings because of the absence of a convenient branch of his usual supplier. Such factors mean that adding a new branch many increase average sales of all the company's outlets in that region. Of course there are limits to this synergy. After a point diminishing returns will set in, and eventually a decline in average outlet sales may occur as increasing the number of outlets in a region leads to sales cannibalization. As noted below, several authors have proposed an S-shaped relationship between the number of branches in an area and average outlet sales.

Another important source of dependency which remains substantially unexplored in the literature are cost relationships. If an organization opens its stores, gas stations, or bank branches simply by selecting the locations in the country with the largest potential trade (as implied by most microlocation models), it would have a very dispersed network with a high cost structure. Concentrating branches within a specific region leads to significant economies of scale in marketing, distribution, and administrative overheads. For instance, adding another outlet to a region where the company already advertises heavily is unlikely to lead to a proportionate rise in advertising. By contrast, opening an outlet in a region where the company has no previous presence will require disproportionately high advertising costs with no spillover advantages for neighboring outlets. Similarly distribution, inventory, and administrative expenses are usually lower for a more concentrated network of outlets.

Such cost and secondary demand interdependencies account for the regional concentration strategies of many leading service organizations. For example, FTC (1966) and Furhan (1972) identified a strong correlation between a store's regional market share and profitability but no correlation between national size and profitability. Given a choice between gaining toehold positions in a large number of city-market areas or devoting resources to building a leading position in one region at a time, it appears that the latter strategy usually pays off better.

Macromodels and Market Share Effects

Hartung and Fisher (1965) were first to explore the importance of secondary demand effects in the location decisions of service organizations. In their model the unit of observation is not the individual location but the region (the Bureau of the Census standard metropolitan area) within which a group of outlets could be located. The model postulates a Markov process of customer brand switching behavior where the transition probabilities depend upon the percentage of the total industry outlets the company has in the region. The higher the outlet share, the greater the probability customers will stay with the company. The model parameters were estimated for a company operating in the gasoline market. It was shown that opening new outlets in areas where the company already had a substantial outlet share was more effective than opening where the company's presence was weak. In the Hartung-Fisher study, the secondary effects from the boost to sales of existing company outlets could double the primary sales generated by the new outlet.

Two excellent studies by Naert and Bultez (1975) and Lilien and Rao (1976, 1979), subsequently questioned the robustness of the Hartung-Fisher model. Both got meaningless results in attempting to replicate the study. Instead they suggested that a saturation effect would make an S-shaped rather than a linear relationship between the number of outlets and sales more plausible. Both authors found a logistic relationship gave effective fits to their data. Despite the technical differences, the authors' results concurred with the policy implication of the Hartung-Fisher study: secondary effects make strong regional concentration a more effective growth strategy than attempting to expand initially on a national basis.

While these models add an important dimension omitted in the microlocation models they have a number of limitations which prevent their application to the general growth problem of service institutions. First, neither Hartung and Fisher nor the subsequent work have modeled cost interdependencies between outlets. As shown below these may have even greater implications for the choice of location than demand interdependencies. Second, as Lilien and Rao (1979, p. 27) note, this type of model only applies to those services where convenience is virtually the sole criterion for the outlet choices of consumers. Gasoline service stations are the only markets for which the models have been applied. For most service companies, however, advertising and other marketing mix factors have a major effect and need to be included in a model. A third problem is that the Hartung-Fisher formulation focuses on maximizing market share rather than company profits. The implicit rule is usually interpreted as being: outlets should be allocated to regions where incremental sales will be highest (e.g., Kotler 1971, p. 310). But such a rule neglects incremental costs which again vary regionally, meaning that profit maximization and sales maximization can be quite different. Finally, by using the region as the unit of analysis rather than the individual location it becomes impossible to link the two decisions. It has been suggested that the choice of region and choice of location can be treated as independent decisions (e.g., Naert and Bultez 1975, p. 1102), but in practice this is rarely so. Managers frequently make trade-offs: while region A may be better than region B for the company, an especially attractive location in B may offset the macro advantages of A. Managers need to be able to evaluate both micro (location) and macro (regional) effects.

III. Model Specification

A case study is used to illustrate a more general approach to this problem. Data were obtained on the location, characteristics, and performance of the approximately 200 outlets operated by a British retailer of household durables. The chain had grown by opening new branches in the 1960s and 1970s. However, in the last 3 years rising rents, stagnant branch volume, and pressure on profit margins and cash flow had led to a more cautious approach to branch expansion. The work described forms part of a review of the growth strategy of the business. While the actual data are illustrative, the results accurately indicate the findings of the study. The company is sufficiently representative to suggest that the model and implications are of general relevance to other retailers and service organizations.

The model aims to evaluate the type of growth strategy that would be most profitable for the company. In particular, Should it use its limited resources for outlet expansion to expand into territories of high potential where it was unrepresented, or should it focus on reinforcing its position in existing strongholds?

Demand Function

From previous work and discussions with management, the model was based upon a number of operating criteria and hypotheses. The first criterion was that if the model was to be useful for location decisions, it should utilize the individual store rather than regional aggregates as the unit of analysis. Second, profit was a more meaningful objective function than market share. This meant that it was necessary to estimate the main costs of alternative growth strategies. The primary hypothesis, emerging from examining previous studies (e.g., Hartung and Fisher 1965; Doyle et al. 1979; Little 1979*b*) and the observed behavior of many successful companies, was of a positive relationship, over some range, between an outlet's sales and the existence of other company outlets in the region. Second, in this as with most service companies, other variables were hypothesized to have an important effect on outlet performance, in particular, advertising support, the number of competitors sharing the trading area and the quality of the outlet's location. From previous findings we would hypothesize that these relationships would be nonlinear (Horsky 1977; Little 1979*a*).

The second hypothesis needs amplification. In practice there is usually an interaction between the number of outlets in a region and the impact of advertising on the demand function of the individual outlet. Total advertising in a region (e.g., standard metropolitan area) generally rises with the number of stores in the region, though less than proportionately. A store in a region with 10 other company stores is usually supported by a much higher level of advertising than an isolated store. Often this is because retailers budget an advertising allowance per store. Besides number of stores and advertising, other important predictors were the number of competitors within the trading area and the quality of the outlet's location. The latter was based upon ratings by corporate staff of the position, size and appearance of the store. Since prices and product ranges were relatively homogeneous across the outlets they were not included in the model.

On the form of the demand function, there is considerable evidence that S-shaped curves better describe the effects of marketing variables on sales (Kotler 1979, pp. 96–97). The logistic and cumulative normal are the most widely used functions for describing such a relationship. As there is almost no difference between the two over the usual range of data (Griliches 1957), the logistic was chosen to represent the effects of area differences and regional advertising budgets since it is simpler to fit and easier to interpret. The impact of additional stores in a region on sales of an existing outlet appeared to be more complex, however. Like Naert and Bultez (1975) and Lilien and Rao (1979), we postulated additional stores as assisting sales of an established store until some saturation level is reached. Further stores would then diminish sales in established stores as they cannibalized business from each other. Such an effect is captured in a quadratic expression for N_j. Note that this form describing the individual outlet is consistent with the previous authors' assumption of a logistic relation between market share in a region and the number of outlets. While market share continues to increase as outlet expansion occurs, after a while a decline in average sales per outlet occurs.

The demand function for any outlet i in region j is then

$$q_{ij} = \frac{\overline{Q}_{ij}}{1 + e^{-(\alpha + \beta N_j - \gamma N_j^2 + \sigma A_j + \omega C_{ij} + \mu G_{ij})}} \tag{1}$$

where q_{ij} = sales (\$) for store i in region j; $i = 1, \ldots, N_j$; $j = 1, \ldots, n$; $\overline{Q}_{ij}$ = maximum potential sales (\$) for store i in region j; N_j = number of other company stores in region j; A_j = company advertising (\$) in region j; C_{ij} = number of competitive retailers in the trading area of outlet i; G_{ij} = quality rating of the location of outlet i.

Profit Function

Unlike previous studies, this study brings the profit function to the forefront of the programming problem. This highlights the neglected issue of cost interdependencies among branches within the network. Only advertising costs are explicitly considered, although it is straightforward to extend the model to cover other interdependencies in distribution, inventory, and administrative costs.

Although advertising is a decision variable, few companies appear in practice to approach budgeting scientifically. Most stick to traditional rules of thumb. In these situations the structure of advertising costs depends upon the budgetary rules employed by the company. Two archetype rules can be considered to clarify this issue. One is the *proportional* rule, whereby a company budgets a given advertising sum per store, thus advertising expenditure in a region increases proportionately with the number of stores. By contrast, there is the *constant sum* rule where the company provides a given advertising budget per region irrespective of the number of stores. With the former rule external economies operate solely through the demand function. With more stores in a region, unit advertising costs remain constant but each store is boosted by the larger regional advertising budget. With the constant sum rule all the economies operate through the cost function: additional stores do not lead to additional advertising costs but they benefit from the advertising incurred for the established stores. In practice, most retailers follow a compromise strategy: advertising in a region rises with the number of stores but less than proportionately, implying economies are distributed through both functions. This was the pattern observed for the company under study.

The profit function for the individual store may then be written as

$$\Pi_{ij} = mq_{ij} - (A_j/N_j), \qquad (2)$$

where Π_{ij} = profit contributed by store i in region j, m = average gross margin, and A_j/N_j = average advertising expenditure per store in region j.

IV. Estimation and Results

To estimate the demand function data were obtained on sales, outlet distribution, regional advertising, competition, and quality ratings for all stores in the group. Trade area potential was estimated from census data on retail sales. The ceiling trade area share, $\bar{Q}_{ij}$, was estimated to be 30%. There are several methods of estimating the parameters of this type of nonlinear demand function (e.g., Naert and Bultez 1975; Dixon 1980). The method chosen involves the transformation of the logistic into an equation linear in the parameters. By dividing both sides by $(\bar{Q}_{ij} - q_{ij})$ and taking the logarithm, the linear transform is obtained, allowing the parameters to be estimated directly by least squares.[1] That is, we estimate

$$\ln \frac{(q_{ij})}{(\bar{Q}_{ij} - q_{ij})} = \alpha + \beta N_j - \gamma N_j^2 + \sigma A_j + \omega C_{ij} + \mu G_{ij}. \quad (3)$$

The equation and parameter estimates for the demand function were then $\alpha = -1.625$ (-8.17), $\beta = 0.125$ (2.12), $\gamma = 0.012$ (2.63), $\sigma = 0.0039$ (1.81), $\omega = -0.00016$ (-1.92), and $\mu = 0.00013$ (1.54), for $\bar{R}^2 = .51$ and $F = 42.8$. Given the nature of the cross-sectional data and the limited number of predictors employed, the model appears to give a reasonably good fit to the data. The t-statistics (in parentheses) indicate that advertising, competitors, and the number of stores were significant determinants of store sales and the signs are consistent with the hypotheses advanced. The economic interpretation of the coefficients is developed in the following section. Finally, to test the stability of the results, the total sample was randomly dichotomized and separate regressions were run for both groups of observations. The Chow Test indicates that there was no statistically significant reason to reject the hypothesis that both groups came from the same population, $F(.05) = 1.8$; critical $F(.05) = 2.6$.

V. Discussion of Results

The relationships identified in the model have significant implications for the growth strategy of the company. In particular, they have implications for optimal location policy, the marketing mix, and the development of long-term investment strategy.

Location Policy

The model shows that the estimation of the impact of an additional outlet needs to be separated into three components. First is the primary effect of the sales that store achieves. This is the magnitude which traditional microlocational models have tried to estimate. In our model a broad estimate of this is given by equation (1). Of course, for final site selection decisions a more detailed analysis of the potential and competitive characteristics of the specific site and trading area is

1. Berkson (1953) has argued that in certain circumstances the parameters ought to be estimated by weighted least squares to deal with the potential problem of heteroscedasticity. However, inspection did not indicate that the residual variance in the OLS results tended to be higher at extreme values of q_{ij} and weighted estimators led to an insignificant difference in the estimated parameters. Hence weighted results are not reported here.

required. But (1) suffices to incorporate the key dimensions of the problem for the formulation of strategy. Next, as identified by Hartung and Fisher (1965), there is a *secondary* or market share effect caused by the additional store having an impact on the sales of existing stores. In their model this effect is always positive because saturation effects are omitted. In our model additional stores can easily have negative effects on the performance of neighboring stores. This can be seen in examining the derivative of the demand function (1) with respect to N,

$$\frac{\partial q_{ij}}{\partial N_j} = \frac{q_{ij}}{\bar{Q}_{ij}} (\bar{Q}_{ij} - q_{ij}) (\beta - 2\gamma N_j). \tag{4}$$

The third effect of the additional outlet is on network costs, in this case store advertising costs. This is identified when we examine the derivative of the profit function (2),

$$\frac{\partial \Pi_{ij}}{\partial N_j} = m \frac{q_{ij}}{\bar{Q}_{ij}} (\bar{Q}_{ij} - q_{ij}) (\beta - 2\gamma N_j) + \frac{A_j}{N_j^2}. \tag{5}$$

How these costs behave depends, as is shown below, upon whether the company is oriented toward proportional or constant sum regional advertising. Consideration of network costs highlights the danger implicit in the Hartung-Fisher model of using incremental sales and market share as the criteria for location planning. This is clear in tables 1 and 2.

Using the parameter estimates from the demand function, table 1 shows the primary and secondary market share effects of opening a new store in regions where the company has a varying number of established outlets (holding the competition and location quality variables constant). Index numbers are used to preserve the confidentiality of the company. Separate estimates are made according to whether the company holds advertising constant or increases advertising proportionately with the new store opening. The first row of the table shows the disadvantage of opening a store in a region where the company has been unrepresented. The store itself has a lower expected turnover and it can have no secondary effects on other stores. Initially, added stores in a region have increasing primary and secondary sales effects, but then saturation is reached and new stores eventually cannibalize on neighboring outlets. As would be expected, if the company increases advertising proportionately, this support increases both primary and secondary sales. Incremental profits, however, are of more concern than sales. These are shown in table 2. While additional stores are profitable in all regions, the incremental profit diminishes rapidly beyond seven stores in a region, particularly where the company is not raising advertising expenditure proportionately. Maximum incremental profit is obtained by opening a new store in a region with five established outlets in this case.

TABLE 1 **Sales Generated by an Additional Outlet in Different Regions ($ Index)**

Existing Outlets (N_j)	Constant Advertising			Proportionate Advertising		
	Primary	Secondary	Total Sales	Primary	Secondary	Total Sales
0	100	0	100	100	0	100
1	114	14	128	122	20	142
3	140	18	158	148	39	187
5	159	6	165	168	46	214
7	173	−27	146	182	33	215
10	168	−114	54	176	−33	143

TABLE 2 **Profit Contributed by an Additional Outlet in Different Regions ($ Index)**

Existing Outlets (N_j)	Constant Advertising			Proportionate Advertising		
	Primary	Secondary	Total Profit	Primary	Secondary	Total Profit
0	100	0	100	100	0	100
1	122	15	137	124	23	147
3	148	20	168	155	44	199
5	170	7	177	177	51	228
7	184	−30	154	191	40	231
10	178	−129	49	185	−38	147

A further contrast to Hartung-Fisher type models can be seen when aggregate sales and profits for the regions are calculated after an additional store is added. For region j total sales is given by $\Sigma_i q_{ij}$ and total profits by $\Sigma_i \Pi_{ij}$. Calculating the former from table 1 supports the rather obvious conclusion of Hartung and Fisher that the more outlets the company has in a region the greater will be its market share. If the company increases advertising proportionately this relationship is likely to be strengthened. However, using table 2, it can be seen that after a saturation level is attained total regional profits may well decline and profit per store will certainly fall as the company finds it increasingly costly and difficult to win customers away from competition. Increasing market share after a point will lead to declining margins and return on investment.

Advertising Policy and Location

Economies of scale in advertising is commonly a significant factor affecting the growth strategy of a service organization. Little (1979) reviews the evidence for a threshold level of expenditure below which advertising is ineffective. With only one or two stores in a region, it is frequently too costly to incur this threshold expenditure. Higher levels of expenditure are more effective where the organization has a larger number of stores to benefit from it and over which the costs can be spread.

These relationships are evident in the results presented. The effects of incremental advertising upon outlet sales and profits are given as

$$\frac{\partial q_{ij}}{\partial A_j} = \left(\frac{q_{ij}}{\bar{Q}_{ij}}\right)(\bar{Q}_{ij} - q_{ij})\,\sigma \tag{6}$$

$$\frac{\partial \Pi_{ij}}{\partial A_j} = m\left(\frac{q_{ij}}{\bar{Q}_{ij}}\right)(\bar{Q}_{ij} - q_{ij})\,\sigma - \frac{1}{N_j}. \tag{7}$$

Tables 3 and 4 show average store sales and profitability for regions with varying numbers of company outlets as advertising expenditure is increased. Table 3 illustrates the reasonable result that increased advertising raises sales in each region, although for the 10-store region the advertising does not offset the cannibalization effect of having so many neighboring outlets. Table 4 is more interesting, showing how profits vary under increasing advertising. With only one store in a region it does not pay to advertise, as the incremental contribution generated $m(q_{ij}/\bar{Q}_{ij})\,(\bar{Q} - q_{ij})\,\sigma$ does not offset the advertising cost. As the number of stores grow, the optimal regional advertising increases, both the costs and the benefits being spread across more outlets.

Programming Marketing Expansion

It is possible to use these results to define an optimal location and advertising plan. The problem is defined as determining both the num-

TABLE 3 **Average Outlet Sales as Advertising Increases in Different Regions ($ Index)**

Advertising Expenditure	Number of Stores in Region (N_j)				
	1	3	5	7	10
0	100	119	124	124	110
20	212	236	268	268	229
40	352	367	378	380	361
60	443	450	453	452	452
80	489	493	493	494	492
100	508	511	509	510	510

ber of branches to build and the amount of advertising to spend in each of J regions in each of the next Y years. For specificity, it is assumed that the company seeks to maximize the net present value of a y-year investment program subject to constraints on the capital to be invested in new outlets, a maximum number of outlets to be opened in any region, and a maximum amount to be spent on advertising.

The additional parameters needed to define this problem are m_y = profit margin in year y, N_{jy} = number of outlets existing in region j in year y, n_{jy} = added outlets in region j in year y, A_{jy} = amount of advertising in region j in year y, R = the discount rate, K_y = amount of capital available in year y for outlet construction, A_y = amount available in year y for advertising, L_{jy} = maximum number of outlets in region j in year y, and T_{jy} = construction cost per outlet in region j in year y. The decision variables are n_{jy} and A_{jy}. The objective of the mathematical programming problem is to find the set of n_{jy} and A_{jy} which maximizes the net present value for all areas over each year. This is expressed as

$$\max \sum_{y} \sum_{j} [m_y\, q_{ijy}\, (n_{jy} + N_{jy-1}) - A_{jy}]\, (1 + R)^{-y} \tag{8}$$

where

$$q_{ijy} = \bar{Q}_{ijy} \left\{1 + e^{-[\alpha + \beta\,(n_{jy} + N_{jy-1}) + \gamma\,(n_{jy} + N_{jy-1})^2 + \sigma A_{jy} + \omega C_{ij} + \mu G_{ij}]}\right\}^{-1}. \tag{9}$$

TABLE 4 **Average Outlet Profitability as Advertising Increases in Different Regions ($ Index)**

Advertising Expenditure	Number of Stores in Region (N_j)				
	1	3	5	7	10
0	100	120	130	131	115
20	61	173	202	201	186
40	16	282	336	344	339
60	−10	305	349	387	390
80	−150	299	392	424	456
100	−284	264	375	419	455

subject to the following constraints:

$$\sum_j T_{jy}\, n_{jy} \leq K_y \qquad y = 1, \ldots, Y \tag{10}$$

$$\sum_j A_{jy} \leq A_y \qquad y = 1, \ldots, Y \tag{11}$$

$$N_{jy} \leq L_{jy} \qquad j = 1, \ldots, n; y = 1, \ldots, Y \tag{12}$$

$$\Pi_{ijy} \geq \Pi^* \qquad i = 1, \ldots, Nj; j = 1, \ldots, n; \quad y = 1, \ldots, Y. \tag{13}$$

Several solution methods are available. One is a concave approximation procedure, replacing the nonconcave objective function by its concave envelope (Furhan 1972; Freeland and Weinberg 1980). This method produces computationally efficient results and yields values for the objective function which are close to the global optimum. However, the quality of this solution procedure is less good for the optimal levels of the decision variables n_j and A_j. In particular, the concave envelope approach can lead to recommending investment on the envelope itself rather than on the curve. If the number of outlets is small, this may be a serious problem. Since the main aim of the proposed model is to find, not the NPV, but the optimal new building path of outlets over the planning horizon, an alternative method may be more appropriate. Other computationally less efficient but more rigorous procedures include branch and bound and dynamic programming approaches.

Various alternatives were tried and the following iterative procedure was found most suitable. Starting with initial values of q_{ijy} (q^0_{ijy}), the problem defined by equations (1)–(5) can be interpreted as a simple linear programming problem. The resulting optimal values for n^0_{jy} and A^0_{jy} are then fed into (2) to compute a new q^1_{ijy} value. The latter is then used in an analogous second step. The iterative process is continued until $q^{\text{step } k}_{ijy}$ is equal to $q^{\text{step } (k-1)}_{ijy}$ or sufficiently close to it, that is,

$$\frac{q^{\text{step } k}_{ijy} - q^{\text{step } (k-1)}_{ijy}}{q^{\text{step } (k-1)}_{ijy}} < \epsilon,$$

where ϵ is a small positive constant. Since the algorithm does not guarantee a global maximum, the process has to be repeated for several different starting values of the q_{ijy} vector to check the convergence of the solution.

This procedure was used for a 5-year planning horizon on eight geographical regions. The two major problems for the optimization models were related, not to the technical characteristics of the algorithm, but to the quality and availability of some of the inputs. More specifically, the data for $\bar{Q}_{ijy}$ and C_{ij} for the 5-year period were not easy to judge. Also the stability of the estimated parameters of the response function (α, β, γ, σ, ω, and μ) was not obvious. In an effort to evaluate these problems, a sensitivity analysis was undertaken for both $\bar{Q}_{ijy}$ and the estimated parameters. Overall it was felt that the resulting model could provide management with indicators of where and to what extent the existing outlet portfolio should be expanded.

VI. Conclusion

Service organizations normally grow by opening new branches. The choice of where to locate a new outlet has been oversimplified in both practice and theory. Evaluating a potential location requires estimating three effects: the primary effect—what sales and profit the outlet will attain; the secondary effect—what the impact of the new outlet on the performance of existing outlets will be; and the network cost effect—how the new outlet will affect the cost structure of all the outlets within the group.

Conventional location models have only considered the first effect. Hartung and Fisher (1965) identified the importance of the secondary effect, suggesting that it can be at least as important as the primary effect. Unfortunately, this study suffered a number of serious technical shortcomings, particularly in neglecting the saturation effect as the number of neighboring outlets increased. It and subsequent studies also failed to consider how regional location strategy affects network costs and how the marketing mix and individual trading area characteristics impact on the location choices of the organization.

The model presented here seeks to suggest how the three aspects of the decision may be integrated within a realistic marketing framework. It confirms that the regional roll-out strategies observed for many successful chains are likely to be more profitable than nonregional national expansion. Such a strategy is supported by the secondary effects and the economies of scale in network costs, which initially encourage regional concentration, and by the subsequent saturation effects which stimulate the later push into new regions.

It is clear that this approach can be developed further. For example, a more detailed specification of the competitive characteristics of the outlet's trading area and site could permit more precise guides to the microlocation decision. Also, competitive responses might be explicitly modeled. The concept of the "reaction matrix" (Bensoussan, Bultez, and Naert 1978) which reflects the competitors' probabilities of retaliating could be extended to include reactive competitive outlet extension strategies. Similarly, the approach might also incorporate some of the recent work in economics which considers preemptive policies—opening new facilities specifically to preclude competitors' establishing their own market positions (Prescott and Visscher 1977; Rao and Rutenberg 1979; West 1981). Additional constraints can also be introduced into the model to reflect the different strategic priorities businesses may have. For instance, longer-term considerations might suggest the introduction of a strategic constraint to enforce the opening of new areas sooner than the model would predict as optimal. In addition, the programming model could incorporate "salvage values" for the outlets at the end of the planning horizon to model explicitly the timing of new outlet investments.

In practical operation, the model has clarified for senior managers the dangers of looking at individual stores in isolation and the importance of programming store development in terms of the three criteria discussed. The model currently operates as a screening procedure for quickly testing alternative location opportunities. The final decision depends, of course, on a thorough study of the attributes of the proposed site and assessment of its potential. As always, the model represents a tool to support, not replace, managerial judgment.

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