INFORMATION TO USERS

This material was produced from a microfilm copy of the original document. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the original submitted.

The following explanation of techniques is provided to help you understand markings or patterns which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting thru an image and duplicating adjacent pages to insure you complete continuity.

2. When an image on the film is obliterated with a large round black mark, it is an indication that the photographer suspected that the copy may have moved during exposure and thus cause a blurred image. You will find a good image of the page in the adjacent frame.

3. When a map, drawing or chart, etc., was part of the material being photographed the photographer followed a definite method in "sectioning" the material. It is customary to begin photoing at the upper left hand corner of a large sheet and to continue photoing from left to right in equal sections with a small overlap. If necessary, sectioning is continued again – beginning below the first row and continuing on until complete.

4. The majority of users indicate that the textual content is of greatest value, however, a somewhat higher quality reproduction could be made from "photographs" if essential to the understanding of the dissertation. Silver prints of "photographs" may be ordered at additional charge by writing the Order Department, giving the catalog number, title, author and specific pages you wish reproduced.

5. PLEASE NOTE: Some pages may have indistinct print. Filmed as received.

University Microfilms International
300 North Zeeb Road
Ann Arbor, Michigan 48106 USA
St. John's Road, Tyler's Green
High Wycombe, Bucks, England HP10 8HR

77-7976

LUNDSTEN, Lorman Lester, 1942-
A MODEL TO IMPROVE THE QUALITY OF THE RETAIL SHARE OF MARKET FORECAST FOR BANKING OFFICES.

The University of Michigan, Ph.D., 1976
Business Administration

Xerox University Microfilms, Ann Arbor, Michigan 48106

A MODEL TO IMPROVE THE QUALITY OF THE RETAIL SHARE OF MARKET FORECAST FOR BANKING OFFICES

by
Lorman Lester Lundsten

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Business Administration)
in The University of Michigan
1976

Doctoral Committee:

Professor Martin R. Warshaw, Chairman
Professor C. Merle Crawford
Professor Thomas G. Gies
Associate Professor Thomas C. Kinnear
Professor John D. Nystuen

ACKNOWLEDGMENTS

I am indebted to Martin R. Warshaw, Ellen Stockdale, and William A. Longbrake for supplying constructive comments on the manuscript through its development. The members of my committee supplied guidance and a sense of academic perspective.

The Division of Banking Research of the Office of the Comptroller of the Currency and its director, Robert R. Dince supported the research reported to this work.

Finally, the invaluable support of members of my family, my parents, Mildred Corwine and especially my wife Kathryn resulted in an environment conducive to the completion of this work.

TABLE OF CONTENTS

ACKNOWLEDGMENTS ii

LIST OF TABLES v

LIST OF ILLUSTRATIONS vii

CHAPTER

I. RETAIL BANKING: A SITUATION ANALYSIS 1

Growth Patterns in Retail Banking
Estimates of Banking Office Performance
The Need for Retail Share of Market Estimates in Banking
Implications of a Spatial Share of Market Model
Determinants of Patronage for a Retail Banking Office
The Purpose of the Research

II. THE LOCATION OF ECONOMIC ACTIVITY 14

The Economic Geographers
The Impact of Location Theory Upon Retail Market Studies
Summary

III. THE GRAVITATION THEORISTS 27

Early Gravitation Models
The Social Physicists
A Contemporary Gravitation Model
Summary

IV. LOCATING NEW BANKING OFFICES 49

The ABA Guide
The BMA Handbook
Models and Simulations
A Review of Available Quantitative Methodology
Summary

V. CHOICE OF A BANKING OFFICE IN TERMS OF A MODEL OF BUYER BEHAVIOR 74

The Learning Curve
An Expanded Model
Phases of Buyer Behavior
A Model of Bank Patronage
Some Retail Market Share Models
Summary

VI. THE MARKET SURVEY 101

The Consumer Survey
Consumer Responses
The Banking Institution Survey
Summary

VII. A MODEL OF CONSUMER BANKING CHOICE 123

Specification and Testing
Hypothesis Testing
Model Specification
Regressions on Savings Behavior
Regressions on Checking Behavior
Overview of Regression Equations
The Inverse-Distance-Squared Model
Results on the Validation Sample
Summary

VIII. CONCLUSIONS 172

Review of the Models
Implementation of the Models
The Transition from a Model of Individual Choice to a Model of Group Choice
Implications for Further Research

APPENDIX 180

SELECTED BIBLIOGRAPHY 198

LIST OF TABLES

1. Net Provision or Use of Funds (Commercial Banks) Amounts in Billions $: 1964 to 1973 . . 2

2. Growth in Number of Offices: 1969-74 3

3. Empirically Determined Value of n 33

4. Characteristics of the Buyer Behavior Phases . . . 78

5. Question 5: When Do You Bank? 105

6. Question 8: Which Bank Used for Checking? 106

7. Questions 8 and 17: Which Institution Used for Savings? 107

8. Question 6: Use Checking? 108

9. Question 7: Number of Banks Used? 108

10. Question 9: Reasons for Using Checking Bank, Summary 110

11. Question 11: Additional Services Used at Checking Bank 111

12. Question 12: Checking Bank Used for Savings . . . 112

13. Question 13a: Checking Branch Used for Savings 112

14. Question 10b: Length of Time at This Office for Checking 113

15. Question 10c: Where Checking Office is Close To, Summary 114

16. Question 10d: How Far is Checking Office From Home? 115

17. Questions 11 and 15: Savings Incidence 116

18. Question 20: Reasons for Using Savings Institution, Summary 117

19. Questions 19 and 11: Additional Services Used at Savings Institution 118

20. Questions 13c and 18b: Length of Time at This Office 119

21. Questions 10d and 18d: How Far is Savings Office From Home? 120

22. Description of Variables 125

23. Analysis of Variance Results Using Parent Bank as Treatment Variable 127

24. Mean Values and T-Statistics for Analysis Variables 128

25. Variance Explained 131

26. Correlations with Savings (n = 26,936) 137

27. Correlations with Checking (n = 17,472) 138

28. Savings Results of Multiple Stepwise Regression, All Bank Office Variables and Location of Checking 144

29. Savings Results of Multiple Stepwise Regression, Restricted Variable Set 145

30. Checking Results of Multiple Stepwise Regression, All Bank Office Variables and Location of Savings 148

31. Checking Results of Multiple Stepwise Regression, Restricted Variable Set 149

32. Results of Four Single Variable Regressions . . . 151

33. Summary Statistics on Regressions 152

34. Analysis of Variance Results: Savings Models . . 160

35. Kolmogorov-Smirnov Tests 165

36. Analysis of Variance Results: Checking Models . . 166

37. Kolmogorov-Smirnov Tests: Checking 170

LIST OF ILLUSTRATIONS

1. Isodapane Analysis for Retail Example 20

2. Flow Chart of the Procedure Suggested in the ABA Green Book 50

3. How Potential and Competition is Aggregated in the ABLES System 60

4. Market Share Allocation in ABLES 63

5. Devaneys Market Share Curves 64

6. The Banking Patronage Decision as a Stimulus-Response-Reinforcement Learning Model 80

7. Rank of Bank Actually Used for Savings 164

8. Rank of Bank Actually Used for Checking 169

CHAPTER I

RETAIL BANKING: A SITUATION ANALYSIS

Financial institutions serving the retail market supply consumers with a set of services that have assumed a crucial role in the functioning of our nation's economy. They serve as financial intermediaries, gathering the smaller deposits of consumers and lending them to borrowers, either other consumers or industry or government. Over the years 1968 to 1973, individuals supplied $164 billion to the commercial banking system in the form of deposits, while borrowing only $67 billion. That net provision of $97 billion made individuals the largest net supplier of funds to the commercial banking industry (see Table 1). Thrift institutions are prohibited from holding corporate accounts, so their dependence on the consumer market is nearly complete.

Growth Patterns in Retail Banking

To serve this consumer business, financial institutions have established an impressive network of offices (see Table 2). At the end of 1974, the U.S. had more than 80,000 operating offices of financial institutions. The total number of offices at the end of 1974 showed an increase of 12,969 over that at the end of 1969. That is a compound

TABLE 1

NET PROVISION OR USE OF FUNDS (COMMERCIAL BANKS)
AMOUNTS IN BILLIONS $: 1964 TO 1973

Year	Individuals	Business	Statewide Government	Federal Government	All Other
1964 through 1968	70	(58)	(13)	(10)	11
1969 through 1973	97	(88)	(9)	(4)	4
Total	167	(146)	(22)	(14)	15

SOURCE: Summarized from pp. 12-13 in Booze-Allen & Hamilton, Inc., The Challenge Ahead for Banking (New York: Booze-Allen & Hamilton, Inc., 1975).

TABLE 2

GROWTH IN NUMBER OF OFFICES: 1969-74

Year	Commercial Banks	Mutual Savings Banks	Nondeposit Trust Companies	Savings And Loan Associations	Credit Unions[1]	Total
1969	33,821	1,483	57	9,773	23,876	69,010
1970	35,585	1,581	55	9,987	23,698	70,906
1971	37,174	1,686	53	10,435	23,270	72,618
1972	38,822	1,840	73	11,149	23,115	74,999
1973	40,912	1,974	80	12,206	22,999	78,171
1974	42,859	2,122	81	13,922	22,995	81,979
5-Year Gain (loss)	9,038	639	24	4,149	(881)	12,969
Annual Compound Growth (%)	+4.8	+7.4	+7.3	+7.3	-0.7	+3.5

SOURCE: Credit Union National Association Yearbook, Madison, Wisconsin, 1975, p. 15.

[1]Data on number of offices for credit unions are not collected. For credit unions, the number of institutions is reported.

annual growth rate of 3.5 percent in number of offices over the five-year period.

The likelihood that growth rate will be equalled or exceeded in the future is high. The legal environment for branch banking is changing. Some states which had permitted only a single office per banking institution are now allowing branch banking within a limited area, and some states that had allowed limited area branching are allowing statewide branching.[1]

That trend is expected to continue. This change in legal environment will allow more financial institutions to seek the economies of scale inherent in branch banking and will give them the opportunity to follow the movement of their customers to the suburbs.[2]

Estimates of Banking Office Performance

The financial services industry, in order to assess the returns from an actual or proposed new office, requires estimates of the net benefit that will result from the organization of that office. Estimates of occupancy cost, staffing expense, account processing costs, and other expenses are required, as well as estimates of income from fees and interest charges.

---

[1]"Florida Countrywide Branching Law, Effective Jan. 3, Having Less Impact than Expected," American Banker, 5 August 1976. (No byline.)

[2]James E. Smith and Robert R. Dince, "Consider the Banking Customer," The Bankers Magazine 159 (Spring 1976): 58-62.

Basically, these costs are related to two factors: first, the endogenous costs related to the planned size of office, the planned staffing levels, and other controllable costs; and, second, the costs related to the level of demand for its services experienced by the new office. Similarly, the benefits may be thought of in two categories: those controllable by management, such as the rate structure, and those external to the firm.

Since demand may not be controlled, it must be forecast by management if it is to be considered in the planning process. It is the purpose of this research to devise a forecasting model for market share which, when coupled with forecasts of deposit levels and with data on cost of operation known to bank management, will give an accurate estimate of the net benefit of an individual banking office.

The Need for Retail Share of Market Estimates in Banking

There is a need for share of market estimates by all financial institutions, whether they are located in states that permit branching or in unit banking states. Estimates of share of market may be required for a banking office at several times during its life.

When application is made to the regulatory authorities to open a new banking office, a deposit level forecast is required on the pro forma balance sheet for the new location. Perhaps the easiest method of arriving at that estimate is to take the estimated account population and

multiply by share of market. The resultant figure can be multiplied by an average account balance to give the required estimate.

During the life of the banking office, management may want to assess the success of the office in relation to the opportunities available to it. A logical yardstick for that evaluation is a share of market estimate that reflects changes in the market structure since the last estimate of market share. Population changes and competitive factors can be factored into the new estimate to give a fair standard for comparison.

Finally, when the potential deposits of an area can no longer justify a banking office, share of market estimates can be used to consider the effects on consumers and competition of closing an office. This can be useful in minimizing the effects of such a closing on a bank's retail market position and in justifying such a closing to consumer groups and to regulatory authorities.

Implications of a Spatial Share of Market Model

A spatial share of market model for financial institutions has implications for three groups:

1. The public (at least the vast majority who regularly use some financial service) will be best served by banking offices that are efficiently located. This research will supply a means of measuring the utility of providing the consumer with services at a given location.

2. The financial community will have a means of assessing the benefits of a given location for a banking office, in terms of market share. Those benefits can then be balanced against the costs of a given location. This may have direct effects in terms of reducing the cost of searching for good locations, and long term effects in terms of improved earnings and a stabilized liabilities base. Consumer deposits can be less costly than other sources of funds for financing loans and are less volatile than many sources.

3. Federal and state regulators will have a way of meeting their responsibility to the public. Accurate market share forecasts can help them ensure that a proposed new banking office will gain acceptance by a sufficient number of consumers to remain solvent. Regulators can also use such techniques to help ensure vigorous competition.

Determinants of Patronage for a Retail Banking Office

Lewis S. Saunders has summarized the attributes thought by most bankers to be important in the success of a new retail banking office.[1] He emphasizes the value of choosing a location near where a consumer lives, works, and shops and also stresses the need to provide adequate parking, convenient drive-in teller services, access from existing traffic patterns and convenience to major thoroughfares.

---

[1]Lewis S. Saunders, Techniques of Opening a Branch Bank (Boston: The Bankers Publishing Co., Bank Study Series, 1969), p. 26.

One thread common to all of these suggestions is the need to supply consumer convenience. They concentrate on two aspects of convenience: (1) nearness, which minimizes the inconvenience of travel to the consumer; and (2) availability of access to banking services.

Another aspect of convenience frequently mentioned by bankers is the consumer's ability to hold other services at the same office.[1] For example, in New York State, where savings banks were recently granted the right to offer demand deposit accounts, the savings bankers found that the bulk of their business in this type of account was coming from customers who already had time deposit accounts at the institution. It seems apparent that the customers of the New York State savings institutions found the convenience of holding two major services at the same location to be substantial.

Although convenience is the most frequently cited marketing element, several others may influence the banking consumer. There are true price differentials in the charging schemes for checking and loans. Variations in interest policies on savings accounts lead to different realized annual percentage rates on savings. Additionally, most banks make an effort to differentiate their services. Preauthorized loans, "wild-card" loan repayment privileges

---

[1] "Thrifts' Checking Plans Appear To Be No Threat," Karen Pennar, The Journal of Commerce, 14 June 1976.

(where a payment may be skipped at the consumer's convenience) and overdraft checking are examples of such efforts. Promotional differences are also evident. Considerable sums are spent in persuading the consumer of the benefits gained by using a particular service or by choosing a particular bank.

Various interpretations of those facts may be given by bank marketers. In the extreme is the assumption that convenience is the only consideration in choosing a bank. Less extreme is the assumption that convenience dominates the choice process--that other features are used to resolve a consumer's choice only if two branches are equally close and there is no closer branch. More in keeping with present banking practice and experience is the assumption that the consumer gains some utility from each part of the marketing mix and is more or less sensitive to each element of the mix. In choosing a bank branch, therefore, the consumer is likely to select the branch that offers the greatest perceived utility to him.

The structure of the financial services industry puts constraints on the use of the various marketing mix elements. The maximum interest rate that may be offered to attract time deposits is set by Federal regulation, thus limiting price competition for such deposits.[1] The service

---

[1]Paul F. Jessup and Mary Bochnak, "Market Pricing ... to Banking," The Bankers Magazine 159 (Spring 1976): ...-102.

packages that may be offered to customers are also limited by regulation. Although banks may vary their offerings within the legal limitations, it is possible that the consumer may perceive no difference between the offerings of various financial institutions, or may consider the differences to be trivial.

Although no regulatory constraint is imposed on the amount spent on advertising by financial institutions, the measurement of the effect of advertising by financial institutions is obscured by the tendency to budget advertising as a fixed proportion of deposits.

The Purpose of the Research

These presumed determinants of patronage have all been expressed from the viewpoint of the banking firm, yet patronage is presumably an individual decision. This research seeks to develop and test a model of individual banking office choice.

Historical Perspective

Chapters 2, 3, and 4 put the retail banking site selection decision into historical perspective.

Chapter 2 deals with the work of the spatial economists and their contributions to optimizing the choice of a location for economic activity. Several of the techniques developed in this discipline will be reviewed for their applicability to the retail location decision.

Chapter 3 examines the contributions of a narrower set of spatial theorists, those concerned with a class of models known as gravitation models. Examples of this type of model from several disciplines will be cited and the impact of these models upon retail location theory will be reviewed.

Chapter 4 will attempt to describe the retail location decision-making process as it occurs in the banking industry. Although these decisions are covered by the discipline of spatial economics and, in some cases, guided by the principles of the gravitation theorists, the bank location function is poorly integrated into these disciplines. Later chapters will integrate this function into the framework of spatial economics.

A Theory of Banking Office Patronage

Chapter 5 will examine a base of current theory of buyer behavior and will develop a general model of banking office patronage. A major set of determinants of patronage chosen from this model, those that are objectively determinable and the results of actions by banking firms, will be used to develop a model of banking patronage.

This model of patronage will be compared with several proposed models of market share and the underlying assumptions of these market share models will be examined. Finally, an analytical technique for calibrating such models will be presented. The use of this technique on individual choice data will be developed and tested in Chapter 7.

Empirical Research

Chapter 6 describes a survey of consumers that was done in the Farmington, Michigan market area to gather bank patronage data for this study. Results are shown that indicate that the model developed in Chapter 5 has considerable validity. Patterns of bank patronage and expressed reasons for choice are shown for the respondents and the relevance of the general model is discussed.

Chapter 6 also describes the procedures used to gather data on the attributes of each banking office used by a respondent in the consumer survey. These two data sources supplied the major part of the data used in the empirical phase of this study.

Chapter 7 presents several formal hypotheses and tests those hypotheses with the data described in Chapter 6. The hypotheses to be tested in Chapter 7 are:

H_1: Bank Patronage is essentially uniform over distance.

H_2: The differences between commercial banks and thrift institutions are not relevant in predicting office patronized for savings services.

H_3: The number of years an office has been open has no effect upon likelihood of patronizing that office.

H_4: Indicators of size have no explanatory power in predicting patronage.

H_5: The explanatory power of a model that considers several banking office attributes simultaneously is essentially the same as that of a random model.

The first four of these hypotheses are concerned with predictors of patronage that have been shown to be important in other retail situations. The last hypothesis concerns the usefulness of a multivariate model of banking office choice.

Tests of these hypotheses will be reported in Chapter 7, along with the specification and testing of a multivariate model of banking office choice.

Chapter 8 summarizes the results of Chapter 7 and shows the implication of these results for bank marketing decision makers. Some procedures for implementation of the forecasting models developed in Chapter 7 by bank marketing decision makers are suggested.

CHAPTER II

THE LOCATION OF ECONOMIC ACTIVITY

The location of economic activity has been a legitimate, if relatively unsung, concern of economists for almost 150 years. Scholarly work in the economics of location done before 1940 was done primarily by Germans and was almost invariably published in German. The impact of the non-German world in this area was not felt until the mid-twentieth century.

Offering a definition of this discipline, Isard states that

> . . . the general theory of location and space-economy is conceived as embracing the total spatial array of economic activities, with attention paid to the geographic distribution of inputs and outputs and the geographic variations in prices and costs.[1]

Isard emphasizes that the concept must be considered in a temporal framework. He calls for explicit recognition of

> . . . the obvious fact that economic activity takes place in a time-space continuum. In general, to minimize effort or factor services in producing a given social output or to maximize social output with

---

[1]Walter Isard, Location and Space-Economy (Cambridge, Mass.: M.I.T. Press, 1956), p. 53.

> a given amount of effort and factor services, is not to choose a path of action with respect to the time axis alone, or to the space axis alone, but rather with respect to both axes.[1]

Not surprisingly, he considers economic general equilibrium theory to be a special case of the general theory of location. Given that grand and all inclusive definition of the scope of locational economics, the major contributions of the discipline, especially where they are relevant to the retail location decision, will be reviewed.

The Economic Geographers

Von Thünen

The first great locational economist was Johann Heinrich von Thünen. Von Thünen concerned himself with the location of agricultural production around population centers. He assumed equal fertility and freight rates proportional to distance from market centers. Given those assumptions, he deduced circular production areas. Under certain conditions, where a given commodity can tolerate a higher freight rate than another commodity and still yield a profit, production will take place in a series of concentric rings, called Thünen rings, around the market center.

Von Thünen's theories are not specifically directed toward retail market description, but a slight modification of his assumptions produces the familiar three-mile circle description of retail financial markets. These

---

[1]Ibid., pp. 77-78.

modifications of von Thünen's assumptions are an equal incidence of use of financial services and an equal consumer disutility for travel.

An additional assumption, required because we are dealing with market areas, is that all competing institutions, perhaps as few as one, are located at a point. Other assumptions lead to noncircular market areas.

Weber

Alfred Weber was the first major location theorist of this century. Weber sought to explain the dynamic industrial growth that had taken place since the time of von Thünen. He considered the costs of inbound raw materials and outbound products of differing weights, and allowed raw material sources and consuming points to be located anywhere in a spatial plane. His major simplifying assumptions were that freight costs are linearly related to weight and distance and that raw materials all cost the same amount at their source.

Location Figures

One of Weber's major analytical tools was a mathematical construction called a location figure (Weber triangle). Using that technique, determination of the optimal location for a factory or warehouse with a total of three or fewer sources of supply or markets becomes a matter of solving a trigonometric equation. Given Weber's assumptions, the solution is exact, although the constraint of a total of

no more than three sources and markets makes the method of very limited practical utility.

Problems involving a more realistic number of markets or supply points may be solved by an analog method called a Varignon Plane[1] or by use of a digital computer. Those methods treat the problem as finding the resultant of a set of vectors. They are especially appropriate for single warehouse location studies.

Although Weber retains most of the credit for the discovery of location figures, the economist Wilhelm Launhardt[2] used them a decade before Weber's publication and the Swedish economist Tord Palander expanded upon and corrected Weber's basic theory.[3]

Isodapanes

Another convenient analytical tool proposed by Weber is the use of isodapanes, or lines of equal total freight per unit of product. That device requires no assumptions about the linearity of transportation cost. In the simplest case, when freight costs are linearly related to weight and distance, isodapane analysis and the use of a location

---

[1]August Lösch, The Economics of Location (New Haven, Conn.: Yale University Press, 1954), pp. 18-19.

[2]Isard, Location and Space-Economy, p. 28, citing "Die Bestimmungdes zweckmässigsten standartes einer gewerblichen Anlage," Zeitschrift des Vereins deutscher Ingenieure 26 (1882).

[3]Isard, Location and Space-Economy, pp. 42-43, citing Beiträge zur Standortsthearie (Uppsala: Almqvist & Wiksells Boktrifckeri -A. -B., 1935), chaps. X and XI.

figure will yield the same answer. Isodapane analysis can handle any number of supply points and markets, but becomes very cumbersome as that number gets large.

Isodapane analysis allows the handling of multiple modes of transportation and produces a graphic picture of the market. The location decision maker can actually see the cost of choosing a nonoptimal location and can find the position of a series of these locations.

The implications of Weber's work for retail location analysis can best be seen after redefining some of his terms so they apply to the retail situation. Weberian theory is concerned with the location of a factory or a warehouse; the equivalent retail institution would be a retail outlet. Where Weber speaks of distribution costs as being borne by the firm, retail distribution costs are borne by the customer (the case of free delivery will be ignored as this cost may be handled by a conventional Weberian location model). Weber assumes transport cost to be linearly related to weight and distance. In a retail setting, the comparable cost is consumer utility, a poorly defined construct that is presumably a function of the retail firm's marketing effort which is related to convenience, not directly to distance.

A further difference between industrial and retail location theory is in the concept of weight. In Weber's setting, locational weight, the total weight transported per unit of product, was an appropriate measure. In a retail setting, average retail consumption or, better, average

profit per customer, might be a more useful measure in choosing a location.

Finally, Weber's analysis assumes that demand is known and fixed. In retail terms, that would be an absolute monopoly situation, where there is no cost to the retailer for transport. In such a case, it is difficult to justify a location that will minimize the transport cost of the customer.[1]

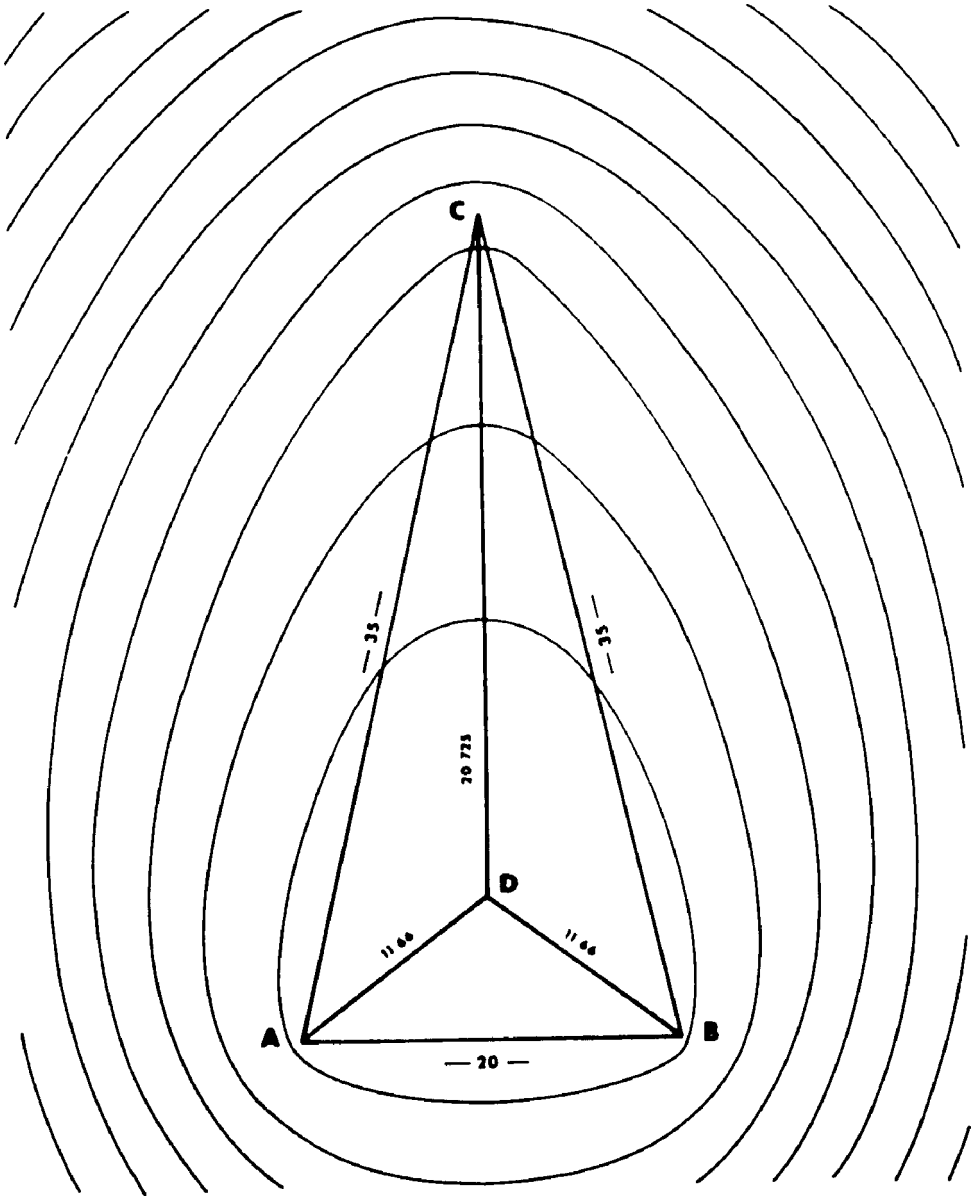
A Retail Example

Since this type of analysis is so restricted, it is difficult to think of a meaningful example in retail location. We will consider a retailer who sells a good for which all households have a need, but which can, at some great effort, be produced at home. His demand, then, is linked to the travel cost of his consumers. Suppose there are three population centers A, B, and C, with equal populations. Also suppose that the customer's cost (disutility) is directly proportional to distance. Additionally, suppose the retailer is located directly at his source of supply and has no inbound transportation costs.

This problem can be solved by the use of isodapane analysis or by the use of a location figure. The solution is shown as figure 1.

---

[1]Isard, Location and Space-Economy, p. 144.



The Figure ABC is a location figure (Weber Triangle) showing the optimal location for a retail outlet serving markets A, B and C where the relevant cost of transport is a 15 unit annual loss of demand for each unit of distance travelled. It is assumed that only one outlet serves the 3 markets. The enclosed curves are isodapanes (lines of equal cost) showing incremental 100 unit losses in sales. Assuming annual demand of 15,000 units at A and B and annual demand of 20,000 units at C, the optimal location iS D with a demand of 49,346 units.

Fig. 1. Isodapane Analysis for Retail Example

Lösch

August Lösch was notable for his synthesis of a general theory of location. He declared that previous work in locational economics had as its primary object the minimization of transport cost and used techniques that involved substitution of one manufacturing input (such as transport cost) for another input (such as economic rent). He wanted to go beyond that partial analysis and, therefore, set out a simplified static model of an entire economy, which operated on a two-dimensional plane at a single point in time, under conditions of monopolistic competition. His model consisted of a series of simultaneous linear equations. He did not solve the system of equations, but showed the theoretical possibility of solution.[1] Each factory price, factory location, market area and market boundary adds a variable to Lösch's system, so the data requirements for a realistic regional market are considerable.

The assumptions necessary for Lösch to develop a solvable set of equations were also considerable. He postulated

> . . . a broad, homogeneous plain with uniform transport features in all directions and with an even scatter of industrial raw materials in sufficient quantity for production; a uniform distribution of agricultural population with a uniform set of tastes and preferences, each homestead at the start being self sufficient; technical knowledge disseminated

---

[1] Lösch, The Economics of Location, n. 1, p. 99, states that the system was not meant to be solved, but to be a clear statement of the problem and the required conditions.

throughout its plain and production opportunities available to all.[1]

Certainly, that model has little practical use in retail location, but it does yield some useful concepts. Losch shows that the ideal market area is a hexagon because it deviates least from a circle, because it fully covers a plane, and because transport expense to the extreme market boundaries is minimized.[2] He shows that different products yield hexagonal networks of different sizes and that the overlapping vertices of those different hexagonal networks form ideal production sites for cities of varying sizes, if there are no breaks in the transport cost structure.

Lösch also supplies a formula for determining the distance between competing spatial monopolists to give the theoretical value for the radius of the inscribed circle of the hexagonal market area. It is:

$$b = a\sqrt{n}$$

where, b = the distance between two enterprises of the same kind;

a = the distance between the settlements supplied; and

n = the number of settlements supplied.

Lösch gives empirical verification for this formula by examining the spacing of German towns of various sizes.

---

[1] Isard, Location and Space-Economy, p. 44.

[2] Lösch, The Economics of Location, p. 114, credits earlier incomplete work by Launhardt and Christaller in developing the hexagonal market lattice.

Isard attempted a graphic representation of this formula consistent with the hypothesized population distribution.[1] Although he did not prove that it was impossible for the formula to hold, he was unable to reproduce a diagram of a Löschian market structure that adhered to the required assumptions.

Hoover

The American economist Edgar M. Hoover showed how the transfer cost minimizing strategies of Weber and Lösch affected the American economy. His primary focus was on heavy industry and agriculture. He felt that retailers, in general, follow population and income shifts[2] and he offered only limited explanation of the microeconomic phenomena that define a single retailer's market. His simplification of the retail market led him to ignore share of market estimation totally.[3] Hoover's concept of retail market analysis consisted of tracing the extreme boundaries of the total retail trade areas for a given commodity around a given town. In this analysis, he omitted mention of the earlier work of William Reilly[4] or the concurrent work of P. D. Converse[5] in quantifying retail market areas.

---

[1]Isard, Location and Space-Economy, n. 1, p. 274.

[2]Edgar M. Hoover, The Location of Economic Activity (New York: McGraw Hill, 1948), p. 546.

[3]Ibid., p. 121.

[4]William J. Reilly, "Methods for Study of Retail Relationships," Studies in Marketing, No. 4, 1929, Bureau of Business Research, University of Texas, Austin, 1959, reprint.

[5]P. D. Converse, "A Study of Retail Trade Areas in East Central Illinois," Business Studies - Number 2, University of Illinois, 1943.

It is only fair to mention that Hoover's main interest was in locational policy as a government tool, not in optimizing the location of retail firms. His work is notable as a statement of the focus of location theory in this country in the middle of this century. The orientation was macro-, not micro-, and wholesale and commercial, not retail.

Isard

The American Regional economist Walter Isard made contributions to the theory of location and to its methodology. He founded the discipline of regional analysis which took as its area of concern location theory, economic geography, and a detailed study of the many interrelationships between geographic regions.

Among Isard's important contributions were: Location and Space-Economy,[1] which summarized the work of the German location theorists and built a general theory of space economy with a more explicit recognition of the many and complex interrelationships of a real world economy; and Methods of Regional Analysis,[2] which brought together the techniques that might be used to specify the linkages in such an economic system.

---

[1] Isard, Location and Space-Economy.

[2] Walter Isard, Methods of Regional Analysis: An Introduction to Regional Science (Cambridge, Mass.: M.I.T. Press, 1960).

Isard's unit of analysis was the region, not the retail market area of a single firm, so the application of his work to retail markets is not direct. Like Hoover, his analysis is macro-, not micro-, and commercial and industrial, not retail. However, he offers an exhaustive treatment of gravity and potential models and their use in regional analysis that establishes a firm empirical footing for the use of such models in retail market analysis.

The Impact of Location Theory Upon Retail Market Studies

Location theory as it was before 1960 gave little specific guidance to the retail firm in a realistic market situation. The typical retailer faces competition from other retailers and the demand for his goods decreases with the inconvenience of his customer base. His customers may do without his goods, or may shop elsewhere for them. Also, transport cost, an eminently quantifiable number for a profit maximizing industrialist, is not directly correlated with net utility for a product on the part of a retail customer. There was no mechanism for treating retail firms competing for a dispersed customer base, where the customer's utility for a firm was the relevant transport cost.

The primary legacies spatial economists left to retail theorists were an appreciation that an economy exists in space as well as time and that the interrelationships between the factors in an economy are complex, and some basic tools to display these relationships. Primary among

these tools were various adaptations of Weber's isodapane analysis. While isodapanes are lines of equal transport costs, the extension to lines of equal profit for the firm is direct.

Summary

The basic problem in application of the analytic techniques presented in this chapter is their inability to handle problems where there is no objective expression for cost to the firm. The retail gravitation models to be presented in Chapter 3 are an attempt to quantify the utility or disutility to the firm of various locations.

CHAPTER III

THE GRAVITATION THEORISTS

Modern retail gravitation models are the direct results of approximately a century of empirical study that attempted to quantify social and economic interaction of all kinds. The name gravitation models has been given to the formal statements of the results of this research because their mathematical form resembles that of the physical science models for gravitational force or gravitational potential. There is no reason to expect human behavior to follow the rules of physics and the character of much of the early work is strictly empirical.

Gravitation models attempt to combine the effects of two general factors, utility giving and utility taking, to arrive at an expression for the relative utility of a stimulus to an individual. The utility giving attributes correspond to the measures of mass in physics, the utility taking attributes correspond to measures of distance.

These models have been developed in a wide range of economic disciplines including economic geography, sociology, psychology, and marketing. In some cases a theory of behavior was used to supply the rationale for the gravity model, in some cases the model had no theory but was

strictly empirical, and in yet other cases models resulted from a direct transfer of physical science principles into the behavioral sciences, with neither theory nor empirical reasons.

Early Gravitation Models

Carey

The first speculation that the gravitation model might be useful outside of physical science was made by H. C. Carey in 1858. Carey "observed the presence of gravitational force in social phenomena, stating that the force was in direct ratio to mass and inverse to distance."[1]

A mathematical statement of Carey's model is:

$$F = k\frac{m}{d},$$

where, F = social gravitational force;

m = social mass;

d = distance from the individual to the mass; and

k = an appropriate constant for the phenomenon under study.

Although Carey showed no empirical validation for his model, the formulation was to be rediscovered and tested several times over the next century.

---

[1] H. C. Carey, Principles of Social Science (Philadelphia, Pa.: J. Lippincott, 1858-59), quoted in Isard, Methods of Regional Analysis, n. 2, p. 11.

Ravenstein

Another early prose model was supplied by E. G. Ravenstein in 1885. Ravenstein's model applied to the migration of populations between two points. It was given a mathematical statement by Isard.[1] Isard's formulation of the Ravenstein model is:

$$M_{ij} = \frac{P_j}{d_{ij}} \cdot f(Z_i)$$

where, M_{ij} = the migration from j to i;

$f(Z_i)$ = some function to estimate attraction at destination i;

P_j = population at source j; and

d_{ij} = the distance separating i from j.

If population is a proper measure of social mass and if $f(Z_i)$ is equal to a constant, that model reduces directly to Carey's earlier model.

Young

In 1924, E. C. Young, another migration theorist, hypothesized that the second power of the distance measure was a more appropriate measure of attraction.[2]

Young's model may be stated:

$$M_{ij} = \frac{k}{d_{ij}^2}$$

---

[1] Isard, Location and Space-Economy, p. 64, citing Ernest G. Ravenstein, "The Laws of Migration," The Journal of the Royal Statistical Society 48 (June 1885).

[2] George K. Zipf, Human Behavior and the Principle of Least Effort (Cambridge, Mass.: Addison-Wesley, 1949), p. 69.

where the symbols have the same interpretation as in the earlier models. Young's model states that migration between two points is inversely proportional to the square of their distance.

Reilly

William Reilly, in 1929, published the next important work on a gravitational model.[1] Reilly was the first retail trade theorist to develop a model of this type. He cites no prior work in the field, presumably his adaptation of the laws of physics was original with him. Reilly was interested in the problem of predicting the amount of retail business from outside a town's boundary that could be expected by merchants within the town. He saw the solution to that problem offering small merchants a means of planning. Using such a model, merchants could stock the merchandise most likely to be purchased and could avoid stocking that which was likely to be purchased in larger cities.

Reilly's work is notable in two respects. He was the first to validate his hypotheses with a large scale empirical study. He studied the charge account patronage and newspaper circulation of the larger cities in Texas, noting the proportions of each that came from the smaller, surrounding towns. His final calculations are based on 255

---

[1]Reilly, "Methods for Study of Retail Relationships."

relationships, certainly a large data base before the availability of electronic computers.

Another first for Reilly was his empirical determination of the exponent of the inverse distance term. Reilly noticed a striking regularity in the pattern of retail trade in Texas in his study. That regularity caused him to propose a law of retail gravitation. He notes that

> It is so readily acceptable that the amount of outside trade which a city enjoys in any surrounding town is a direct function of the population of that city and an inverse function of the distance of the city from that town, that the general law needs no support.[1]

Reilly's general law is:

$$\frac{B_a}{B_b} = \left(\frac{P_a}{P_b}\right)^N \left(\frac{D_b}{D_a}\right)^n ,$$

where, B_a = the business which city A draws from intermediate town T;

B_b = the business which city B draws from intermediate town T;

P_a = the population of city A;

P_b = the population of city B;

D_a = the distance of city A to town T;

D_b = the distance of city B to town T; and

N and n = exponents to be determined empirically.

Reilly accumulated 255 observations of the B_i, P_i, and D_i terms, leaving only the N and n terms unknown. He uses a deductive argument to set N equal to one. He notes that, other things being equal, outside trade varies

---

[1] Ibid., p. 48.

directly with the size of the cities involved. That leaves only the n term to be determined. With N set to unity, the equation becomes:

$$\frac{B_a}{B_b} = \frac{P_a}{P_b} \left(\frac{D_b}{D_a}\right)^n$$

Rearranging terms and taking the logarithms of both sides yields:

$$\frac{B_a}{B_b} \cdot \frac{P_b}{P_a} = \left(\frac{D_b}{D_a}\right)^n ,$$

$$\log \left(\frac{B_a}{B_b} \cdot \frac{P_b}{P_a}\right) = n \log \left(\frac{D_b}{D_a}\right) ,$$

$$n = \frac{\log \left(\frac{B_a}{B_b} \cdot \frac{P_b}{P_a}\right)}{\log \left(\frac{D_b}{D_a}\right)}$$

He solved that equation for each of the 255 observations. His results for the value of n are shown in Table 3.[1]

Reilly accepted the "clear mode" at n = 1.51 - 2.50 as an indication that n = 2 was correct. He realizes that these results may be peculiar to the region and class of goods studied.[2] However, his enthusiasm for the model and

---

[1]Ibid., p. 16.

[2]Ibid., p. 49.

TABLE 3

EMPIRICALLY DETERMINED VALUE OF n

Value of n	Frequency
0.0 - 1.50	45
1.51 - 2.50	87
2.51 - 3.50	35
3.51 - 4.50	24
4.51 - 5.50	15
5.51 - 6.50	14
6.51 - 7.50	6
7.51 - 8.50	5
8.51 - 9.50	12
9.51 - 10.50	5
10.51 - 11.50	3
11.51 - 12.50	4
Total	255

SOURCES: Adapted from Reilly, Methods of Study, pp. 49-50.

his hopes for its wide application indicate that he may expect the relationship to be true over wide areas.

Paul Converse, in his introduction to the 1959 reprint of Reilly's work, endorses the wide applicability of Reilly's basic formula to broad areas of the United States. He cites the usefulness of the formula and others derived from it in retail store location, trading area delineation and sales forecasting for a given retail center.

Two conceptual problems flaw Reilly's model. First, it models aggregate human behavior although the choice of a shopping area is presumably an individual one. Only in the situation where the same choice model operates for all residents of an area, with the same basic parameters, can an aggregate model be used. Even then, the model should be based on some theory of individual behavior aggregated for all residents of an area solely for convenience in analysis.

The next flaw is that Reilly's model considers a pair of towns at a time. Frequently, a consumer must choose between more than two places to shop. The model will not handle such a situation. The model may be used to decide upon a "breaking point," a line along which the influence of two trade centers are equal. A typical trade analysis assigns all areas up to the breaking point to the town at the center of the area. With multiple cities, some areas are assigned to two or more cities, a logical impossibility.

Stouffer

Samuel A. Stouffer, in a criticism of the migration models of Young, Carey, and Ravenstein, developed a migration model that had no distance term at all. He "maintained that there is no necessary relationship between distance and mobility, but that the number of persons going a given distance is directly proportional to the number of opportunities at that distance and inversely proportional to the number of intervening opportunities between the origin and destination."[1]

Stouffer's model may be stated:

$$M_{ij} = \frac{O_{jj}}{O_{ij}}$$

where, M_{ij} = mobility (migration) between i and j;

O_{jj} = opportunities at point j; and

O_{ij} = the opportunities between i and j, excluding j.

Stouffer claims that distance is merely an auxilliary variable that has a high correlation with the number of intervening opportunities.

In the context of a migration model, where the decision to move may be made infrequently, and travel cost may be of less importance, that model has some appeal. In retail patronage decisions that are made frequently, the distance, or at least the travel time required would, however, seem to be a required factor. Stouffer's model also

---

[1]Isard, Location and Space-Economy, p. 69, and Lösch, The Economics of Location, p. 538, citing Samuel A. Stouffer, "Intervening Opportunities: A Theory Relating Mobility and Distance," American Sociological Review 5 (December 1940): 846-47.

fails to explicitly consider the location of the opportunities.

Stouffer's model places an undue influence upon the direction of the opportunity under consideration. If it can be considered intervening, it blocks all of the influence of a distant opportunity. At an equal distance, but in a nonintervening position, it blocks none of the influence of a distant opportunity.

A model that is so sensitive to the position of intervening opportunities is seriously faulted in any widespread application to retail trade.

The Social Physicists

In the late 1930s and early 1940s several models concerning the adaptation of models from physical science to the social sciences were advanced. Two men approached the topic from different viewpoints. One, J. Q. Stewart, envisioned a wide-scale application of physical science models, even without any behavioral theory to support them, and was active in defining the social analogs of such physical science terms as gravity, mutual energy, and gravitational potential.

George K. Zipf attacked the problem from a different perspective. He proposed a behavioral law, the law of least work, then sought to derive models that, although similar to Stewart's models, derive from that law. Because of the overlapping times of publication and the differences in focus of these two men, their work is treated separately.

Stewart

Stewart lists the following laws from physics, then proposes analogous laws in social science:

gravitational force

$$F = \frac{GMm}{d^2} \qquad (1)$$

mutual energy

$$E = \frac{GMm}{d} \qquad (2)$$

and gravitational potential

$$Va = \frac{GM}{d} \qquad (3)$$

where, M = the mass of a particle at point A,

m = the mass of a particle at point a;

d = the distance from point A to point a;

F = the force acting on line Aa;

G = the gravitational constant;

E = the mutual energy of the two masses; and

Va = the gravitational potential produced by M at A.

Stewart redefined those concepts in social and demographic terms as:[1]

demographic gravitational force

$$F = \frac{G(N_1\mu_1)(N_2\mu_2)}{d^2} \qquad (1)$$

---

[1]John Q. Stewart, "Demographic Gravitation: Evidence and Applications," Sociometry 11 (February-May 1948): 34-35.

demographic energy

$$E = \frac{G(N_1\mu_1)(N_2\mu_2)}{d} \qquad (2)$$

and demographic potential of population

$$Va = \frac{G(N_B\mu_B)}{d} \qquad (3)$$

where, μ_i = the "molecular weight" of the persons involved at point i (defined as unity for the "average American");

N_i = the number of persons at point i;

G = the demographic gravitational constant (empirically determined); and

Va = the demographic potential at A caused by population at B.

The remaining symbols have their conventional interpretation. Stewart called this area of study "Social Physics."

Lines of equipotential drawn using Stewart's formula with physical mass of goods shipped used instead of demographic mass are intimately related to Weber's isodapanes. The point of highest potential corresponds to Weber's least cost point.

Stewart cites Reilly's work as empirical validation of the existence of demographic gravitational force.[1] Stewart credits Reilly with being the first to recognize demographic gravitation. Stewart was apparently unaware of the earlier work in migration models cited previously.

---

[1]Ibid., p. 35.

Stewart computed values for demographic potential for various geographical areas and used correlation analysis to show their relation to various social and economic phenomena. Those phenomena included population densities, rural rents, farm value, monthly wages, death rate, miles of railway tracks per unit area, suicide rate, birth rate, and median age. He finds that his measure of population potential, because it includes information about the proximity to population centers, is more suitable than population density alone as a "determinant of vital statistics."[1]

In the absence of any theory linking his measure of population potential to the vital statistics of an area, he failed to show causation, and the word "determinant" seems too strong. He did, however, show a regular structure of social and economic phenomena that is correlated in some way with measures of size and distance.

Stewart seems to have caused a good deal of controversy among his contemporaries. He states,

> There is no longer excuse for anyone to ignore the fact that human beings, on the average and at least in certain circumstances, obey mathematical rules resembling in a general way some of the primitive "laws" of physics. "Social Physics" lies within the grasp of scholarship that is unprejudiced and truly modern. When we have found it, people will wonder at the blind opposition its first proponents encountered.[2]

---

[1]Ibid., p. 45.

[2]John Q. Stewart, "Empirical Mathematical Rules Concerning the Distribution and Equilibrium of Population," The Geographical Review 37 (July 1947): 481.

Stewart's major shortcoming was as a theory builder. He showed a wide range of correlations with his arbitrary measures, but he built little theory and offered few hypotheses about the causal structure of human society.

Zipf

Zipf did a great deal of empirical work in an attempt to verify a basic hypothesis of human behavior, the law of least effort. He cites a principle set out by L. S. Tsai, the law of minimum effort:

> Among several alternatives of behavior leading to the equivalent satisfaction of some potent organic need, the animal, within the limits of its discriminative ability, tends finally to select that which involves the least expenditure of energy.[1]

A similar principle set out by C. L. Hull states,

> If two or more behavior sequences, each involving a different amount of work, have been equally well reinforced an equal number of times, the organism will gradually learn to choose the less laborious behavior sequence leading to the attainment of the reinforcing state of affairs.[2]

Zipf believes those concepts lack consideration of the possible time span involved. He proposes a law of least effort that states "an organism survives at all times with least effort."[3] Effort is defined as work discounted over

---

[1]L. S. Tsai, "The Laws of Minimum Effort and Maximum Satisfaction in Animal Behavior," Monograph of the National Institute of Psychology (Peiping, China), I, 1932, abstracted in Psychological Abstracts, VI, No. 4329 (1932), p. 294.

[2]C. L. Hull, Principles of Behavior (New York: Appleton-Century, 1943).

[3]Zipf, Human Behavior and the Principle of Least Effort, p. 14.

an organism's expected life span, but he does not mention an appropriate discounting procedure. Zipf's statement, roughly translated means that an individual seeks to maximize subjective expected utility, if utility is inversely related to effort spent satisfying a need. That theory has been well tested in psychology and seems to describe a large proportion of human behavior.[1]

Zipf extends the principle into the spatial realm. He states that human spatial relationships are structured so that the sum of the products of all masses moved, when multiplied by the work--distance will be a minimum.[2] That insight confirms the work of Weber a century earlier. In fact, Zipf shows an example of a six-point generalized location figure, offering no proof.

How can a society minimize effort?

> One course is to move the population to the immediate sources of raw materials in order to save the work of transporting the materials to the persons; the effect of this economy, which we shall call the Force of Diversification, will be to split the population into a larger number of small, widely scattered and largely antarchal communities that have virtually no communications or trade with one another.[3]
>
> The other course of economical action, which we shall call the Force of Unification, operates in the opposite direction of moving the materials to the population, with result that all production and consumption will take place in one big city where the entire population will live.[4]

---

[1]Clyde H. Coombs, Robyn M. Dawes, and Amos Tversky, Mathematical Psychology: An Elementary Introduction (Englewood Cliffs, N.J.: Prentice Hall, Inc., 1970).

[2]Zipf, Human Behavior and the Principle of Least Effort, p. 364.

[3]Ibid., p. 352.

[4]Ibid.

Zipf sees all observed locations as the result of those two forces seeking equilibrium. A great deal of his analytical work consisted of observing relationships between concentrations of population using a model of the type:

$$I = \frac{p}{d}k$$

where, I = some measure of interaction;

p = a measure of population size;

d = a distance measure; and

k = an appropriate constant.

The guiding hypotheses and the volume of empirical validation that Zipf includes to show the validity of his concepts give a scientific structure to Zipf's work.

The idea that man seeks to avoid effort both now and in the future is intuitively appealing. However, Isard rebuts this theory:

> Though in its present form there may be considerable value to Zipf's framework for a general study of human behavior, it needs to be substantially revised and extended for an analysis of the space-economy. Though his framework rightly points out the essential factor of minimizing transport effort in terms of probable distributions of raw materials in general, it should in addition encompass the vital consideration of agglomeration (and deglomeration) economies which consist of the economies, (and diseconomies) of scale within the plant,[1]

and of localization and urbanization.

---

[1]Isard, Location and Space-Economy, p. 79.

A Contemporary Gravitation Model

Huff

David Huff was the first to link gravitation models to a specific theory of behavior. He showed how Luce's choice axiom could be applied to a consumer's choice of a retail store.

Axiomatic Basis

Luce's choice axiom may be stated:

$$P(X;y) = \frac{V(X)}{V(X)+V(y)}$$

where, $P(X;y)$ = an individual's probability of choosing alternative X over y;

$V(X)$ = a positive, real-valued function of X representing the value or utility of X to the consumer; and

$V(y)$ = a positive, real-valued function of y representing the value or utility of y to the consumer.

Luce's axiom extends to any finite number of choices offered to a consumer. The probability of choice is simply the ratio of the utility of the particular alternative to the total utility of all salient choices.[1]

An initial attempt to model consumer spatial behavior in terms of Luce's basic choice axiom was made by Huff.[2] The

---

[1]Luce's model and the results of his empirical research in testing this model are summarized in R. D. Luce, Individual Choice Behavior (New York: John Wiley & Sons, 1959).

[2]David L. Huff, "A Probabilistic Analysis of Consumer Spatial Behavior," in Emerging Concepts in Marketing, ed. W. S. Decker (Chicago: American Marketing Association, 1962), pp. 443-61.

positive real-valued function V(X) that was used in the model, for the j th facility is:

$$V(j) = A_j^{\gamma} D_{ij}^{\lambda}$$

where, A_j = an attraction index of retail facility j;

D_{ij} = the accessibility of a retail facility j to a consumer located at i; and

γ and λ = empirically determined parameters.[1]

Originally γ, the exponent of the attraction measure (mass or size in gravitation terms), was set at unity for ease of computation. The similarity to Reilly's model is striking. Both set the mass exponent at unity, both allow empirical determination of the exponent on distance (λ).

The differences between the models are:

1. Huff's model is a model of individual choice, not of the behavior of an entire town;
2. Huff's model is cast within the framework of a theory of consumer choice;
3. Huff's model is operative over a full set of consumer alternatives, not just two choices; and
4. Huff's model is valid for any point in the market area, not just at the "breaking point." It is logically consistent, the market shares

---

[1]David L. Huff and Richard R. Batsell, "Conceptual and Operational Problems with Market Share Models of Consumer Spatial Behavior," in Advances in Consumer Research, ed. M. J. Schlinger, vol. 2 (Chicago: Association for Consumer Research, 1975).

sum to unity and the probability of patronage decreases smoothly with distance.

Other Assumptions

Huff mentions several untested assumptions common to models of this type. They are:

Trip type. The attraction function applies for a given single purpose shopping trip. Also, the distance function is applicable between the consumer's present location and a single destination. If several stores are visited, a consumer might seek to maximize some joint utility and to minimize total distance travelled. Hilliard reports some results that indicate that effect is mixed, and may be negligible.[1]

Product type. Since the model applies to a single purpose, single destination trip, the attraction function must be specified in terms of that specific product at that specific location. Aggregate measures for the store as a whole, while easier to obtain, may result in inaccuracies. A possible result of that type of error would be systematic overprediction of market share for a poorly stocked department of a very large store.

Spatial equilibrium. The model predicts equilibrium market share in the form of a stochastic preference vector

---

[1]Jimmy E. Hilliard, Ronald L. Vaughn, and Fred D. Reynolds, "A Generalized Utility Model of Shopping Behavior," in Advances in Consumer Research, ed. M. J. Schlinger, vol. 2 (Chicago: Association for Consumer Research, 1975).

for all consumers at a given point in space. Clearly, individual behavior and needs may vary considerably. Some consumers may make an extensive search for a given product while others may give the process only cursory attention. Additionally, assigning an equilibrium market share figure, say 30 percent, to a retail location does not specify whether 30 percent of the population shop there all of the time or whether a random 30 percent shop there at any given time.

Consumer loyalty. The model does not specify consumer loyalty, and lacks consideration of temporal dynamics. In considering any well established product, it may be reasonable to assume that the survey sample used to specify the model is a reasonable cross section of the steady state universe of buyers. Golledge indicates that, when this is not true, model errors may be significant.[1]

Choice alternatives. Systematic exclusion of establishments that are patronized by the public for the type of good in question can cause overprediction of the market share of the included establishments. Similarly, inclusion of alternatives not actually considered by the purchaser will result in an understatement of the predicted market share of the establishments actually used.

Group behavior. The Luce choice axiom applies to choices made by individuals. The application as a retail location model requires its use as a group behavior model in

---

[1]R. G. Golledge, "Some Equilibrium Models of Consumer Behavior," Economic Geography 46 (1970): 417-23.

order to simplify the data collection procedure. Any systematic differences in determining the utility of a given retail location by individuals or groups of consumers cannot easily be dealt with. This fault is particularly hard to deal with on an individual basis. If homogeneous groups of respondents can be identified, a model can be specified to predict the behavior of each group.

The dimensions of choice. Huff's final comment deals with the need for a multidimensional model of consumer utility. The original model requires only two variables to compute the utility measure, distance (either actual or subjective), and "size." Two exponents serve as sensitivity measures and mediate the effects of those measures. Huff believes that those variables are surrogates for a number of other correlated measures and that two variables were chosen to make parameter estimation possible. Obviously, many variables might enter the consumer choice process, and a method of deciding upon important variables and specifying coefficients for the resultant model would be desirable. Huff notes the recent work of Nakanishi and Cooper in showing that least squares regression is an appropriate means of specifying such multivariate multiplicative models.[1]

Each of those areas of concern will be examined in the empirical research reported here. The Nakanishi-Cooper estimation procedure will be covered at length in chapter 5.

---

[1]Huff and Batsell, "Conceptual and Operational Problems with Market Share Models of Consumer Spatial Behavior."

Summary

The general concept that aggregate human behavior may be explained by measures of "attraction" and "distance" has appealed to many researchers in many fields. In marketing, the work of Reilly and Huff has been particularly useful because of its immediate practical application in retail location. The theoretical flaws of those models have been emphasized, but that does not negate the fact that they have been useful in many practical, day-to-day marketing decisions.

The long history and interdisciplinary flavor of gravitation models has been shown, and some recent retail choice models using the basic concepts of these models have been presented. Although gravitation models have been used to help make other types of location choices, their usage in the location of retail banking offices is not widespread.

Chapter 4 will describe the current practices in locating retail banking offices. The techniques used by bankers to make these decisions will be reviewed, with the objective of showing where the market share estimation process fits in the location choice decision. One instance of use of a gravitation model by a bank will be shown. Finally, a summary of the available quantitative methodology that may improve the retail location choice process will be given.

CHAPTER IV

LOCATING NEW BANKING OFFICES

In banking, estimates of retail share of market are the most frequently used indicators when choosing and applying for permission to open new banking offices. Several of the most widely used procedures will be reviewed in this chapter. The procedures mentioned are not inclusions, since many banking institutions may rely on unpublished methods to locate new offices, but it is felt that the models mentioned are typical of current practice. A wide range of procedures is covered, ranging from a traditional check-list approach to a computerized search algorithm.

The ABA Guide

Perhaps the most widely known procedure for selecting and evaluating a possible banking office location is the one suggested by the American Bankers Association in their book A Guide to Selecting Bank Locations.[1] A flow chart of the procedure is shown in Figure 2. The method actually is only a judgmental check list. Choice of candidate locations,

---

[1] American Bankers Association, A Guide to Selecting Bank Locations (New York: 1968). Originally printed by the Department of Automation and Marketing Research in 1965 (Department of ABA).

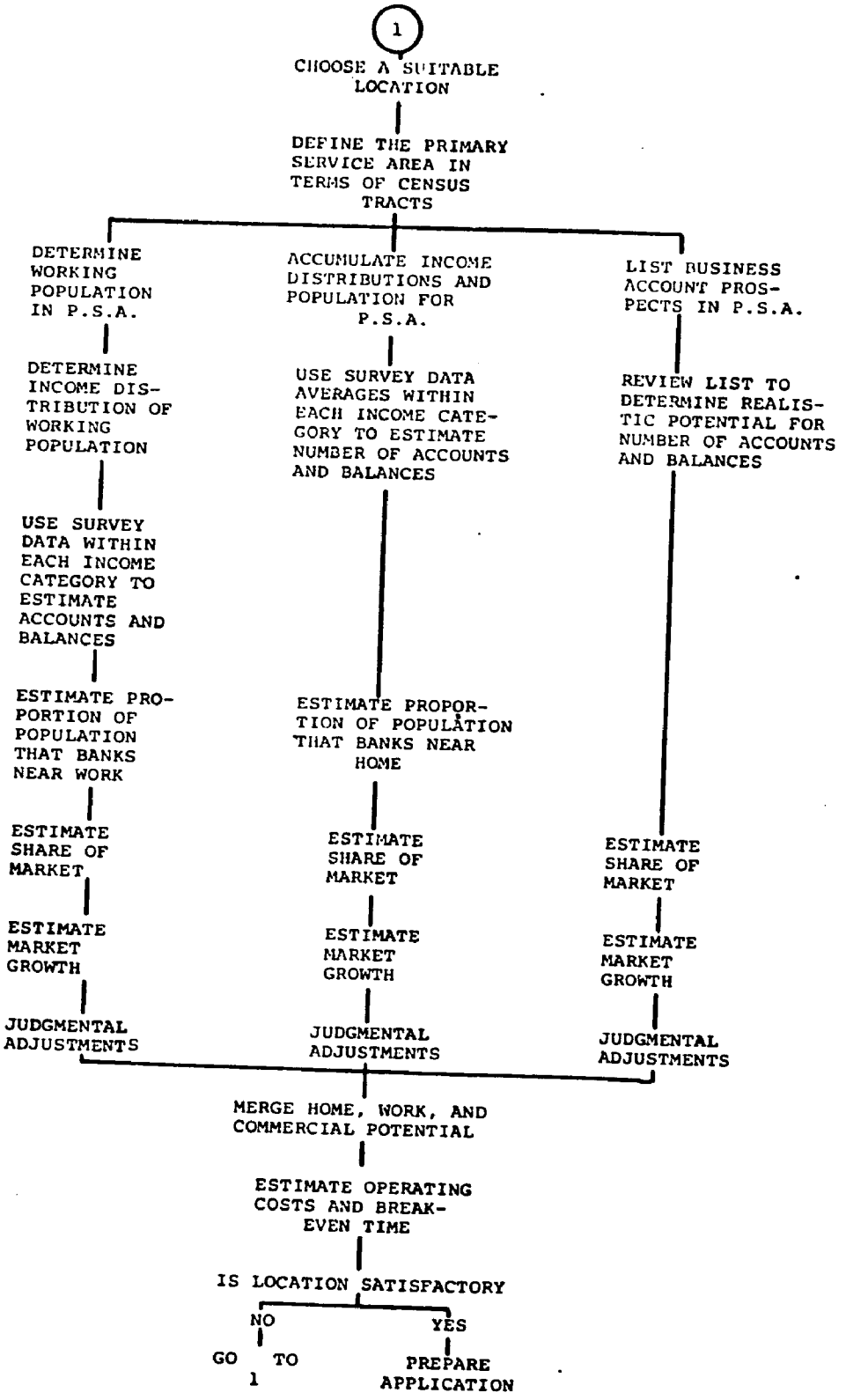


Fig. 2. Flow Chart of the Procedure Suggested in the A.B.A. Green Book

definition of primary service area, estimation of proportion of the population who bank near home or work, estimates of share of market realizable and final adjustment to balance, and number of account figures is left to the discretion of the locations expert. Although the book lists several guidelines to help shape the thinking of the analyst, it sets out few objective procedures; presumably, it is meant to accommodate the wide variations in practice among the ABA's constituent financial institutions.

Two shortcomings of the ABA process are noteworthy. They arise in two stages, the determination of the trading area (Primary Service Area) and the determination of the bank's share of that market. Both of those determinations rely heavily on the experience of the analyst. The book recommends that the trading area be established by determining the "normal drawing radius" for the location, further defining that as ". . . the distance that people will customarily travel to the proposed location for shopping or business purposes."[1] The circle indicated by the radius is then modified, judgmentally, to account for traffic barriers, traffic flow patterns, driving time variations, public transportation routes and stops, population density, and competition. The authors then note, after leaving so much to personal judgment, that "the final value of the study is

---

[1]Ibid., p. 12.

dependent, to a large extent, upon how realistically the trading area has been determined."[1]

The estimation of market share is also left to the judgment of the analyst. The guide suggests factors the analyst should consider--the effect of transfer of existing business to the new office, the effect of competition from other financial institutions, the effect upon the new office of any ideosyncratic consumer behavior--and tells him to be guided by past experience in similar areas.

In summary, the procedure recommended by the ABA, and many of the modifications of that procedure which are in use, determine spatial market share by estimating a trading area and its gross potential, then taking some proportion of the potential as the bank's share. This produces several logical inconsistencies. For instance, no weight is given to persons outside the trading area, although some consumers will cross the line and trade at the new banking office. Also, each household within the area is assigned an equal probability of patronizing the new branch. The probability of patronage however, should decrease with distance from the new branch. A defense would be that the judgmental process affords the expert analyst the opportunity of making corrections to the estimates that will properly consider these facts. Any objective procedure for choosing a banking office location may require judgmental revision, so it might be argued that

---

[1]Ibid., p. 13.

the reliance of this procedure upon expert judgment to such a large extent is not inefficient.

The BMA Handbook

The Bank Marketing Association publication, Bank Branch Location: A Handbook of Effective Technique and Practice,[1] serves the same general purpose as the ABA guide. In the body of the handbook, the authors outline a judgmental procedure very similar to that of the ABA guide. The appendices cover material on two location models which will be reviewed separately. As with the ABA guide, the primary evaluative tool is expert judgment.

The great effort and expense undertaken by retail organizations in general, and by banks in particular, to systematize the retail location evaluation function and to make it as accurate and objective as possible would seem to indicate dissatisfaction with expert judgment alone as a way of making such estimates. Moore, Taylor, and Kramer all focus on inadequacies in banking office location practice.[2] Many of the same functional problems are noted in all four

---

[1]James E. Littlefield, G. Jackson Burney, and William V. White, Bank Branch Location: A Handbook of Effective Technique and Practice (Chicago: Bank Marketing Association, 1973).

[2]Phillip W. Moore, "An Outline of 12 Ways to Determine Branch Locations," Banking, September 1963, pp. 48-49. Phillip W. Moore, "Nine Axioms of Branch Bank Location," Banking, February 1964, pp. 61-62. B. C. Taylor, "Locating Profitable Office Sites," Banking, March 1965, pp. 55-56. Robert L. Kramer, "Modern Methods for Locating Branches," The American Banker, March 24, 1972.

articles. Apparently, the improvement in practice over the nine years from 1963 to 1972 was negligible.

Models and Simulations

Models of Banking Office Performance

There have been several published models which attempt to quantify the retail banking office location decision. Some of them have improved upon the state of the art in estimating market area and share of market (spatial market share).

Clawson

The model described by C. Joseph Clawson in the Journal of Marketing[1] has many similarities to the model described by John Jeglic in the BMA Handbook.[2] Both models use a multivariate linear additive model to estimate deposit growth within a circular trade area.

Clawson's model uses a fixed two-mile radius to estimate the trading area. He mentions that previous studies had shown that such a circle includes 60 to 90 percent of a branch's customers. He considers those customers to be adequate surrogates for the 10 to 40 percent he ignores. His dependent variable is annual net savings gain, not market share so, strictly speaking, the model does not estimate

---

[1]C. Joseph Clawson, "Fitting Branch Locations, Performance Standards, and Marketing Strategies to Local Conditions," Journal of Marketing (January 1974), pp. 8-14.

[2]John M. Jeglic, "Statistical Approach to Locating New Branches," in Bank Branch Location: A Handbook of Effective Technique and Practice, pp. 68-83.

deposit levels. It has been included because it is a spatial model dealing with financial institutions. Unfortunately, Clawson's modeling procedure is seriously flawed. His analysis strategy involved gathering a set of twenty-five potential predictor variables for each branch of the institution under study. He then used stepwise multiple linear regression to arrive at a set of ten predictors of annual net savings gain. He reports an explained variance of 91.5 percent.

In the initial stage of the stepwise regression, twenty-four variables had the opportunity to enter the equation. The data base consisted of twenty-five observations on each variable.

It is appropriate, in stepwise regression, to calculate the number of degrees of freedom remaining using the greatest number of variables allowed to enter the equation, not just the final number.

The apparent number of degrees of freedom for his F ratio[1] were: k and N-k-1, 24 and 14. He reports an F ratio of 16.1. Since the critical value at a .01 level of significance is 3.43, the model seems valid.

Using the entire set of twenty-four variables as an appropriate value for k causes a zero value for N-k-1. Since the F ratio is defined only for positive degrees of freedom, no significance testing is possible. Similarly, his R^2

---

[1]Edward J. Kane, Economic Statistics and Econometrics (New York: Harper & Row, 1968), p. 268.

vanishes if the appropriate correction for degrees of freedom is made.[1]

Another real fault in the structure of Clawson's model lies in his use of a single bank to calibrate the model. To make any valid conclusions about influences in the market area, all competing financial institutions in the relevant market should be used to determine the effects of the predictor variables. Obviously, there would be some very stringent data gathering problems in that approach, but without such data, his model is specific to a single institution, within a single market over a single interval of time.

The depletion of degrees of freedom and the resultant impossibility of meaningful hypothesis testing in Clawson's model could be remedied by gathering a new set of data, either for a different bank or for the same bank over a different time period and testing the model's predictive power. A reliable estimate of the model's true explanatory power could then be made.

Jeglic

Jeglic's model, reported in the Bank Marketing Association Handbook,[2] uses a multivariate linear additive model in two stages of analysis. First, the ordinary least squares regression is used to estimate a normal trading radius for the proposed branch; the model is calibrated with

---

[1]Ibid., p. 309.

[2]Littlefield, Burney, and White, Bank Branch Location, pp. 68-79.

data from other branches of the same bank. The normal trading radius is defined as the radius of a circle which encompasses 75 percent of a branch's customers. Once again, it is assumed that the three customers out of four that are included are appropriate surrogates for those omitted. His omission of competing banks from the data input creates results specific to a single institution in a single market, at a single time. He does allow a variable draw radius, however, and in that way his model is more spatially sophisticated than Clawson's model.

The second stage of Jeglic's procedure involves an ordinary least squares regression of demographics and competitive factors on the branch growth rate. He does not reveal the details of his regression results, hypothesis testing, or initial variable set but does mention that many regressions must be run before specifying the final variable set. The number of observations used to specify his regression is not reported but, as an average national bank has about eight branches,[1] and banks with more than one hundred branches are quite rare, and the potential set of predictor variables is very large, we might assume that a problem with depletion of the degrees of freedom available exists with this model also. As with Clawson's model, this does not mean that the model is invalid, only that it has not been proven valid in a statistical sense.

---

[1]Comptroller of the Currency, 1974 Annual Report (Washington, D.C.: Office of the Comptroller of the Currency, 1975), table 3, p. 6.

Models of Spatial Market Share

The remaining models that will be considered are actual spatial market share models. They are two step models, first predicting gross area potential, then predicting a spatial market share for the given location in order to arrive at an estimated deposit level and number of accounts.

Healy

The first of these models is the ABLES Model[1] (Automatic Branch Location Evaluation System) used by Manufacturers Hanover Trust Company in New York City. This model uses a computer to perform calculations of the estimated performance of a great number, typically thousands, of possible locations and then uses manual evaluation to rank some number of the best locations.

ABLES is a true innovation in that it is automated and is spatially sophisticated. It explicitly considers consumer banking as a phenomena that happens in space. Much of ABLES is a mechanization of the ABA procedure. The major steps are summarized below.

First, area potential is computed for Census Tracts using the ABA procedure of univariate extrapolation. Instead of using the University of Michigan Survey Research Center

---

[1]J. A. Healy, "ABLES: An Automated Branch Locations System," paper presented to the URISA (Urban and Regional Information Systems Association Conference), Boston, Mass, Fall 1972.

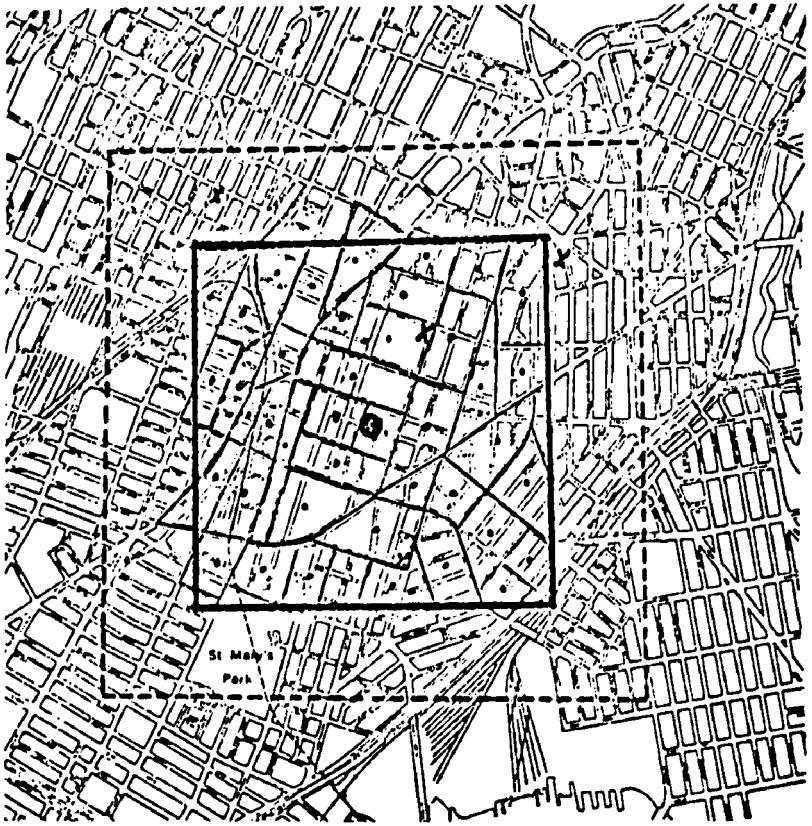
figures found in the Survey of Consumer Finances[1] to estimate balance level and likelihood of having an account, ABLES uses potentials computed from a local survey of banking habits.

ABLES then allocates share of market and potential to each competing institution and to a hypothetical new institution placed sequentially at each of the intersections of a half-mile grid network. Figure 3 shows a hypothetical ABLES market area.

ABLES is heuristic in nature and it is not possible to test many of the assumptions used to construct it. The survey data used for the balance estimates, account incidence and the distance decay curve are based upon consumer interviews and are certainly statistically valid, but the assembly of all that into a model such as ABLES cannot be justified by prior findings. One way to verify the model would be to use it to forecast deposit levels for a number of known branch locations. Because this deposit data was not used to specify the model, it is statistically valid to perform an analysis of variance to test the hypothesis that the model explains no variance in the realized deposit levels and number of accounts of each branch. A strong rejection of that hypothesis would serve to confirm the usefulness of the ABLES technique. No results of such a test have been published.

---

[1]George Katona, Lewis Mandell, and Jay Schmiedeskamp, 1970 Survey of Consumer Finances (Ann Arbor, Mich.: Survey Research Center, The University of Michigan, 1971).



Map shows urban area with simulated market area of one square mile (inner grid). All block group coordinates within the inner grid are aggregated into the grid potential total; banks in the quarter mile outer grid, as well as the inner grid are considered as competition.

- Hypothetical site for new branch bank
- X Location of competing bank
- • Block group centroid
- - - Boundary of outer grid (for competition)
- —— Boundary of inner grid

SOURCE: Joyce A. Healy, ABLES: Automated Branch Locations System.

Fig. 3. How Potential and Competition is Aggregated in the ABLES System

Other shortcomings of ABLES have to do with its market definition and market allocation assumptions. ABLES assumes a square primary market area, surrounded by a larger square secondary market area. It allows for no leakage of deposits inward from outside of the secondary market area. There is no empirical justification for a square market area. Presumably, a square market area was used because it simplifies the computer search algorithm which locates population centers and competitors in the market area. In assigning market share, ABLES divides the total potential by a weighted average of the number of banks in the primary and secondary market areas. Commercial banks, including the branch location under study, are given a weight of one and thrift institutions are given a weight of two. That weighting is meant to consider explicitly the fact that thrift institutions have savings accounts with larger balances. The formula for market share for savings is:

$$S = \frac{1}{\Sigma B_c + 2\Sigma B_t + 1}$$

where, S = market share of the new branch;

B_c = existing commercial banks in the market area under question; and

B_t = thrift institutions in the market area under question.

The addition of one in the denominator adjusts for the presence of the new institution. For checking accounts, the formula is:

$$S = \frac{1}{\Sigma B_c + 1}$$

The market share function implied by these assumptions is shown as Figure 4.

It is realistic to allow for the effects of competition. Certainly, a market will yield a smaller market share where there are many competitors than where there are few. The major weakness of this algorithm is its lack of grounding in any theory of consumer behavior.

Devaney

F. John Devaney[1] describes a model that is used by Wilbur Smith & Associates, a retail bank locations consulting firm. The model is different from those previously described in that it uses a network approach. Nodes of potential are located and the major street network is used to link the nodes together. Competitive branches are also assigned to nodes. The travel time between adjacent nodes is measured and recorded. A computer algorithm is used to find the minimum travel time between all consumer nodes and all bank locations.

Devaney's market share determination uses a distance (travel time) decay curve as shown in Figure 5.

---

[1]F. John Devaney, "A New Way to Choose Those Branch Locations," Bank Marketing, February 1973. Reprinted in Bank Branch Location: A Handbook of Effective Technique and Practice, p. 65.

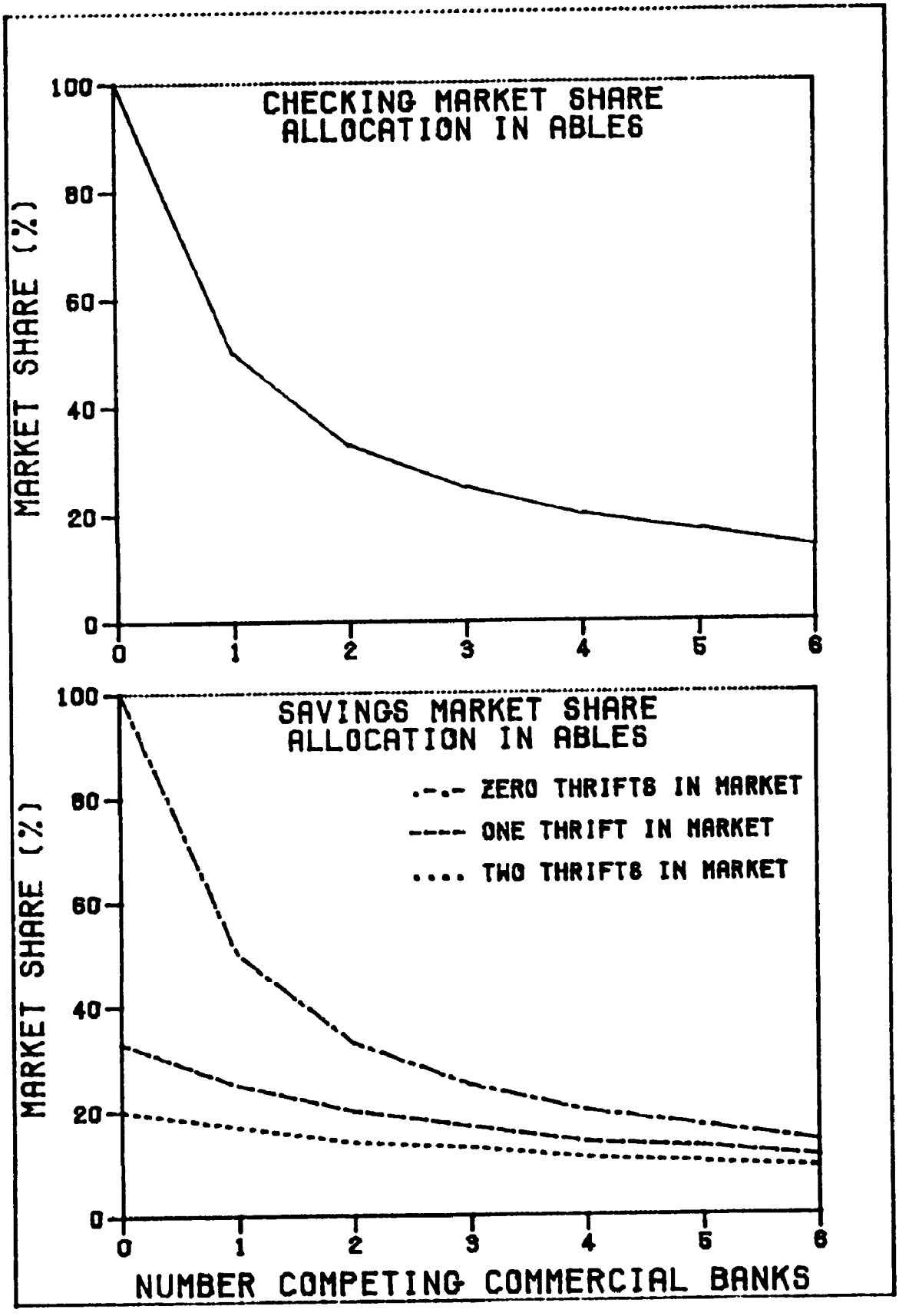


Fig. 4. Market Share Allocation in ABLES

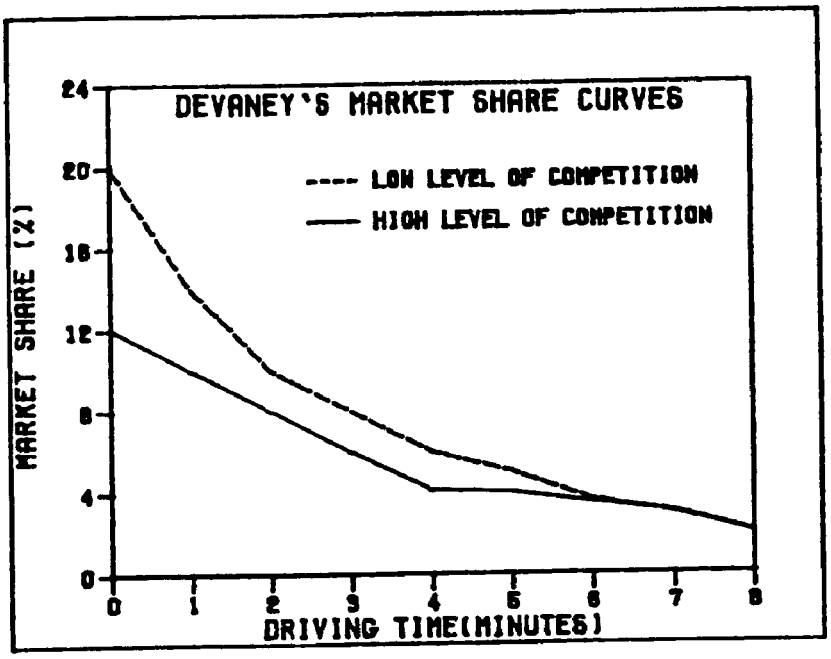


Fig. 5. Devaney's Market Share Curves

The curve shows the result of differing travel times upon the market share to be expected by a new banking office. His algorithm has the capability of using different decay curves for customer nodes that are in different environments. A customer in a dynamically growing suburb may feel differently about travel than a customer who lives in the central city and Devaney's program can handle that difference in preference.

The article is unclear as to the exact procedure for allocating share of market. Presumably, the appropriate market share figure is applied to the consumer potential of a given node which is then summed over all nodes to arrive at an estimate for the new branch. The article does not state Devaney's method of handling the influence of competition. This is presumably handled by using a more severe distance decay function for a new location in a severely competitive environment.

The primary faults of this model are:

1. Its inability to explicitly factor in the effects of competitive institutions located near the proposed branch;

2. Its assumption that the new branch will achieve a zero market share from customers who are located further from the bank than some maximum distance;

3. Its failure, because of its market share allocation procedure, to assure market shares that sum to unity; and

4. Its need for the recalculation of a new travel time matrix with any change in the transportation network. That matrix is the most costly portion of the computer routine.

In support of Devaney's model, however, it does offer a methodology for considering travel time. The usual simplifying assumption that Euclidean distance is an appropriate surrogate for travel time in explaining consumer convenience is not always valid. For instance, when a consumer's path to a financial institution falls primarily on residential streets, it is reasonable to assume that the institution is less convenient than one equally distant which is accessible by an improved highway.

Nystuen

John D. Nystuen developed a spatially sophisticated method of forecasting market share for financial services.[1]

[1]Interview with John D. Nystuen, Professor of Geography, University of Michigan, Ann Arbor, Michigan, June 1975.

His method uses a distance decay function similar to Devaney's but performs a Bayesian modification of the market shares assuring that they sum to unity. Nystuen's methodology involves:

1. Obtaining a representative sample, several hundred random addresses, of home addresses of customers of a particular branch;

2. Plotting these addresses on a map and recording the distance from the branch to each home address;

3. Fitting a smooth curve to the data indicating probability of banking at the given branch as a function of distance; and

4. Using that curve for each population node, census tract, enumeration district, or other geographic unit, calculating the probability of banking at each institution in the relevant market area.

The estimate of market share for each institution is given by dividing the initial estimate of the market share by the sum of the initial estimates of market share for all institutions. That is:

$$S_{ij}^{*} = \frac{S_{ij}}{\sum_{k} S_{kj}} \text{, for k banking offices}$$

where, S_{ij} = market share for institution i at population node j,

d_{ij} = distance from institution i to population node j,

S_{ij}^{*} = normalized market share for institution i at population node j,

k = number of banking institutions in the market area,

$S_{ij} = f(d_{ij})$, and

f = an empirically determined, monotonically decreasing continuous function.

Because of this revision of the initial probabilities, this model produces logically consistent results. However, the reliance on branches of one banking institution for the sample of addresses could introduce bias in the market share estimation. If distance is the primary factor influencing patronage, this model is unbiased, but if the likelihood of patronage differs substantially between offices of different institutions, the model will be biased.

Wadsworth and Gagnon

A sophisticated method of branch site share of market analysis, developed by James A. Wadsworth and Katherine Gagnon of the Wilmington Trust Company, is presented in the ABA publication Bank Location Analysis-Techniques and Methodology.[1] The method is logically consistent in allocating market share--the allocated market shares sum to unity--and it is spatially realistic; there is no absolute market boundary for an office site and estimated market shares decrease monotonically with distance.

The model uses a subjective evaluation of a "competitive factor" and weights that factor by the inverse of the consumer's travel time to the banking office in question.

---

[1]Rex O. Bennett, Bank Location Analysis-Techniques and Methodology (Washington, D.C.: American Bankers Association, 1975), p. 85.

Factors considered in evaluating the subjective "competitive factor" are:

1. The services offered;
2. The quality and quantity of personnel;
3. The surrounding environment in which the office is located;
4. The accessibility to and from the branch;
5. The physical facilities of the branch (size, appearance, drive-up, 24-hour machines, for example);
6. Parking facilities;
7. Visibility; and
8. All other factors deemed appropriate.[1]

The mathematical statement of the model is:

$$MS_j = \frac{\Sigma_j (CF_i)(DV_j^{-1})}{\Sigma_i \Sigma_j (CF_i)(DV_j^{-1})}$$

where, CF_i = the overall (subjective) competitive rating for branch i on the factors listed;

DV_j^{-1} = the inverse of the travel time in minutes from the population center in question to the banking office j; and

MS_j = market share for banking office j.

The model is essentially a Huff model with a subjective size measure. The immediate shortcomings of the model are its reliance on the apparently untested assumption that patronage falls off linearly with travel time and the subjective nature of the competitive factor size measure. There is no evidence that the components of the competitive factor will be weighted properly by the analyst or that different analysts will reach similar evaluations. Methods for overcoming those difficulties will be presented in a later chapter.

---

[1] Ibid., p. 85.

A Review of Available Quantitative Methodology

Robert L. Kramer,[1] in a speech before the Marketing Division of the American Bankers Association in 1972, gave a summary of the inadequacies of current techniques and set forth a series of steps that incorporate modern quantitative decision-making aids. His steps may be considered to be a prose model of the branch locations function. Kramer's treatment is complete; it covers the same basic areas as the ABA guide and is decision oriented. He suggests methods that are well defined and that give specific criteria for banks' decision makers, minimizing the need for expert judgmental adjustments.

Kramer starts by listing some unscientific techniques that are still in use at some banks. They are:

1. Acceptance of broker offerings;
2. Use of executive judgment or intuition;
3. Branching in prestige locations; and
4. Pre-emptive branching, branching at a given location just to prevent a competitor from branching there.

While all of these techniques have some merit, they lack any cost-benefit function tying them together. There is no objective measure of the benefit to the bank, nor any

---

[1]Robert L. Kramer, "Modern Methods for Locating Branches Are Discussed," American Banker, March 24, 1972.

certainty that an optimal location, or even a good location, has been chosen.

Kramer believes there is a need for improved location decisions because:

1. A bank's customer base is constantly shifting, along with its potential customers;

2. Many states are liberalizing their branching laws;

3. New legislation will allow increasing competition from thrift institutions;

4. Capital to support new branching is becoming increasingly costly; and

5. Electronic funds transfer systems, where the customer's principal contact with a bank will be at a remote transactions terminal, will make location the paramount factor in consumer patronage.

Finally, Kramer suggests the implementation of the following techniques in choosing branch locations. Taken together, they form a model of a branch location evaluation system. Kramer's techniques are:

1. Use of the U.S. Census Addressing Coding Guide to attach geographic coordinates and census tract data to customer addresses at a reasonable cost, thus simplifying the mapping of large numbers of customer addresses to help define actual trading areas;

2. Use of U.S. Census Data through the tract identification given by the ACG, so that detailed demographic

information on the geographic areas where customers live may be examined;

3. Use of localized surveys rather than national surveys like the Survey of Consumer Finances[1] to determine consumer banking habits. (Kramer argues that the accurate determination of local correlates of banking activity and balances requires a local survey. Mandell and Lundsten indicate that satisfactory adjustment can be made in national data to make it useful at a local level.[2] Since the Survey Research Center has discontinued the annual Survey of Consumer Finances, this point has become somewhat academic.);

4. Use of mathematical modeling to estimate likelihood of using a bank and probable deposit levels. (Although income is the single most important factor in determining household incidence and balances, other factors, such as population density and neighborhood type, interact. Kramer suggests the use of models that reflect that interaction.);

5. Use of a spatial share of market model (Kramer mentions the theory of retail gravitation[3] and cites recent successes with this theory in locating shopping centers. He cites no empirical testing of this type of model in a banking framework.);

---

[1]Katona, Mandell, and Schmiedeskamp, 1970 Survey of Consumer Finances.

[2]Lewis Mandell and Lorman L. Lundsten, "Market Potential Estimation: A New Approach," Bank Marketing, September 1973, pp. 39-42.

[3]Reilly, Methods for Study.

6. Use of a time dependent growth curve (Kramer cites his work in fitting an exponential curve to several types of bank account growth phenomena.[1] Essentially, the data are normalized to a standard year one projection, then future growth is extrapolated using a formula of the type $Y_t = at^b$.);

7. Use of probabilistic confidence intervals around a bank's projections of costs and revenues for a new branch; and

8. Use of discounted cash flow, with appropriate confidence intervals around the discount rate, as the figure of merit for evaluating the bank's investment in the new branch (Kramer states that years-to-break-even and other types of ROI could produce incorrect evaluations.).

Kramer's methodology suffers from a flaw shared by the ABA and BMA methodology--it is a check-list approach. The model suggested is spatially sophisticated, however, and he supplies a single, objective figure of merit to aid the decision maker.

Summary

This research centers on retail share of market determination, but the entire locations process is described in several of the models reviewed, in order to show where retail share of market determination fits as a part of the entire process.

---

[1]Robert L. Kramer, "Forecasting Branch Bank Growth Patterns," Journal of Bank Research (Winter 1971), p. 17.

Much of the current practice in the location of banking offices is not based on any explicit consideration of consumer behavior.

Chapter 5 will look at the decision to patronize a banking office from the viewpoint of the consumer. Several models of consumer behavior will be analyzed in terms of their applicability to the retail banking office choice decision and a model of individual banking office choice will be developed.

A subset of this model using data that are available to bank marketing decision makers before the opening of a new office will be proposed.

A set of assumptions that make this model of choice applicable to market share estimation for new banking offices is discussed, and a technique for empirical estimation of such a model is developed.

CHAPTER V

CHOICE OF A BANKING OFFICE IN TERMS OF A MODEL OF BUYER BEHAVIOR

To a great extent the consumption of financial services may be considered a continuous process, in contrast to the repetitive purchase of some types of consumer goods.

The actual choice of office and of institution is made infrequently. Although there may be frequent visits to the office where an account is held and frequent transactions on the account, they are of a different character than visits to a supermarket for the purchase of a consumable good. Many of the processes of choice are the same; however, their relative emphasis is changed.

In their discussion of demand analysis Rewoldt et al.[1] describe buyer behavior in terms of three distinct but interrelated models; the behavioral equation, the learning curve, and the expanded model of buyer behavior. Buyer behavior may be described under the appropriate conditions, in terms of each of those models.

---

[1]Stewart H. Rewoldt, James D. Scott, and Martin R. Warshaw, Introduction to Marketing Management (Homewood, Ill.: Richard D. Irwin, 1969), p. 43.

The simplest model cited is the behavioral equation.[1]

$$B = P \times D \times K \times V,$$

where, B = Behavior (purchase, for instance),

P = Predisposition toward the alternatives,

D = Level of drive,

K = Incentive potential,

V = Cue intensity

The terms of this equation are shown as multiplicative because a zero value for any of them causes a zero probability of behavior.

It should be emphasized that this equation is extremely simplified. It assumes that adequately scaled, valid measures of the factors that influence behavior are available.

It is believed that there are strong relationships between the variables and that those relationships vary over time, depending on the subject's experiences and environmental factors. Further, some of the effects may be of a cyclical nature.

Examples of changes in some of the parameters of this type of equation in a marketing context are:

1. A pleasant experience with a purchased good modifies upward the predisposition toward further purchase;

2. Hunger leads to increased probability of purchase of certain foodstuffs; and

---

[1]Howard gives a version of this equation as the Hullian learning model in John A. Howard, Marketing: Executive and Buyer Behavior (New York: Columbia University Press, 1963), p. 102.

3. An increased level of product knowledge leads to upward modification of the incentive potential of a good.

There are many other examples of that type of modification; in fact, much of the marketing effort of business firms can be seen as an attempt to modify those parameters.

The Learning Curve

Because of the effects of experience and the correlated nature of the variables, the equation is not immediately useful in predicting behavior. Changes in the value of one of the parameters produce nonlinear changes in behavior. One example of such nonlinearity is the "learning curve," where repeated behavior is thought to change the predisposition parameter, and perhaps other parameters as well, to create the familiar exponential curve.[1]

An Expanded Model

Because the complete relationships are unknown and tested measures of all parameters are not available, the complex relationships between psychological factors and purchasing behavior are perhaps best represented in a graphic model. Under the proper conditions, such a model might be simplified to a testable model (such as a learning

---

[1]Coombs, Dawes, Tversky, Mathematical Psychology, p. 258. Coombs shows an appropriate set of general parameters which allow for both positive feedback from the behavior and negative feedback from lack of action.

curve repurchase model), but the full model is too formidable to test in its entirety.

Thus, the behavioral equation, the learning curve model, and the model to be developed in the empirical phase of this research may be considered to be simplifications of this more general model of consumer behavior.

Phases of Buyer Behavior

Buyer behavior may be classified into three basic phases: (1) extended problem solving (EPS); (2) limited problem solving (LPS); and (3) automatic or routinized response behavior (RRB). These phases differ markedly in the amount of external influence they assert upon the purchase decision and in the effect they have on internal predispositions. Table 4 shows some of the characteristics of each of these phases.

One of the descriptive parameters, probability of repeat purchase, is not as meaningful in a financial service choice setting and, for this purpose, will be modified somewhat. In the sense given, probability of repeat purchase refers to a dimension of brand loyalty while in the financial choice process, a similar concept is probability of use of a specific office for a service. The latency, degree of ideation and size of evoked set parameters are meaningful in their conventional sense in a financial service context.

With that set of definitions, learning can be described as a change in value of the probability of patronage

TABLE 4

CHARACTERISTICS OF THE BUYER BEHAVIOR PHASES

	EPS	LPS	RRB
P (REPEAT)	Low	Intermediate	High
LATENCY	High	Intermediate	Low
IDEATION	High	Intermediate	Low
SIZE OF EVOKED SET	Large	Intermediate	Small

SOURCE: Summarized from Rewoldt, Scott, and Warshaw, Introduction to Marketing Management, pp. 37-38.

P (REPEAT)	Probability of repeat purchase
LATENCY	Time elapsed between perception of need and actual purchase
IDEATION	Intensity of thought processes leading to the decision
SIZE OF EVOKED SET	Number of alternatives considered

of a banking office.[1]

A Model of Bank Patronage

The bank patronage decision seems to fall into two of the three basic buyer behavior phases. The decision to choose a banking office may be considered as EPS behavior, and the decision to continue patronage at an office presently used may be considered to be RRB behavior.

---

[1]Howard, Marketing: Executive and Buyer Behavior, p. 101, defines learning as a modification of the probabilities associated with a repertoire of possible behavior.

The decision to consider initial banking office choice to be an extensive problem solving situation is an arbitrary one. The latency of response, degree of ideation, and the size of the evoked set have not been adequately measured by prior research. Indeed, much of the prior research assumes that a single variable, distance, is the primary choice determinant. To allow the specification of a model with the potential for a rich set of choice determinants, the potential banking office patron will be assumed to be in the extensive problem solving stage.

The specification of routinized response behavior for the office patron is less arbitrary. Results will be presented in chapter 6 which show that in one metropolitan market the median length of office patronage for checking services is 5.9 years and the median length of patronage for savings services is 6.7 years. That cannot be characterized as rapid turnover. The assumption that the probability of behavior change has reached some asymptotic value seems reasonable.

Figure 6 shows a diagram of a general model of banking office choice. This diagram models a stimulus - response - reinforcement process which is assumed to pertain to the choice of a banking office. This diagram is a revision of several popular descriptive behavioral models, with the terminology changed to refer to the banking office choice process.[1] An attempt has been made to include the

---

[1]Rewoldt, Scott, and Warshaw, Introduction to Marketing Management, p. 47; John A. Howard, Jagdish Sheth,

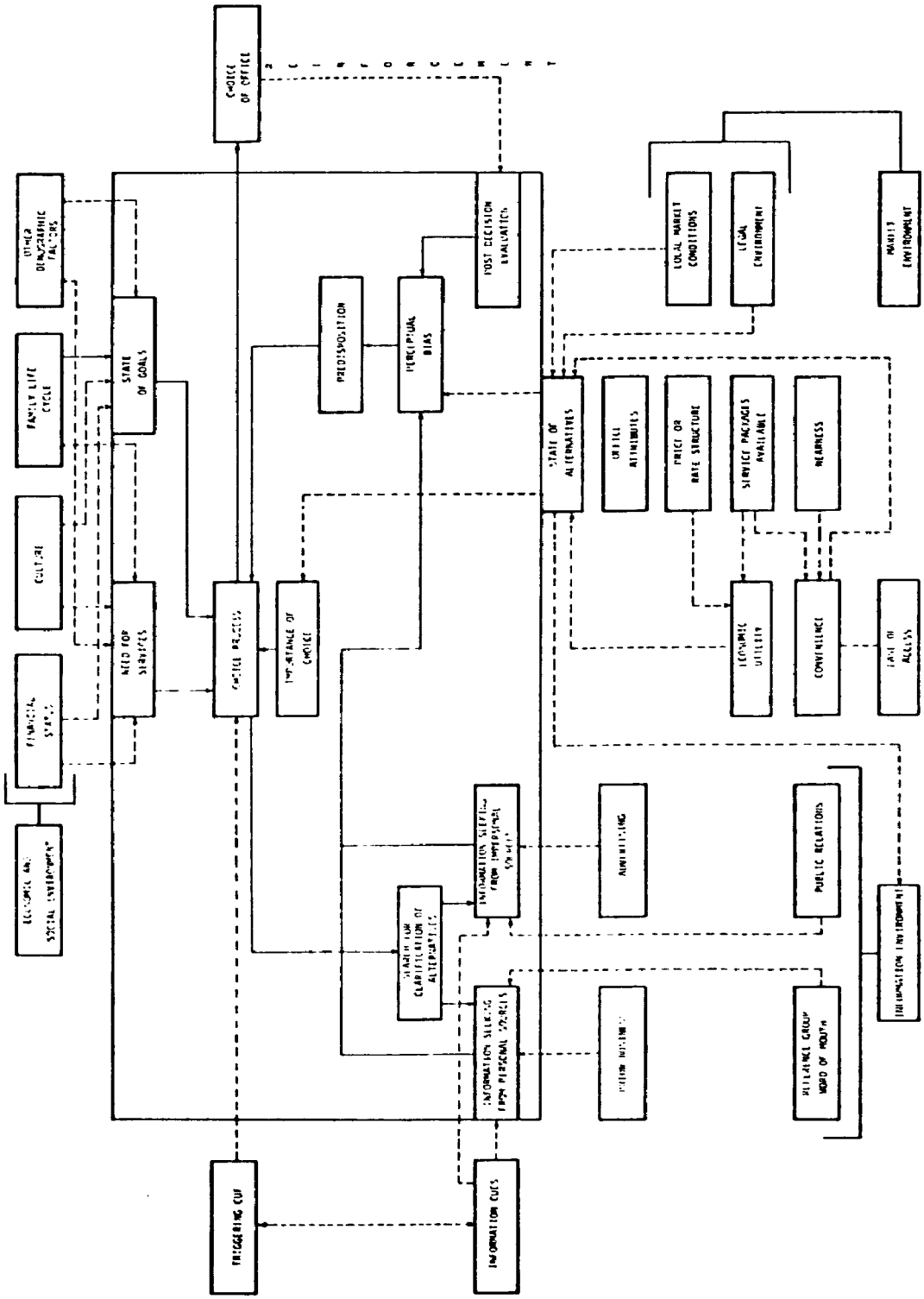


Fig. 6. THE BANKING PATRONAGE DECISION AS A STIMULUS-RESPONSE-REINFORCEMENT LEARNING-MODEL.

major objective influences upon banking office choice and those psychological and sociological influences thought to exist.

This model is presented for the purposes of discussion. Only a portion of the linkages in this model can be tested with current statistical procedures, and only some of them will be directly investigated in this study. The explicit statement of the influences and linkages thought to exist in banking office choice is valuable because it clarifies the influences on behavior that are ignored or assumed away in building a more restricted model.

The diagram is shown with the major exogenous variables outside the box and with the variables considered to be endogenous to the individual's choice process inside the box. The exogenous variables have been divided into three major groups, each of which will be considered separately.

The Economic and Social Environment

The factors considered as parts of the economic and social environment are considered to be determinants of

---

The Theory of Buyer Behavior (New York: John Wiley and Sons, Inc., 1969), p. 30; Herbert G. Heneman, III and Donald P. Schwab, "Evaluation of Research on Expectancy Theory Predictions of Employee Behavior," Psychological Bulletin 78 (1972): 2; Howard, Marketing: Executive and Buyer Behavior, p. 99; Robert W. Pratt, Jr., "Measuring Purchase Behavior" in Robert Ferber, ed., Handbook of Marketing Research (New York: McGraw Hill Book Co., 1974), pp. 3-137; Francisco M. Nicosia, "Consumer Buying Behavior," in Robert G. Murdick, ed., Mathematical Models in Marketing (Scranton, Pa.: Intext Educational Publishers, 1971), pp. 99-100.

need for banking services. They represent the position of an individual in a social, cultural, and economic framework. Financial status has been shown to be linked closely to the consumption of banking services. Some level of wealth or income is clearly needed before banking services become relevant; after that level has been reached, income has been shown to be the strongest single determinant of balance levels in individual accounts.[1]

Other demographic descriptors are useful in predicting these environmental factors, and are thought to be determinants of need. Family life cycle is thought to be an important summary measure of many of the relevant demographic forces that influence buyer behavior,[2] and cultural norms are a useful summary of the group influences common to a given culture.[3]

The items listed in this area are not all inclusive, but represent those measures that have assumed some importance in the literature of bank marketing and of buyer behavior.

Information Environment

This category of stimuli represents commonly used sources of information about banking offices and services.

---

[1]Mandell and Lundsten, "Market Potential Estimation," p. 40.

[2]Howard, Marketing: Executive and Buyer Behavior, p. 170.

[3]Ibid., pp. 147-49.

The two major personal sources of information for a prospective customer are word-of-mouth and prior experience. The major impersonal sources are thought to be the advertising and public relations efforts of a banking institution. Results presented in chapter 6 show those forces to be operative in the Farmington, Michigan market and they are thought to be representative of the same sources in most markets.

Market Environment

The market environment is meant to include those influences which summarize most of the directly actionable marketing policy variables and their effect upon the structure of a local bank market. The attributes of the set of available banking offices coupled with the local market conditions and the legal environment (branch banking or unit banking state, mandated interest levels, etc.), is thought to determine the state of alternatives available to a potential customer. A linkage is shown between this environment and the information environment to indicate that the market alternatives provide a major source of information content for the information sought by a potential customer. In this diagram, two major objective variables, convenience and economic utility, are offered as summary measures of the market structure.

Convenience is thought to be a function of the physical closeness of a banking office, the ease of access or availability of that office (hours of access, number of teller stations open to serve the public, etc.), and the

service packages that are available at the office (the availability of both checking and savings at the same location, for example).

Other External Elements

In this model, cues (stimuli) are shown as inputs to the choice process. These cues can serve to bring information to the prospective customer or to trigger the choice process, or both. Typically, the last cue occurring before the choice process is initiated is considered to be the triggering cue.

Choice of office (response) is shown as an output of the model and as an input to the reinforcement process (which is internal to the decision maker). In its simplest form, these influences comprise a stimulus-organism-response-reinforcement model, with the triggering cue serving as the stimulus and with all of the internal variables considered as part of the organism (decision maker).

Processes Internal to the Decision Maker

The economic and social environment is the major influence in the decision maker's need for financial services and in the state of his goals. In conventional terms, they represent the wants and needs of the decision maker. Those wants and needs serve as inputs to the choice process.

The market environment influences the decision maker's conception of the importance of his choice. A market with a wide variety of similar choice possibilities

is assumed to cause any single choice to be conceived of as less important than it would be in an environment where there was wide differentiation among a few competitors.

The final direct input to the choice process shown is the set of predispositions held by the potential consumer toward the available options. Those predispositions may be thought of as a set of probabilities attached to each possible response and are thought to be influenced by the degree of perceptual bias used by the decision maker to modify information obtained from other sources--personal, impersonal, and experiential.

The final area of internal decision making represented by the model is information seeking behavior. The decision maker may seek information from personal or impersonal sources (Information Environment), or from experience with the office chosen or the set of banking offices considered to be possible choices (Market Environment).

Initial Choice of a Banking Office

It is assumed that new market entrants follow a form of extensive problem solving behavior when choosing a banking office. This behavior involves a stimulus that leads to initiation of the choice process (the triggering cue), a search by the market entrant for clarification of alternative behavioral options, and an evaluation of wants and needs for financial services coupled with an evaluation of the valence (importance) of the decision. After the choice

has been made, the consumer begins a process of evaluating the choice, causing a modification of his probabilities of further behavioral choice (the perceptual bias--predisposition linkage). It is possible for the consumer to remain in an information seeking loop for an indefinite period, possibly long enough to cause extinction of the decision to choose a banking office.

The Choice Process for Market Participants

Once the initial choice of a banking office has been made, the consumer is assumed to enter a less complex process. His need for information is lessened and his knowledge of the market environment is at a higher level. The assumption is made that he maintains a constant post-decision evaluation of his choice, with infrequent further assessment of the state of alternatives or search for clarification of possible alternate choices. This state corresponds to Howard's Routinized Response Behavior.

Presumably, changes in Economic and Social Environment, changes in Market Environment, or the acquisition of new information (changes in the Information Environment) could cause the consumer to become receptive to a triggering cue for a change in behavior (i.e. to choose a new office at which to bank). Such a cue would cause the extended problem solving phase to be entered, with its wider range of behavioral influences upon possible choice.

Model Subset for Bank Marketers

The model of consumer choice presented serves two major purposes. First, it allows a full consideration of the pattern of influence thought to exist upon the retail banking customer, including both observable and unobservable variables as well as variables exogenous and endogenous to the marketing decisions of the firm. Finally, it allows a clear statement of those areas of the decision making process that will be incorporated into the empirical research to be performed and those areas of the process that will be assumed to remain constant over the relevant range of the research.

The primary purpose of this research is to build a model to predict retail market share for banking offices which would be useful to bank marketing decision makers and to bank regulators. Ideally, such a model should use inputs that are available in advance of a banking office's opening that are low in cost, that are objective, and that enable an unbiased and powerful prediction of market share.

This research will test whether or not a model built using only observable, objective variables has a useful amount of predictive power. The assumption will be made that the internal decision influences are homogeneous over the relevant market area or, if not homogeneous, that the individual differences are well mixed and geographically scattered. In addition, it will be assumed that demand is not altered by the actions of the firms in the market. That is, market share will vary as consumers switch between

competing offices, but the number of customers in the market will remain constant. That assumption eliminates consideration of the linkages between the economic and social environment of each household in the market and their perceived need for banking services. All assumptions are common to ordinalist decision models.[1]

The model to be specified will use inputs shown in the diagram under Market Environment and Information Environment. Those variables will be examined for their ability to predict patronage.

The model to be built is similar to models proposed earlier by several marketing theorists. Since these models lay the foundation for retail share of market estimation, they will be discussed at some length.

Some Retail Market Share Models

Kotler

Philip Kotler develops a set of market share models that incorporate the notion that a firm's market share is related to its share of the marketing effort.[2]

The simplest version of this model, his fundamental theorem of market share determination, is:

---

[1] In addition to those assumptions, Howard lists the assumption of divisibility (fractional patronage or purchases) and additivity. The definition of market share as a probabilistic concept assumes this also. Howard, Marketing: Executive and Buyer Behavior, p. 78.

[2] Philip Kotler, Marketing Decision Making, A Model Building Approach (New York: Holt, Rinehart and Winston, 1971), pp. 92-99.

$$s_i = m_i = \frac{M_i}{M}$$

where, s_i = firm i's market share

m_i = firm i's effort share

M_i = firm i's marketing effort measured in dollars

M = total industry marketing effort in dollars

Kotler then allows some modifications of that basic model to incorporate known marketing phenomena. First, he allows for the differing effectiveness of the marketing expenditures of different firms. He adds a multiplier α_i that differs according to the qualitative effect of each firm. The equation becomes:

$$s_i = \bar{m}_i = \frac{\alpha_i M_i}{\Sigma \alpha_i M_i}$$

Next, he allows a stochastic error term to enter to allow for unforseen and uncontrollable factors. And, finally, he allows for a degree of temporal autocorrelation by allowing last period's market share to enter the equation for the current period.[1]

Incorporating many of these equations Kotler derives:

The Additive Version of the Fundamental Theorem of Market Share Determination

$$s_i = m_i = \frac{k_i - pP_i + aA_i + dD_i + rR_i}{\sum_i (k_i - pP_i + aA_i + dD_i + rR_i)}$$

---

[1]Ibid., p. 95.

The Exponential Version of the Fundamental Theorem of Market Share Determination

$$s_i = m_i = \frac{k_i P_i^{-p} A_i^{a} D_i^{d} R_i^{r}}{\sum_i (k_i P_i^{-p} A_i^{a} D_i^{d} R_i^{r})}$$

where, P = Price

A = Promotion

D = Distribution

R = Product Quality

and k, p, a, d, and r are constants to be empirically determined

Kotler's theorem of market share determination is actually an axiom. Its existence does not rest on an axiomatic base.

Bell-Keeney-Little

Others have sought to formulate a market share model from more basic axioms. David Bell, Ralph Keeney, and John Little[1] propose a market share theorem that is derived from a set of testable axioms. The final theorem is similar to Kotler's models, but an explicit and testable axiomatic structure is given for the theorem.

These authors assume that market share is completely determined by the attraction of the set of competing firms to the customers in the market place. They allow attraction

---

[1]David E. Bell, Ralph L. Keeney, and John D. C. Little, "A Market Share Theorem," Journal of Marketing Research 12 (May 1975): 136-41.

to be a function of the marketing mix variables for the competitors, individually or as a group.

Their axioms are:

A1: The attraction vector is nonnegative and nonzero.

$a \geq 0$ and $\sum_{i=1}^{n} a_i > 0$ where a = the attraction vector for all firms and a_i = the attraction of the i-th firm.

A2: A seller with zero attraction has no market share.

If $a_i = 0$ then $M(S_i) = 0$ where $M(S_i)$ is the market share of the i-th firm.

A3: Two sellers with equal attraction have equal market shares.

If $a_i = a_j$ then $M(S_i) = M(S_j)$

A4: The market share of a given seller will be affected in the same manner if the attraction of any other seller is increased by a fixed amount Δ.

$f(a + \Delta e_j) - f_i(a)$, for all $j \neq i$ is independent of j, where $M(S_i) = f(a)$. (The market share of the i-th firm is a function of the market attraction vector.)

Bell, Keeney, and Little use these axioms to derive a market share theorem that states:

$$M(S_i) = \frac{a(S_i)}{\sum_{j=1}^{n} a(S_j)} \qquad i=1,2,\ldots,n$$

In words, the market share of a firm is equal to the attraction of that firm, divided by the total attraction of all firms in the market. According to this theorem, a firm's share of market is identical to its share of attraction.

Discussion of the Axioms

A1: The attraction vector is nonnegative and nonzero. By definition attraction is a positive or zero number and at least one firm must have a positive attraction. In marketing practice, this is certainly noncontroversial.

A2: A seller with zero attraction has no market share. This axiom corresponds to the common belief that consumers shop because of some perceived benefit (which contributes to attraction) and in the absence of the benefit they will refrain from patronizing the given establishment. More simply, given A1 and A2, a consumer will choose some establishment with a positive attraction over a firm with zero attraction.

A3: Two sellers with equal attractions have equal market shares. If we define attraction as a function of a complete bundle of consumer benefits, then this axiom is not controversial. Two firms may differ on any of several components of attraction. Presumably excesses in some components compensate for deficiencies in other components.

A4: If the attraction of a competitor increases by some amount, then the new market share of the firm will not depend on which competitor made the increase. The authors offer an equivalent statement of this axiom that corresponds more closely to usual marketing management notions. It is: "The market share of seller i depends only on his attraction a_i and the sum of all attractions."

This is the familiar "us versus them" situation. A firm must focus on its attributes in relation to the attributes of all other firms who compete for the same customers.

The Bell, Keeney, and Little model that results from these axioms is identical in form to the model proposed by Kotler. Their contribution was not in the final structure of the model, but in showing a set of underlying axioms for the model.

The authors show a simple method of using their model in segmented markets. The model is applied to each segment in turn, and the resulting market share is weighted by the size of the market segment. They allow for different attraction functions within each segment.

They do not deal with the problem of determining the components of attraction, but they mention the Nakanishi-Cooper technique which shows the use of a regression technique for determining the coefficients of a multiplicative log linear model of this type.

Luce

R. D. Luce developed an axiomatic model of choice[1] that results in a similar model. Huff's adaptation of this model to the determination of market share was discussed in chapter 4. The axiom underlying this model will be discussed here.

---

[1]R. D. Luce, Individual Choice Behavior (New York: John Wiley and Sons, 1959).

The axiom is:

$$P(x;T) = P(x;R)P(R;T) \text{ for } R \epsilon T.$$

where, T is a finite set of choice alternatives

R is any subset of T,

x is an element of R,

P(x;T) represents the probability of choosing x from the set T

and P(R;T) represents the probability that a choice from T will be in the subset R

That single axiom, along with the conventional laws of probability (probabilities sum to unity, are not negative, etc.) and with the assumption that uncertainty exists (no single probabilities are zero or unity) can be used to derive several results that give a model of choice in a marketing situation. Tversky shows[1] some of these consequences.

The Constant Ratio Rule

$$\frac{P(x;T)}{P(y;T)} = \frac{P(x;R)}{P(y;R)} = \frac{P(x,y)}{P(y,x)}$$

Briefly, the ratio of the choice probabilities of any two alternatives is independent of the remaining alternatives. This rule can be shown to be equivalent to the choice axiom. This rule is also equivalent to Bell, Keeney, and Little's[2] axiom 4, except that Luce's model deals with

---

[1]Coombs, Dawes, and Tversky, Mathematical Psychology, p. 151.

[2]Hereafter referred to as BKL.

choice alternatives for individuals and BKL deals with an aggregate market phenomenon.

Choice from Larger Sets

Tversky shows:

$$P(x;T) = \frac{1}{\sum_{y} \frac{P(y,x)}{P(x,y)}}$$

That is, the pairwise choice information can be used to derive choice probabilities from any combination of choices from T.

If the ratio of choices of x over y to the choices of y over x is thought of as the "relative strength" of x, represented by V(x), the expression given earlier, used by Huff[1] (chapter 3) can be derived

$$P(x,y) = \frac{V(x)}{V(x) + V(y)}$$

In general:

$$P(x;T) = \frac{V(x)}{V(T)}$$

In several comparisons of the Luce model with other models of choice, no model is clearly superior. In a practical sense, Luce's model requires fewer assumptions about the shape of the distribution of the data and might, therefore, be preferred.

---

[1]Huff, "A Probabilistic Analysis of Consumer Spatial Behavior," pp. 443-61.

Most applications of that model, including Huff's, have used pooled choice data which impairs the testability of the model.[1] It is possible for all individuals in a group to satisfy the model yet pooled data may not.

BKL Versus Huff

The axiomatic approach given in 1975 by Bell, Keeney, and Little can be very closely approximated by taking Luce's original axiom and assuming homogeneity of choice behavior among individuals. That assumption leads directly to Huff's model.

The BKL article omits citations to Huff and to Luce. One unique contribution of the BKL work was in showing how a model of this type may be used in segmented markets.

Implementation of Models of this Type

Models of this type have been developed and tested by several marketing theorists. Huff[2] and Hlavic and Little's[3] models dealt explicitly with spatial market share,

---

[1]Luce, Individual Choice Behavior, p. 8.

[2]Huff, "A Probabilistic Analysis of Consumer Spatial Behavior," pp. 443-61.

[3]Theodore E. Hlavic and John D. C. Little, "A Geographic Model of an Urban Automobile Market," Proceedings, Fourth International Conference on Operations Research (New York: Wiley - Interscience, 1969), pp. 302-11.

while the models of Kotler,[1] Kuehn,[2] and Urban[3] concentrated upon other parts of the marketing mix.

All these models were specified using an iterative search process. In such a process, a digital computer is used to evaluate the efficiency of the model while varying the value of the model coefficients. A search technique is used which rejects most values of the coefficients and consistently improves the fit of the model, stopping when some criterion measure of goodness of fit is reached. Although more efficient than an exhaustive search, this technique can become prohibitively expensive with a large data base and many predictors of market share. A regression technique would be desirable from a computational standpoint because of the need for only one pass through the data and because of the objectivity of the least squares fit criterion.

Nakanishi and Cooper

Nakanishi and Cooper showed a regression technique for specifying a large class of models of this type.[4] Their

---

[1]Philip Kotler, "Competitive Strategies for New Product Marketing Over the Life Cycle," Management Science 12 (December 1965): 51-67.

[2]Alfred A. Kuehn and Doyle L. Weiss, "Marketing Analysis Training Exercise," Behavioral Science 10 (January 1965): 51-67.

[3]Glen Urban, "An on Line Technique for Estimating and Analyzing Complex Models," in Reed Moyer, ed., Changing Marketing Systems (Chicago: AMA, 1968), pp. 322-27. Glen Urban, "Sprinter Mod III: A Model for the Analysis of Frequently Purchased Consumer Products," Operations Research 19 (September 1970): 805-54.

[4]Masao Nakanishi and Lee G. Cooper, "Parameter Estimation for a Multiplicative Competitive Interaction

general model is:

$$\pi_{ij} = \frac{\prod_{k=1}^{q} X_{kij}^{\beta_k}}{\sum_{j=1}^{m} \prod_{k=1}^{q} X_{kij}^{\beta_k}}$$

where,

π_{ij} = the probability that a consumer in the i-th choice situation selects the j-th object;

X_{kij} = the k-th variable describing object j in choice situation i;

β_k = the parameter for sensitivity of π_{ij} with respect to variable k.

They call this general model a Multiplicative Competitive Interaction model. The models cited previously in this chapter may all be considered to be specific cases of this MCI model. The authors show that a logarithmic transformation makes this model linear in the β_k's. The linear model is:

$$\log\left(\frac{\pi_{ij}}{\tilde{\pi}_i}\right) = \sum_{k=1}^{q} \beta_k \log\left(\frac{X_{kij}}{\tilde{X}_{ki}}\right) + \log\left(\frac{\zeta^*_{ij}}{\zeta^*_i}\right)$$

where, ζ = a random error term and the terms in the denominator represent the geometric means of the respective variables over the relevant ranges.[1]

This transformation may be interpreted as a measure of relative intensity. In the marketing context, the X_{kij}

Model--Least Squares Approach," Journal of Marketing Research 11 (August 1974): 303-11.

[1] Ibid., p. 304.

are attributes of a particular element of a firm's marketing mix. In the case of distance, the transformation would be the logarithm of the distance from a consumer's home to a retail outlet divided by the geometric mean of the distance to all other relevant retail outlets. That ratio is a dimensionless measure of nearness, with values smaller than one indicating locations nearer than average and values greater than one indicating locations further away than average. The use of the geometric mean as a measure of central tendency is necessary because of the multiplicative form of the model, but its use can be defended by the relative success of models of this type, especially in the field of retail location.

Summary

A diagrammatic model of retail banking office choice was presented (Figure 6). The relationship of this model to several models of behavior common to the social sciences was shown. A vital element of the model was its provision for the modification of the prior probabilities of behavior (predisposition) by the incorporation of experience and information processing behavior.

The assumptions necessary to calibrate this model with objective, market-oriented measures were shown and the existence of several similar models was noted.

Finally, a technique that allows calibration of such models by linear regression was shown. This technique will be used to calibrate the model to be built in this research.

The model of banking office choice that was suggested in this chapter is similar to several established models of buyer behavior, but there is no reason, a priori, to assume that the model captures the major determinants of banking office choice.

Chapter 6 presents the results of a consumer survey of six hundred households in Farmington, Michigan. Several questions were asked that probe the reasons for choosing a banking office by these consumers, and the patterns of service usage for each household was determined.

Chapter 6 summarizes these results and details the procedures used to collect the consumer data and the banking office data.

CHAPTER VI

THE MARKET SURVEY

It was decided to use a survey to gather data on banking patronage and on attributes of banking offices for this study. The survey technique offered several advantages over other methods of collecting data. It eliminated the need for access to any internal banking office records; it assured a wide geographic dispersion of households; it provided an objective determination of the banking offices actually used by Farmington residents; and, it allowed the gathering of additional information such as reasons for use and the number of offices used for all banking relationships. Two distinct surveys were done to gather patronage data--a telephone survey of consumers and a mail survey of banking offices used by those consumers.

These methods of gathering survey data are considerably less expensive than personal interviews and offer the advantage of allowing a substantially larger number of respondents than could be obtained by personal interviews.

Consumer data were required on actual banking office patronage and on location of the patron's home. For the banking offices, a number of office attributes thought

to influence patronage needed to be measured. To maximize response rate, the questions asked of each sample were confined to those areas.

The Consumer Survey

During December 1975, six hundred telephone interviews were conducted in the Farmington, Michigan community by Yee-Minard Associates, a Detroit marketing research firm. The questionnaire used is shown in full in the appendix. Because of the need to have a verifiable address for each home contacted, the sampling frame was all homes in the city of Farmington and the city of Farmington Hills that were listed in the most recent issue of Bresser's Cross Index, a commercial listing of all addresses in those communities. Using a random start, every thirty-second listed home was contacted. If the contacted home refused the interview, a close neighbor was contacted for an interview. The refusal rate was less than 5 percent, and the replacement scheme assured a good geographic scatter. Because of the wide variation in the length and arrangement of the city blocks in the Farmington area, any systematic bias due to sampling homes in the same position on a block should be negligible. The Farmington area was chosen for the survey because it contains offices of most of the major Detroit-based financial institutions.

Coding of the Consumer Interviews

The response data from the consumer survey was key punched and key verified. The U.S. Census Address Coding Guide for the Detroit SMSA was used to attach a latitude and longitude value to each interview. When the address was missing from the Address Coding Guide, a street map of Farmington was used to estimate latitude and longitude. The error in the geocoding of the interviews is thought to be less than one-eighth mile. In a separate operation, the geographic coordinates were merged with the consumer response data.

Respondent Screening

The respondent in this survey was chosen to be the person who was responsible for at least half of the household banking or financial business.

The respondents were first screened to eliminate those who worked at a financial institution or at the advertising agency for such an institution. It was felt that those individuals' bank usage and attitude patterns might be atypical and might bias any interpretation. Those who did not use any bank, savings and loan association, or credit union were also eliminated. Since the major purpose of the study was to investigate the choice between banking offices, it was necessary to have a respondent who had made such a choice. A very small proportion of respondents were screened out based on those criteria (less than 2 percent of those contacted).

After that initial screening, several questions about shopping behavior were asked to foster rapport between interviewer and respondent in preparation for asking the relatively sensitive and difficult banking questions.

Consumer Responses

General Banking Behavior and Market Share

Question 5, "When do you bank?", was an attempt to link banking behavior with other consumer behavior (shopping) and with other repetitive behavior. The question allowed a free response, and up to three mentions were recorded for each respondent. The results are shown as Table 5.

Special trips to the bank accounted for 38.7 percent of the responses to this question. Bank visits during a shopping trip were next in importance, accounting for 27.8 percent of the mentions. Bank visits while travelling to or from work made up an additional 15.4 percent of the total. Banking during working hours accounted for 12 percent of total mentions and other responses accounted for about 6 percent.

Most responses were consistent with a model that considers distance from home to be a principal determinant of bank office patronage. The bank-at-work and bank-by-mail responses accounted for a relatively minor proportion of the total.

Tables 6 and 7 separate bank use into checking and savings accounts and show the financial institutions

TABLE 5

QUESTION 5: WHEN DO YOU BANK?*

Do you do your banking . . .	Code Value	Mentions 1	2	3	Total	Percent
When shopping for groceries	1	124	---	---	124	16.4
While doing nongrocery shopping	2	36	47	3	86	11.4
While travelling to or from work	3	104	8	4	116	15.4
During working hours	4	55	13	1	69	9.2
Special trips to bank	5	233	43	16	292	38.7
Whenever handy	6	9	1	4	14	1.9
Bank by mail	7	16	4	1	21	2.8
On pay day during work	8	3	1	1	5	.7
On Fridays or Saturdays	9	8	4	---	12	1.6
When pension check comes	0	5	---	---	5	.7
Not ascertained	10	1	477	568	---	---
First of month	11	4	1	2	7	.9
Other times	12	2	1	---	3	.4
Total		600	600	600		
Total Nonmissing		599	123	32		
Base for Percentages					754	100.0

*Up to three mentions were coded.

TABLE 6

QUESTION 8: WHICH BANK USED FOR CHECKING?

What is the name of the bank that you use for your household's primary checking account? By primary, I mean the checking account you use the most or the one you consider most important.	Code Value	n	Percent
Bank of the Commonwealth	1	48	8.5
City National Bank	2	22	3.9
Detroit Bank & Trust	3	77	13.7
Manufacturers National Bank	4	91	16.2
Michigan National Bank	5	37	6.6
National Bank of Detroit	6	215	38.3
Metropolitan National Bank	7	49	8.7
Wayne Oakland Bank	10	1	.2
National Bank of Southfield	11	10	1.8
Other area banks	14	9	1.6
Out of area banks	15	3	.5
Don't use checking	100	27	---
Refused name	101	11	---
Total		600	
Base for Percentages		562	100.0

TABLE 7

QUESTIONS 8 AND 17: WHICH INSTITUTION USED FOR SAVINGS?

Among all the places you and members of your household save, what is the name of the institution that you consider your household's primary place of savings?	Code Value	n	Percent
Bank of the Commonwealth	1	27	5.0
City National Bank	2	16	2.9
Detroit Bank & Trust	3	50	9.2
Manufacturers National	4	59	10.8
Michigan National Bank	5	31	5.7
National Bank of Detroit	6	169	31.0
Metropolitan National Bank	7	22	4.0
Security Bank (Novi)	8	1	.2
Wayne Oakland Bank	10	2	.4
National Bank of Southfield	11	4	.7
First Federal S&L	20	37	6.8
Standard Federal S&L	21	40	7.3
American S&L	22	7	1.3
Metropolitan S&L	23	4	.7
First Farmington S&L	25	10	1.8
Other banks		4	.7
Other S&Ls		9	1.7
Credit Unions		53	9.8
Refused name		---	---
Don't use savings	100	40	---
Total		600	
Base for Percentages		545	100.0

used for each of those services. The percentage of families in the survey population that use each financial institution for the appropriate service is also shown.

The National Bank of Detroit shows a strong position in this market. In Farmington, it is represented by five offices (more than any other bank), and it is the largest commercial bank in the Detroit metropolitan area.

Checking Account Habits

Questions 6 and 7 are aimed at determining the incidence of use of checking services and the number of banks families used for that service (tables 8 and 9).

Less than 5 percent of the households in the Farmington market do not use checking services. Only 16.3 percent of those who use checking use multiple banks for the service. Detailed location and reasons for using were obtained for only the primary checking account, because of time limitations in the interview. The responses to question 7 indicate that this procedure should not introduce a major bias into the analysis.

Question 9 sought to obtain a full list of reasons that a respondent had for choosing the bank which was used for the household's primary checking account. A free response was allowed, followed by interviewer probing. Up to two mentions were coded. Table 10 shows the responses to this question.

Convenience to home dominates the list of reasons for selection of a bank used for checking. That, along with

TABLE 8

QUESTION 6: USE CHECKING?

Do you or anyone in your household presently have a checking account?	Code Value	n	Percent
Yes	1	573	95.5
No	2	27	4.5
Total		600	100.0

TABLE 9

QUESTION 7: NUMBER OF BANKS USED?

How many different banks do you and other members of your household use for checking account services?	Code Value	n	Percent
1	1	475	83.8
2	2	74	13.1
3	3	13	2.3
4	4	2	.4
5 or more	5	3	.5
Refused to answer	11	6	---
Don't use any	10	27	---
Total		600	
Base for Percentages		567	100.0

TABLE 10

QUESTION 9: REASONS FOR USING CHECKING BANK, SUMMARY*

Thinking about the bank you use for your household's primary checking account, please tell me all the reasons that cause you to use this particular bank for checking account services.	Code Value	Mentions 1	Mentions 2	Total	Category	Percent	Category Percent
"Convenience"					380		42.2
Convenient to home	1	219	64	283		31.5	
Convenient to work	2	62	27	89		9.9	
Near shopping	3	2	6	8		.9	
"Service"					110		12.2
Nice personnel	5	11	29	40		4.4	
Good service	6	15	49	64		7.1	
Quick service	7	1	5	6		.7	
"Facilities, Hours"					59		6.5
Good, convenient hours	10	15	27	42		4.7	
Convenient branches	11	3	7	10		1.1	
Has drive-in service	12	2	4	6		.7	
Better parking	13	1	--	1		.1	
"Price"					71		7.9
Free, best checking	8	37	29	66		7.3	
Higher interest	9	4	1	5		.6	
"Relationship"					163		18.1
Doing business there	14	88	35	123		13.7	
Handle all our business	15	16	7	23		2.6	
Gave us a loan	16	10	7	17		1.9	
All other reasons	--	85	33	118	118	13.1	13.1
Not ascertained	101	2	243	245	245	---	---
Don't use checking	100	27	27	54	54	---	---
Total		600	600	1,200	1,200		
Base for Percentages		571	330	901	901	100.0	100.0

*Up to two mentions were coded.

other convenience factors, accounts for 42.2 percent of the reasons mentioned.

Other business relationships with the bank account for 18.1 percent of the mentions, with the quality of the service afforded at the bank receiving 12.2 percent of the mentions. Price factors and factors related to hours and facilities were next in importance to the consumer, judging from the marginal totals.

A direct measure of the degree to which a bank was used for several services was attempted with question 11. The results are shown in Table 11.

TABLE 11

QUESTION 11: ADDITIONAL SERVICES USED AT CHECKING BANK

Besides keeping your primary checking account at (name of primary bank) which of the following additional services do you use there?	n	Percent Using
Savings account	429	74.8
Bank charge card	185	32.3
Installment loan	91	15.9
Mortgage	76	13.3
Safe deposit	164	28.6
Base for Percentages	573	

The use of a single bank for both checking and savings is the most common evidence of multiple service usage in the Farmington market area. Other frequently mentioned services held at the primary checking bank were a bank charge card and a safe deposit box.

Questions 12 and 13a were asked to determine the extent to which checking and savings accounts held at the same bank were held at the same branch office. Tables 12 and 13 show the results.

TABLE 12

QUESTION 12: CHECKING BANK USED FOR SAVINGS

You mention having a savings account at (name of primary checking bank). Is this same bank also your household's primary place of savings, or do you consider another institution as your household's primary place of savings?	Code Value	n	Percent
Same bank	1	343	80.0
Another institution	2	86	20.0
No such account	10	171	
Total		600	
Base for Percentages		429	100.0

TABLE 13

QUESTION 13a: CHECKING BRANCH USED FOR SAVINGS

Do you use the same branch office for savings services as you do for checking?	Code Value	n	Percent
Yes	1	335	97.7
No	2	8	2.3
Not applicable	10	257	
Total		600	
Base for Percentages		343	100.0

The savings account at the primary checking bank was considered to be the primary savings account by 80 percent of respondents with both types of accounts, and 97.7 percent of those held both at the same branch.

The responses to question 10b give an indication of the stability of the customer base in Farmington. The results are shown in Table 14.

TABLE 14

QUESTION 10b: LENGTH OF TIME AT THIS OFFICE FOR CHECKING

Approximately how many years have you used this particular office for checking account services? Would you say . .	Code Value	n	Percent
1 or less years	1	69	12.1
About 2 years	2	69	12.1
About 3 years	3	55	9.6
4 to 5 years	4	70	12.2
6 to 10 years	5	135	23.6
More than 10 years	6	174	30.4
Don't use checking	10	27	---
Refused	11-12	1	---
Total		600	
Base for Percentages		572	100.0
Median: 5.9 years			

The median length of patronage of the primary checking office is 5.9 years and more than 30 percent of checking customers have used the same office for more than ten years. That indicates that a new banking office in Farmington would take some time to realize its equilibrium market share.

Questions 10c and 10d in Tables 15 and 16 attempt to define the proximity to home of the office used for checking. Most checking patrons in Farmington use an office close to home, with 1.6 miles as the median distance travelled.

TABLE 15

QUESTION 10c: WHERE CHECKING OFFICE IS CLOSE TO, SUMMARY

How would you describe the location of this banking office? Would you say it is close to home, close to work, on the way going to or from work, or what?	Code Value	n	Percent
Close to home	1	408	72.7
Close to work	2	56	10.0
On way to work	3	31	5.5
Close to home and work	4	30	5.3
Close to home and on way to work	5	18	3.2
Other answers	6-9	16	2.9
Not close	11	2	.4
Refused	12	12	---
Don't use checking	10	27	---
Total		600	
Base for Percentages		561	100.0

TABLE 16

QUESTION 10d: HOW FAR IS CHECKING OFFICE FROM HOME?

Approximately how many miles would this banking office be from your home? Would you estimate that it is . . .	Code Value	n	Percent	Cumulative n	Cumulative Percent
Less than a mile	1	165	28.8	165	28.8
About 1 mile	2	114	19.9	279	48.7
About 2 miles	3	139	24.3	418	72.9
About 3 miles	4	53	9.2	471	82.2
About 4 or 5 miles	5	32	5.6	503	87.8
6 to 10 miles	6	27	4.7	530	92.5
More than 10 miles	7	43	7.5	573	100.0
Don't use checking	10	27	---		
Total		600			
Base for Percentages		573	100.0		
Median: 1.6 miles					

Savings Account Habits

At present, only commercial banks compete for checking account customers in the Farmington market. For savings accounts, however, thrift institutions enter into the market. A set of questions about savings habits, similar to those about checking habits, was asked of the respondents to the survey. Table 17 shows the savings account incidence figures for the Farmington market.

TABLE 17

QUESTIONS 11 AND 15: SAVINGS INCIDENCE

Besides keeping your primary checking account at NAME OF PRIMARY BANK which of the following additional services do you use there? Do you or any members of your household have a savings account with any commercial bank, credit union or savings and loan association?	n	Percent
Use Savings	560	93.3
Do not use	40	6.7
Total	600	100.0

Question 20 was asked to determine the reasons for choosing the household's primary place of savings. The results, in Table 18, are similar to those found for choice of place of checking. One notable difference is in the increased importance of the price factor. This is to be expected, given the true differences in this rate between thrift institutions and commercial banks.

TABLE 18

QUESTION 20: REASONS FOR USING SAVINGS INSTITUTION, SUMMARY*

There are many reasons why people rely on one place to save rather than another. Thinking about your household's primary place of savings, please tell me all the reasons that cause you to make it your household's primary place of savings rather than some other institution.

	Code Value	Mentions 1	2	Total	Category	Percent	Category Percent
"Convenience"					267		32.9
Convenient to home	1	164	47	211		26.0	
Convenient to work	2	30	22	52		6.4	
Near shopping	3	1	3	4		.5	
"Service"					103		12.7
Nice personnel	5	16	32	48		5.9	
Good service	6	12	36	48		5.9	
Quick service	7	1	6	7		.9	
"Facilities, Hours"					15		1.8
Good, convenient hours	10	4	5	9		1.1	
Convenient branches	11	---	1	1		.1	
Has drive-in service	12	1	4	5		.6	
Better parking	13	---	---	---			
"Price"					121		14.9
Free, best checking	8	5	3	8		1.0	
Higher interest	9	77	36	113		13.9	
"Relationship"					201		24.8
Doing business there	14	53	23	76		9.4	
Handle all our business	15	75	30	105		12.9	
Gave us a loan	16	16	4	20		2.5	
All other reasons	--	90	14	104		12.8	12.8
Not ascertained	101	23	302	325		---	---
Don't use checking	100	32	32	64		---	---
Total		600	600	1,200			
Base for Percentages		545	266	811	811	100.0	100.0

*Up to two mentions were coded.

Table 19 shows the range of services held at the office used for savings. The most common service in this category is a checking account reflecting the fact that most savings accounts are held at commercial banks.

TABLE 19

QUESTIONS 19 AND 11: ADDITIONAL SERVICES USED AT SAVINGS INSTITUTION

Besides using the office for savings, which of the following additional services do you use there?	n	Percent
Checking account	360	64.2
Bank charge card	131	23.4
Installment loan	95	17.0
Mortgage	80	14.3
Safe deposit	128	22.9
Base for Percentages	560	

Table 20 shows the length of time that the household's primary savings account has been held at the office presently used. The median length of time is 6.7 years, somewhat longer than for checking accounts. More than a third of these accounts have been held at the same office for over ten years, reflecting the same low turnover rate seen in checking.

Table 21 shows that, as with checking services, savings services are most likely to be held close to the customer's home. The median distance, 1.9 miles, is somewhat greater than that for checking, 1.6 miles, indicating a somewhat greater willingness to travel to a remote office for this service.

TABLE 20

QUESTIONS 13c AND 18b: LENGTH OF TIME AT THIS OFFICE

And how long have you used the savings services at this particular office? Would you say . .*	Code Value	Save at Checking Bank		Save Elsewhere		All Savers	
		n	Percent	n	Percent	n	Percent
1 year or less	1	41	12.1	22	10.0	63	11.3
About 2 years	2	34	10.0	30	13.5	64	11.4
About 3 years	3	34	10.0	22	10.0	56	10.0
About 4 or 5 years	4	38	11.2	32	14.5	70	12.5
6 to 10 years	5	72	21.3	36	16.3	108	19.3
More than 10 years	6	120	35.4	79	35.7	199	35.5
Refused	12	4	---	4	---	8	---
Base for Percentages		339	100.0	221	100.0	560	100.0
Median: 6.7 years							

*The wording on question 18b was: Approximately how many years have you used this particular office for savings account services? Would you say . . .

TABLE 21

QUESTIONS 10d AND 18d: HOW FAR IS SAVINGS OFFICE FROM HOME?

Approximately how many miles would this branch office be from your home? Would you estimate that it is . .	Code Value	n	Percent	Cumulative n	Cumulative Percent
Less than 1 mile	1	138	24.7	138	24.7
About 1 mile	2	96	17.2	234	41.9
About 2 miles	3	126	22.5	360	64.4
About 3 miles	4	49	8.8	409	73.2
About 4 or 5 miles	5	43	7.7	452	80.9
6 to 10 miles	6	35	6.3	487	87.1
More than 10 miles	7	72	12.9	559	100.0
Not ascertained		1	---		
Don't use savings		40			
Total		600			
Base for Percentages		559	100.0		
Median: 1.9 miles					

The Banking Institution Survey

The banking institutions used by the sample of Farmington area families were independently surveyed.

A questionnaire was sent to each institution with a cover letter and a stamped, addressed return envelope.[1] The study was conducted during March 1976.

Five days were allowed for response from the bank officers before a follow-up telephone call was made to the

[1]The questionnaire and cover letter are shown in the appendix.

banking offices concerned. If possible, the information was collected over the telephone. Individual problems about the confidentiality of this type of information were handled by the researcher, either by reassuring the bank officer or by obtaining clearance from senior management of the bank in question for the completion of the questionnaire. In difficult cases, a visit was made to the office in question and the required data were obtained by observation.

Coding of the Banking Interviews

The data from the sample of banking offices were key punched and checked for validity by the researcher. Latitude and longitude values for each office were obtained from U.S. Geological Survey seven and one-half minute quadrangle maps. A brief analysis of these data was made and returned to those responding banks that indicated they wanted a report of the survey results.

Descriptive statistics on the variables used to build the models of patronage will be presented in Chapter 7.

Summary

The dominance of convenience as a reason for choosing a banking office for both checking and savings services indicates that, like many retail services, bank patronage behavior is distance dependent. Other attributes of the individual offices like service pricing, hours of operation, and availability of drive-up windows were also mentioned as reasons for choosing a bank, but none was as prominent as

distance. The free response structure and probing for reasons for choosing an office produced no unanticipated major reason for choosing an office. Most reasons center on the direct, measurable attributes of the banking office and will be included in the models to be built.

Chapter 7 will integrate the data from the consumer survey and from the banking office survey into models of banking office patronage. The Nakanishi-Cooper estimation technique will be used and the models of individual choice will be of the format described in Chapter 5. The models will be calibrated using a random two-thirds of the sample of households and tested upon the remaining one-third. Several hypotheses about banking spatial behavior will be presented and tested.

CHAPTER VII

A MODEL OF CONSUMER BANKING CHOICE

The survey data on consumer banking choice and the data on the attributes of the banking offices used in the Farmington Market area must be examined jointly if inferences are to be made about the effects of the office attributes upon consumer behavior. This requirement indicates the need for a multivariate model that is able to correctly handle several variables at once.

Specification and Testing

Multiple linear regression will be used to specify the coefficients of the model of consumer banking choice developed in Chapter 5. To allow specification of this model in a linear form the predictor variables will be transformed, using a logarithmic transformation. Approximately one-third of the sample interviews will be withheld and will be used to validate the regression estimates to be developed. Several hypotheses about bank consumer behavior will be tested, including the hypothesis that the developed multivariate models offer no significant increase in predictive power over random chance and over a model that uses only distance as a predictor.

Data Screening

Survey data from the six hundred respondents to the banking survey indicated that they had account relationships with 115 different banking institutions. For twenty-one of these institutions, the name or location of the office was not obtained. The set of banks in the analysis was reduced further by excluding those used only by respondents who chose their banks solely because of nearness to work because the exact location of the place of work of the respondent was not obtained. More than 90 percent of the banking relationships mentioned by respondents in the survey were useable for model construction.

Respondents were excluded if the location of their residence could not be ascertained (twelve cases) or if their only banking relationships were with banks close to work (forty-one cases). Thus, the final analysis was based on the banking relationships of 547 respondents with 74 financial institutions. A total of 22 variables was available for use. These variables are described in Table 22.

A Priori Variable Analysis

The major purpose of the model to be built is to provide a means of forecasting share of market for a new banking office using the relevant attributes of such an office. These attributes are partitioned into three groups. The first group would contain those attributes shared by all institutions of the same type (thrift institutions or commercial banks). Examples of this might be the offering

TABLE 22

DESCRIPTION OF VARIABLES

Variable Number	Variable Name	Description
1	BANKNO	Banking Office Identifier
2	SD1	Located in an office building lobby
3	SD2	Located in a shopping center
4	SD3	Located in temporary quarters
5	MACHINE	Has an automatic teller machine
6	NRSHOP	Near a full range of shopping opportunities
7	PROM	Used promotional activity this year at this office
8	SAFEDEP	1 = Offers safe deposit 0 = Does not offer
9	MORT	1 = Offers mortgages 0 = Does not offer
10	AUTO	1 = Offers auto loans 0 = Does not offer
11	TRAVEL	1 = Offers travel services 0 = Does not offer
12	RESPNO	Respondent Identifier
13	DISTANCE	Distance to banking office in miles
14	TYPE	Type of institution 0 = Commercial 1 = Thrift
15	MAINHRS	Hours per week for main floor
16	XSDRIVE	Hours of additional access at drive-in windows
17	NUMSTA	Number of teller stations at office
18	NUMOPEN	Number of teller stations usually open
19	PARKING	Capacity of parking lot
20	DRIVE	Number of drive-in windows
21	WALK	Number of walk-up windows
22	YRSTHERE	Number of years at present location
23	CKHERE	Checks at this office
24	SVHERE	Saves at this office

For complete text of questions used to create variables, see appendix

of checking accounts by commercial banks or the offering of a 5¼ percent annual rate of return on passbook savings by all thrift institutions. A second useful group would be of those attributes shared by all offices of the same bank. An example of this would be the rate structure for charging for checking services which is usually uniform between all branches of an institution. The final group of attributes would contain those that are unique to a given office at a given location. This category would contain such variables as the number of teller stations open, the availability of parking for bank patrons, and so forth.

In an effort to classify the potential predictors into the three categories mentioned, some descriptive analyses were run. They are shown in Tables 23 and 24. In the first analysis, banks were sorted into seventeen groups according to their parent institution; all branches of a bank were put into the same group. An F-Statistic was computed to test the hypothesis that those groups could be considered to be a random sample from the same universe.

In addition, the correlation ratio, ETA-squared, was computed for each variable. For Table 23, the treatment was parent institution, for Table 24, the treatment was type of bank--commercial or thrift. This statistic summarizes the proportion of the variance in the attribute that can be explained by knowing which treatment group it belongs to.

When a variable (attribute) is perfectly related to another variable, they are said to be confounded, they have

TABLE 23

ANALYSIS OF VARIANCE RESULTS USING
PARENT BANK AS TREATMENT VARIABLE

Variable	Variable Number	ETA-Squared	F Value	Significance Level*
SD1	2	.0773	.3716	ns
SD2	3	.2687	1.6301	ns
SD3	4	.1542	.8092	ns
MACHINE	5	.2473	1.4576	ns
NRSHOP	6	.1411	.7287	ns
PROM	7	.1472	.7659	ns
SAFEDEP	8	.6759	9.2548	.005
MORT	9	.4441	3.5446	.005
AUTO	10	.8301	21.6787	.005
TRAVEL	11	.1238	.6269	ns
MAINHRS	15	.7427	11.7235	.005
XSDRIVE	16	.6577	8.5277	.005
NUMSTA	17	.2424	1.4201	ns
NUMOPEN	18	.2002	1.1108	ns
PARKING	19	.3534	2.4253	.025
DRIVE	20	.3600	2.4958	.050
WALK	21	.1115	.5566	ns
YRSTHERE	22	.2104	1.1824	ns

*Degrees of freedom = 16 and 71.

TABLE 24

MEAN VALUES AND T-STATISTICS FOR ANALYSIS VARIABLES
(60 Commercial Banks; 28 Thrift Institutions)

Variable	Variable Number	Mean		SD			T Value	Sig. Level	ETA-Squared
		Banks	Thrifts	Banks	Thrifts	Total			
SD1	2	.083	.071	.279	.262	.272	.1901	ns	.0004
SD2	3	.050	.107	.220	.315	.254	.9847	ns	.0112
SD3	4	.100	.000	.303	.000	.254	1.7437	<.0500	.0342
MACHINE	5	.217	.071	.415	.262	.378	1.696	<.0500	.0324
NRSHOP	6	.700	.607	.462	.497	.473	.875	ns	.0085
PROM	7	.167	.143	.376	.356	.368	.2813	ns	.0009
SAFEDEP	8	.850	.036	.360	.189	.494	11.2416	<.0005	.5951
MORT	9	.850	.643	.360	.488	.414	2.2369	<.0250	.0550
AUTO	10	.983	.250	.129	.441	.435	11.9016	<.0005	.6222
TRAVEL	11	.233	.071	.427	.262	.388	1.8488	<.0500	.0382
MAINHRS	15	38.251	38.840	5.840	2.907	5.114	.4770	ns	.0029
XSDRIVE	16	10.717	0.0	12.913	0.0	11.759	4.3780	<.0005	.1822
NUMSTA	17	7.764	4.464	4.799	1.774	4.357	3.5217	<.0005	.1260
NUMOPEN	18	6.367	3.857	4.266	1.533	3.802	3.0151	<.0005	.0956
PARKING	19	71.083	143.464	134.851	278.647	193.851	1.6474	<.0500	.0306
DRIVE	20	1.900	.607	1.337	.737	1.322	4.7806	<.0005	.2354
WALK	21	.467	.143	1.359	.756	1.205	1.1765	ns	.0159
YRSTHERE	22	13.250	12.429	11.790	11.574	11.661	.3062	ns	.0280

a perfect correlation and any such variable may be used in an analysis as a substitute for the other(s). If more than one confounded variable is used in a regression analysis, the correlation matrix will be singular and the analysis will fail. Only one of the confounded variables may be used, and it must be understood that it acts as a surrogate for the other perfectly related variable(s).

When the correlation is substantial, but not perfect, the variables may be used in the same analysis, but no reliance may be placed upon the sign or magnitude of the regression coefficients. If the variables are nearly perfectly correlated, a near singular correlation matrix may result that will cause instability of the coefficients.[1]

Seven of the chosen variables show an effect of membership in the same parent institution significant above the 95 percent level. The hypothesis that they were drawn from the same population can be rejected. In four of the variables the effect is marked; membership in the parent bank explains from 65 to 83 percent of the variance in the variables.

Table 24 also shows the results of a t-test on the potential predictor variables between the two types of institution; commercial bank and thrift institution. The

---

[1]There is a discussion of this problem in John Johnston, Econometric Methods, 2d ed. (New York: McGraw-Hill Book Co., 1972), pp. 159-69.

group means and standard deviations are shown, along with the t-statistic and the value of the correlation ratio (ETA squared).

Eleven of the variables show a relationship with type of institution that is significant above the 95 percent level. This relationship explains more than 59 percent of the variance in two of the potential predictors.

This degree of relationship indicates that it may be difficult to assess the effects of these variables independently. They serve as a partial surrogate for the parent institution. This does not prohibit their use in a regression, but it makes interpretation of the coefficients difficult.

Table 25 shows a partitioning of variables within the framework suggested; that is, those variables most closely associated with type of institution were assigned to Category I, those most closely associated with parent institution were assigned to Category II, and the balance were assigned to Category III. The results of the previous tables and the tabulations of the survey results were used to suggest this grouping.

The Category I variables are relevant to an institution's efforts to compete for savings accounts. Clearly, some identifier of type of institution is called for, but inclusion of more than one of the other highly related variables may cause computational problems and will certainly cloud the interpretation of the regression equations.

TABLE 25

VARIANCE EXPLAINED

Variable Name	Parent Institution				Assignment to Category		
	Type	Commercial	Thrift	Total	I Type	II Parent	III Office
SD1	.0004	.0592	.1205	.0773			X
SD2	.0112	.1618	.3653	.2687			X
SD3	.0342	.1243	N.V.	.1542	X		
MACHINE	.0324	.1784	.4615	.2473	X		
NRSHOP	.0085	.1109	.1768	.1411			X
PROM	N.V.	N.V.	N.V.	N.V.			X
SAFEDEP	.5951	.2077	.1358	.6759		X	
MORT	.0550	.4063	.4181	.4441		X	
AUTO	.6222	.1102	.6327	.8301	X		
TRAVEL	.0382	.0811	.1346	.1238	X		
MAINHRS	.0029	.7768	.4135	.7427		X	
XSDRIVE	.1822	.5815	N.V.	.6577	X		
NUMSTA	.1260	.1194	.3540	.2424	X		
NUMOPEN	.0956	.0988	.4017	.2002	X		
PARKING	.0306	.0918	.4564	.3534		X	
DRIVE	.2354	.1264	.6457	.3600		X	
WALK	.0159	.0794	.2222	.1115			X
YRSTHERE	.0280	.2122	.2035	.2104			X
DISTANCE							X
TYPE					X		
				Total	8	5	7

NOTE: The underlined values are significant above the 95 percent level. N.V. indicates that the variable showed no variance within the indicated group.

The Category II variables are representative of institution-wide policy. The inclusion of these variables in a predictive equation is warranted, with the caveat that the effects of any of the strongly related variables will be difficult to separate from the effects of any other bank-wide policy.

The Category III variables are attributes unique to any given banking office. They are not confounded by a close relationship with type of institution or the policy and image factors associated with each individual institution. The interpretation of the effect of Category III variables should be straightforward.

The Data Matrix

The data matrix used to calibrate the model consisted of observation on each competing institution by each of the 364 respondents in the calibration sample. This resulted in a total of 17,472 observations for the checking data and 26,936 observations on the savings data. This assumes that each respondent had some finite probability of checking at each of the forty-eight commercial banks serving the Farmington market and some finite probability of saving at each of the seventy-four banking offices serving the market. The regression formulation may be interpreted as predicting the probability of patronage at each of the offices, given the distance from the respondent's home to each banking office and considering the attributes of each banking office.

Hypothesis Testing

The Farmington survey data allows testing of several hypotheses about choice of a bank for retail banking services. Formally stated, these are:

H_1: Bank patronage is essentially uniform over distance.

H_2: The differences between commercial banks and thrift institutions are not relevant in predicting office patronized for savings services.

H_3: The number of years an office has been open has no effect upon likelihood of patronizing that office.

H_4: Indicators of size have no explanatory power in predicting patronage.

H_5: The explanatory power of a model that considers several banking office attributes simultaneously is essentially the same as that of a random model.

Discussion of Hypotheses

H_1. Previous work in the field of bank marketing and the bulk of the literature in economic geography indicate that distance is a strong factor in predicting patronage. It is expected that the data will allow H_1 to be rejected.

H_2. If banking consumers behave as income maximizers, they might be expected to patronize thrift institutions for savings accounts because of the favorable interest differential. Conversely, commercial banks offer a consumer the opportunity to use other services at the same location. This hypothesis states that the net effect of these forces will not be zero.

H_3: The number of years a banking office has been open might influence market share in two ways. If account turnover is quite low, a banking office's share of market would be slow to respond to new market entrants, giving it a higher market share than might be expected under the circumstances. Another benefit of longevity at a location is the added exposure and familiarity the office gains among the consumers. It is expected that the net effect of length of time an office has been open will be positive.

H_4: Prior research indicates[1] that measures of size of a retail outlet are useful in predicting patronage. For a banking office, these measures fall into two categories. First are those relevant to the office itself, such as number of teller stations open to serve customers, and second are those that are relevant to the parent organization, such as total share of market or total number of offices operated. The effect of size upon likelihood of patronage should be positive.

H_5. It is expected that a model which includes the effects of distance, type of institution and other relevant variables will be more powerful than a random model.

---

[1]Bennett, Bank Location Analysis, p. 85; Reilly, Methods for Study, p. 48; Huff, A Probabilistic Analysis of Consumer Spatial Behavior.

Appropriate Parameters for Significance Tests

In this study, the appropriate market for each service was considered to be all banks used by Farmington residents for that service (excluding banks used solely by patrons who bank near work). If all banks have a finite probability of use by each respondent in the survey, then it is appropriate to use all observations of behavior and bank attributes for significance testing and model building.

If some clear subset of the banks in the market constitutes the relevant market for bank services to each potential customer, then all banking offices not relevant for the individual respondent should be deleted from the data matrix, and the model should be specified with the reduced set of observations. If, for example, only the closest ten banking offices were considered for patronage, or if consumers never travelled more than four miles to a banking office, all banking offices not suitable for patronage by individual consumers would be deleted from the data matrix.

Although such a screening mechanism might exist for consumers in the Farmington market, the exact parameters of it are not clear. For this reason, and to prevent biasing the model toward some arbitrary selection scheme, significance testing and model building were undertaken based on the assumption that a nonzero probability of use for savings existed for all offices of financial institutions

in the market area and a nonzero probability of use for checking existed for all commercial banks.

Under this assumption, there are 17,472 observations of checking office choice and 26,936 observations of savings office choice inherent in the data.

This approach is consistent with that used by the Institute for Social Research in the programs used there for analysis of nominally scaled data by regression techniques.[1]

Unlike the ISR programs, the model under consideration here uses both nominal and interval scaled predictors. It assumes that a log additive model is appropriate instead of an additive model. This model, because of the transformed dependent variable, produces logically consistent results; that is, no predicted probability of patronage will be less than zero or greater than one.[2]

Tests of Hypotheses

For variables in this study that are not seriously confounded with parent organization, a t-test of the significance of the simple product moment correlation coefficient with the indicators of patronage is appropriate. These statistics are shown as Tables 26 and 27.

---

[1]See, for example: Frank M. Andrews and Robert C. Messenger, Multivariate Nominal Scale Analysis (Ann Arbor, Mich.: Institute for Social Research, 1973).

[2]Ibid., pp. 46-47.

TABLE 26

CORRELATIONS WITH SAVINGS (n = 26,936)

Variable Number	Variable Name	R	T	Significance
		Category I		
4	SD3	-.018	-2.95	<.0025
5	MACHINE	-.008	-1.31	n.s.
10	AUTO	.043	7.06	<.00025
11	TRAVEL	.096	15.83	<.00025
16	XSDRIVE	-.001	- .16	n.s.
17	NUMSTA	.042	6.90	<.00025
18	NUMOPEN	.034	5.58	<.00025
		Category II		
8	SAFEDEP	.058	9.53	<.00025
9	MORT	.055	9.04	<.00025
15	MAINHRS*	-.330	-57.37	<.00025
19	PARKING	-.055	-9.04	<.00025
20	DRIVE	.066	10.96	<.00025
15	TYPE	-.050		
		Category III		
2	SD1	-.033	-5.42	<.00025
3	SD2	-.029	-4.76	<.00025
6	NRSHOP	.048	7.89	<.00025
7	PROM	----	----	
20	DRIVE	.066	10.86	<.00025
21	WALK	.008	1.31	n.s.**
22	YRSTHERE	.063	10.36	<.00025
13	DISTANCE	-.158	-26.26	<.00025

*Within the Farmington market area there is a strong (-.5577) correlation between share of market and hours of operation of the main banking floor. This alone would cause the expected correlation on this variable to be negative.

**N.S. indicates that the correlation was not significant at the .10 level.

TABLE 27

CORRELATIONS WITH CHECKING (n = 17,472)

Variable Number	Variable Name	R	T	Significance
		Category I		
4	SD3	-.031	-4.10	<.00025
5	MACHINE	-.026	-3.44	<.00025
10	AUTO	.035	4.63	<.00025
11	TRAVEL	.111	14.76	<.00025
16	XSDRIVE	-.033	-4.36	<.00025
17	NUMSTA	-.040	-5.29	<.00025
18	NUMOPEN	.040	5.29	<.00025
		Category II		
8	SAFEDEP	.038	5.03	<.00025
9	MORT	.057	7.55	<.00025
15	MAINHRS	-.249	-33.98	<.00025
19	PARKING	.005	.66	n.s.
20	DRIVE	.051	6.75	<.00025
		Category III		
2	SD1	-.039	-5.16	<.00025
3	SD2	-.026	-3.44	<.00025
6	NRSHOP	.061	8.08	<.00025
7	PROM	----	----	----
20	DRIVE	.051	6.75	<.00025
21	WALK	-.010	-1.32	n.s.
22	YRSTHERE	.088	11.68	<.00025
13	DISTANCE	-.186	-25.02	<.00025

NOTE: Competitors within the checking market are all commercial banks, so Category I is not meaningful for competition for checking. It is presented merely to retain compatibility with the format for the savings results.

This information enables us to test several of the formal hypotheses.

H_1. Among the Category III predictors, distance is the strongest and is highly significant. H_1 may be rejected, in accord with prior research.

H_2. Among the predictors in Category II type of institution is significant and the negative sign indicates

a net benefit for commercial banks in competing for savings customers. H_2 may be rejected.

H_3. Number of years in a given location is significantly associated with patronage for both checking and savings services. The direction is positive as anticipated. H_3 may be rejected.

H_4 and H_5. Tests of the effects of size and of the explanatory power of a multivariate model of patronage are not appropriate given univariate statistics, and may be made only after specification of the multivariate model. The results of tests are these hypotheses will be presented after such a model has been developed and tested.

OSIRIS

Before each variable was entered in the regression program, it was transformed according to the estimation procedure described in Chapter 5. For the ratio or interval scaled variables, the transformed variable used was the natural logarithm of the original value. For nominal scaled variables (style of building, offering of mortgage service, etc.) the variables were first transformed by raising the number e (the base for natural logarithms) to the first power if the attribute was present and to the zero power if it was not present. The variable was then transformed by taking the natural logarithm of this new variable. This procedure was necessary to avoid taking the logarithm of zero, an undefined procedure.

Statistical Significance Testing

In selecting the variables used for the final model, the statistics supplied by the statistical package OSIRIS were used as a guide in rejecting or accepting variables. Several of the variables were logarithmic transformations, while the balance were dummy variables, so the distribution of errors in the model is subject to question. Ordinary least squares regression estimates were desired because of the simplicity of the data input required and the low cost of computing these estimates. Nakanishi has shown the robust nature of ordinary least squares regression in dealing with these departures from its assumptions.[1]

Still, the final test of the predictive model is its efficiency in classifying cases not used to calibrate the model. To accomplish this test, a random third of the original sample was held out to use in testing the final model. These cases were not used in selecting the best set of predictive variables nor were they used to determine coefficients of the models developed.

The Nature of the Dependent Variable

The dependent variable used for the regressions in this study was a zero-one variable, coded one for the institutions where the respondent maintained a relationship

---

[1]Nakanishi and Cooper, "Parameter Estimation for a Multiplicative Competitive Interaction Model-Least Squares Approach," pp. 303-11.

and coded zero where the respondent did not maintain a relationship.

The use of such a variable as a proxy for a percentage in disaggregated data is customary in ordinary regressions.[1]

However, in a situation where a logarithmic transformation must be used to fit an equation, a zero-one dummy variable is not appropriate because the logarithm of zero is undefined. This problem is customarily solved by transforming the variable in some way. The transformation chosen for this study involved adding a very small number to the dummy variable, which yields values of either slightly greater than zero or slightly greater than one. This transformation is defined for both values of the dummy variable and the interpretation of the variable as indicating patronage or lack of patronage is unchanged.

Computationally, any consistent transformation of the dependent variable would yield the same correlations, since the correlation coefficients are covariance measures of standardized variables with a mean of zero and unit standard deviation.

The choice of an additive transformation does, however, change the magnitude of the raw score regression

---

[1]See, for example, a description of Multiple Classification Analysis in OSIRIS III Vol. I System and Program Description (Ann Arbor, Michigan: Survey Research Center, Institute for Social Research, University of Michigan, 1973), pp. 575-86.

weights, i.e., the B weights. B weights are obtained by multiplying the Beta weights by the standard deviation of the dependent variable and dividing by the standard deviation of the predictor variable.[1] That is:

for j predictors of y

$$B_j = \beta_j \frac{\sigma y}{\sigma_j}$$

This implies that the Beta weights for a set of variables are invariant on any order-preserving transformation of the dichotomous dependent variable, but that the B weights are only unique up to a multiplicative transformation. The relative magnitude and the sign of the B weights remains constant, but the absolute magnitude depends upon the particular transformation chosen.

This implies that the coefficients may be tested for significance in the normal fashion, but that any variance from a theoretical absolute value is not meaningful. Once again, the final test of the utility of the model is its predictive efficiency on the validation sample.

Model Specification

The regression program from the OSIRIS statistical package was used to specify the model coefficients. The

---

[1]William W. Cooley and Paul R. Lohnes, Multivariate Data Analysis (New York: John Wiley & Sons, Inc., 1971), p. 69.

stepwise regression feature was used to select the predictors used in the equations.

Regressions on Savings Behavior

Table 28 shows the results of a stepwise multiple linear regression using the set of variables describing the banks and one additional behavioral variable. The respondent reported the location of his checking account and that was allowed to enter as a predictor of his savings behavior. No variables were excluded on any a priori grounds. This equation should show the maximum possible explained variance, given the variable set, and has some value for indicating possible problems of multicollinearity in the predictor set. The stepwise procedure was halted when no additional predictor could contribute as much as 0.1 percent to additional explained variance.

These results indicate that knowledge of the location of a consumer's checking account supplies the most information about the location of his savings account. This variable cancels the influence of "type of institution" (obviously, the two variables are related strongly).

Next in importance is the number of hours per week that the main floor of the banking office is open. The strong negative sign on this variable is not as expected. This variable is strongly confounded with parent institution and may be considered to be a surrogate variable for parent institution. In examining the individual values for this variable, it was discovered that the largest institution in

TABLE 28

SAVINGS RESULTS OF MULTIPLE STEPWISE REGRESSION, ALL BANK OFFICE VARIABLES AND LOCATION OF CHECKING

Variable Number	Variable Name	Beta	Std. Error Beta	T	Step Entered
23	CKHERE	.4017	.0056	71.73	1
15	MAINHRS	-.1979	.0058	-34.12	2
11	MACHINE	.0802	.0052	15.42	3
13	DISTANCE	-.1018	.0058	-17.55	4
17	NUMSTA	.0810	.0056	14.46	5
16	XSDRIVE	-.0976	.0059	-16.54	6
20	DRIVE	.0495	.0063	7.86	7

Step 7
F Ratio for the Regression 1582.553
R-Squared .29148
Residual Degrees of Freedom 26,928

the market, National Bank of Detroit, was consistent in offering the least access to its main banking floor. This fact would lead to a strong negative coefficient for this variable.

Third in importance in this equation is distance from the respondent's home to the banking office. This variable is significant in its effect, but less important than the effect of other banking relationships or of market dominance.

Three of the other variables behave as anticipated. There is a significant, positive benefit to the bank in offering "drive-up" banking, additional teller stations, and automated teller services.

The sign on the coefficient of the variable representing the additional access afforded by the drive-in teller stations is not in the anticipated positive direction. Again, interpretation is clouded by the multicollinear nature of the predictor set. Examination of the data shows that there is no variance on this measure for thrift institutions. This variable is somewhat confounded by type of institution.

In an effort to avoid the highly collinear predictors, another regression was run. The results are shown in Table 29.

TABLE 29

SAVINGS RESULTS OF MULTIPLE STEPWISE REGRESSION, RESTRICTED VARIABLE SET

Variable Number	Variable Name	Beta	Std. Error Beta	T	Step Entered
13	DISTANCE	-.1617	.0061	26.51	1
14	TYPE	-.0398	.0061	6.52	2
11	TRAVEL	.1001	.0061	16.41	3
22	YRSTHERE	.0260	.0061	4.26	4

Step 4
F Ratio for the Regression 271.752
R-Squared .03880
Residual Degrees of Freedom 26,931

The type of institution variable was included, and variables most highly related to type (number of teller stations and number of extra hours of service at drive-up windows) were excluded. The variable for the number of

hours the main office is open was included as a variable representing the influence of the parent institution and other variables highly related to this influence (offering of automobile loans, availability of safe deposit service, and offering of mortgages) were excluded.

The variables indicating style of office were excluded because their inclusion caused computational problems with the stepwise algorithm. Evidently, some linear combination of predictors can predict the style of building perfectly. These variables exhibit modest correlations with the dependent variable and their exclusion should have little effect on the predictive ability of the model. The variable for use of promotion at the office in this year showed no variance at all in the seventy-four banks in the final sample, and was excluded for this reason.

In this regression, although the explained variance is reduced, the use of more nearly uncorrelated predictors results in a clearer picture of the relationship between the banking office variables and the savings behavior of the banking patron.

Patronage of an office falls off with increases in distance, as expected. The dummy variable for type of institution has a negative coefficient, indicating a preference for commercial banks, which were coded zero, over thrift institutions, which were coded one. Apparently, the added convenience of access to other banking services not available at thrift institutions, primarily checking

services, outweighs the interest rate differential on savings accounts available at thrift institutions. The savings consumer is more likely to patronize a banking office offering travel services.

Finally, older banking offices have more patrons. This may be because of the inertia of the savings customer in changing offices for his savings account, or because old established offices are relatively more familiar.

Although the explained variance of this equation is more modest than the equation allowing all potential variables to enter, data on all of the variables in this equation are available to the banker by observation, and these data are relatively stable over time. In addition, the variable indicating the number of years a branch has been open allows consideration of the effect of time open on a new office's performance. Certainly, the effect of distance and other account relationships upon a consumer's choice of banking office predominates.

Regressions on Checking Behavior

Fortunately, a greater variety of predictor variables is available for use in calibrating a checking model. Those variables that are highly confounded with type of institution when predicting savings behavior are available for use in a model that seeks to explain the choice of an office for checking.

Table 30 shows the results of predicting office patronage for checking services. The most powerful predictor

TABLE 30

CHECKING RESULTS OF MULTIPLE STEPWISE REGRESSION, ALL BANK OFFICE VARIABLES AND LOCATION OF SAVINGS

Variable Number	Variable Name	Beta	Std. Error Beta	T	Step Entered
24	SVHERE	.5546	.0063	88.03	1
13	DISTANCE	-.0992	.0063	-15.75	2
11	TRAVEL	-.0871	.0062	-14.05	3

Step 3
F Ratio for the Regression 2946.299
R-Squared .33599
Residual Degrees of Freedom 17,468

is the variable denoting whether or not the customer holds his savings account at the same office. This reflects the dominant tendency for Farmington households to hold checking and savings accounts at the same office.

Distance from the respondent's residence to the banking office was an important predictor in this equation, as expected, reflecting a tendency for patronage to fall off as distance increases.

An unanticipated result in this equation was the negative sign on the variable representing the offering of travel services. In the savings equations the variable had a positive coefficient. The simple correlations of this variable with checking and savings patronage is positive, so the change in sign may be the result of multicollinearity.

Table 31 shows the results of predicting choice of a checking office omitting variables not usually available

TABLE 31

CHECKING RESULTS OF MULTIPLE STEPWISE REGRESSION, RESTRICTED VARIABLE SET

Variable Number	Variable Name	Beta	Std. Error Beta	T	Step Entered
13	DISTANCE	-.2705	.0091	-29.73	1
19	PARKING	-.0882	.0094	- 9.38	2
20	DRIVE	-.0181	.0097	- 1.87	3
11	TRAVEL	-.0191	.0074	- 2.58	4
17	NUMSTA	.0463	.0080	5.79	5

Step 5
F Ratio for the Regression 198.070
R-Squared .05366
Residual Degrees of Freedom 17,466

early in the banking office location decision (incidence of having a savings account at any banking office in the market area) and the variables that are related heavily to the policies of the parent institution.

As in savings behavior, distance from home to the office in question predominates as a predictor variable. The other potential predictors add only nominal predictive power.

The next strongest predictor (using the absolute magnitude of the Beta weights as an indicator of strength) is the variable indicating availability of parking. The negative sign on this variable is not as anticipated and is apparently a reflection of the fact that the bank branches in this market that offer a large parking area are more remote from the center of population of the market.

A positive relationship is indicated between patronage and the number of teller stations, while the likelihood of patronage is reduced somewhat by additional drive-in window service and the offering of travel services. This effect is slight, compared to the effect of distance upon patronage, and may indicate that the banks which are aggressively competing for market share by offering many drive-in windows and parking spaces have smaller market shares now and have not as yet reaped the rewards of their strategy. It is not possible to examine this hypothesis using the available cross-section data.

As a basis for comparison, Table 32 shows the results of four single variable regressions. The distance variable alone is used to predict checking and savings behavior, the incidence of using checking services at an office is used to predict choice of an office for savings, and the incidence of using savings services is used to predict choice of an office for checking. These regressions can serve as a basis for judging the marginal value of the additional predictors in the regression models.

Table 33 summarizes the predictive power of the regressions to explain choice of an office for the two services.

Obviously, the best predictor of consumer behavior is knowledge of a closely related behavior. The best predictors of choice of an office for checking services is knowing the consumer's choice of an office for savings

TABLE 32

RESULTS OF FOUR SINGLE VARIABLE REGRESSIONS

Distance as a predictor of: CHECKING

F Ratio for the Regression 798.168
R-Squared .04369
Residual Degrees of Freedom 17,470

Variable Number	Variable Name	Beta	Std. Error Beta	T
13	DISTANCE	-.2090	.0074	28.24

Distance as a predictor of: SAVINGS

F Ratio for the Regression 690.241
R-Squared .02499
Residual Degrees of Freedom 26,934

Variable Number	Variable Name	Beta	Std. Error Beta	T
13	DISTANCE	-.1581	.0060	26.35

Incidence of Complimentary Service as a Predictor

USAGE OF SAVINGS AT AN OFFICE AS A PREDICTOR OF CHOICE OF THAT OFFICE FOR CHECKING

F Ratio for the Regression 8119.935
R-Squared .31731
Residual Degrees of Freedom 17,470

Variable Number	Variable Name	Beta	Std. Error Beta	T
24	SVHERE	.5633	.0063	89.41

Incidence of Complimentary Service as a Predictor

USAGE OF CHECKING AT AN OFFICE AS A PREDICTOR OF CHOICE OF THAT OFFICE FOR SAVINGS

F Ratio for the Regression 8378.041
R-Squared .23726
Residual Degrees of Freedom 26,934

Variable Number	Variable Name	Beta	Std. Error Beta	T
23	CKHERE	.4871	.0053	91.91

TABLE 33

SUMMARY STATISTICS ON REGRESSIONS

	Predictors	Number of Predictors	Variance Explained
Regressions Predicting Choice of an Office for SAVINGS			
1	CKHERE	1	23.726%
2	DISTANCE	1	2.499%
3	CKHERE MAINHRS MACHINE DISTANCE NUMSTA XSDRIVE DRIVE	7	29.148%
4	DISTANCE TYPE MACHINE YRSTHERE	4	3.880%
Regressions Predicting Choice of an Office for CHECKING			
1	SVHERE	1	31.731%
2	DISTANCE	1	4.369%
3	SVHERE DISTANCE TRAVEL	3	33.599%
4	DISTANCE PARKING SAFEDEP DRIVE TRAVEL NUMSTA	6	5.447%

services rather than the attributes of the choice chosen.

This variable is questionable, however, in actually explaining the choice process. Presumably, a banking customer frequently chooses an office with a fairly complete knowledge of the services he will use at the office and his choice is determined at the point of market entry by his preferences for the various attributes available.

The tendency to hold both services at the same office merely reflects the consumer's desire for convenience in his banking relationships.

Additionally, the knowledge of the exact banking office chosen for all customers in a bank's service area is not available to the decision makers at either the financial institution or at the regulatory agencies.

For a variable to be identified as being important to a consumer in the choice of a banking office in a study like this, it must first be relevant to the consumer's choice of a banking office, and then it must show sufficient variance in the market area to influence a number of consumers. Distance, as a measure of convenience, showed these properties. The convenience of using a single office for several banking relationships also showed these properties, although the implementation of this dimension of convenience in a usable market model is difficult or impossible. Type of banking office (thrift or commercial bank), as a surrogate for the differing service packages available at the two

institutions and other attributes such as rates, was a powerful predictor of choice of an office for savings.

In the regressions excluding incidence of use of the office for another service, distance is clearly the strongest predictor. The balance of the predictive variables add a marginal 1.381 percent explained variance in the savings equations and a marginal 1.078 percent in the checking equations.

No available indicator of marketing effort is more important than distance as a predictor of patronage.

Overview of Regression Equations

In each of the regression equations, distance was an important variable. This is to be expected because of the large negative correlations between patronage and distance. When used as a predictor, the incidence of use of a companion service at a given banking office adds considerable predictive power to the equations. The influence of this variable is almost certainly overstated because the variable is not available in advance of an office's opening to serve as a predictor of patronage and because, to a large extent, it merely reflects the influence of the true behavioral predictors (represented in the models by the regression independent variables) and may not be used as a determinant of behavior. Its use as a predictor of behavior should be limited to the extent that it reflects the convenience afforded the consumer of holding several services at a single office. As there is no way to determine this

portion of the influence, the regressions are presented with the warning that they should merely serve as an upper bound for judging the effectiveness of the other models.

The balance of the predictive variables added some predictive power to the equations. The type of institution variable, especially, served as an effective surrogate for that group of attributes that may be used to distinguish between commercial banks and thrift institutions. The effect of this variable was uniform in indicating a consumer preference for commercial banks, after controlling for distance and other institutional differences.

The variables in Category II, those that represented institution-wide policy, in general showed significance in predicting patronage, although the signs of the regression coefficients did not always conform to prior hypotheses. In particular, the negative sign attached to the variable indicating the number of hours a week an office was open to serve the public, was highly significant and not in the hypothesized direction. As mentioned, there is a significant negative correlation, in the Farmington market area, between market share and that variable, with the bank holding the highest market share uniformly open the fewest hours.

A very tentative hypothesis might be offered on this observation. It could be that the older, established banks with larger market shares choose not to compete by the relatively costly procedure of offering additional floor

access while the newer, smaller institutions are willing to remain open longer to gain business. This hypothesis would require observation over time to confirm finally, but the significant negative correlation of -.3152 (significant at the 98 percent level) between the main floor hours variable and the years at location variables indicates this may be the case.

At a minimum, Category III variables may be thought of as representing the marketing policy of the parent institution and the significance of several of these variables as predictors of patronage suggest that the effect of these variables is apparent.[1] Because of the contradictory signs and the confounded nature of these variables, no formal rejection of H_4 is made. Evidently, there is an effect upon the patronage to be expected by the banking office of a group of policies determined by a parent organization.

The overall interpretation of the Category III variables, those unique to an individual office, is consistent with the univariate statistics on these variables. Distance dominates the other variables in this category as a predictor of patronage. The other variables in the category supply significant marginal predictive power, in the hypothesized direction. Thus, H_5 may be rejected, on

---

[1]Formally H_4 was stated as: Indicators of size have no explanatory power in predicting patronage.

the grounds that the multivariate behavioral model shows significant power in predicting banking office choice.[1]

Although these statistics show a significant relationship in the two-thirds of the sample used to build the regression model, the actual predictive power should be judged by using the model to predict the banking office choice of the one-third of the sample not used to specify the model coefficients.

The Inverse-Distance-Squared Model

Prior research in spatial attraction cited earlier, especially that by Reilly, Converse and Huff, postulates that market share is a function of some measure of size of a retail outlet, coupled with some measure of distance from the consumer. The measures of size represent the presence of variety of goods available and the measures of distance represent the level of inconvenience to the customer in getting to the retail outlet.

It might be argued that in retail banking, especially for commercial banks, all retail outlets are of the same size. That is, they offer very similar, if not identical, service packages at very similar prices.

In their formulations of distance as a surrogate for inconvenience, Reilly and Converse used an inverse-

---

[1]Formally H_5 was stated as: The Explanatory power of a model that considers several banking office attributes simultaneously is essentially the same as that of a random model. The regression results reported in Tables 24 and 31 allow a strong rejection of this hypothesis.

distance-squared term. Huff and other recent researchers allow the exponent to vary; values closer to zero represent "shopping goods" and values more negative than -2 represent "convenience" goods that the customer will not travel far to find. In a model that predicts individual behavior such as the one under consideration, the exact value of the exponent on distance is immaterial, as any negative exponent will cause the same rank ordering of banking offices.

Since most previous research indicated the importance of distance as the primary factor, a model using distance alone as the predictor of banking choice was developed first.

This model is:

$$P_{ij} = \frac{\frac{1}{D_{ij}^2}}{\sum_k \frac{1}{D_{ik}^2}}$$

for the i-th consumer and the j-th out of k banking offices.

No statistical procedures were used to calibrate this model, so the model may appropriately be run on the entire data matrix. However, to provide a standard for comparison for the models built using statistical procedures, this model was run on the one-third of the entire sample reserved for validating the models built in this study.

Results on the Validation Sample

To judge the power of the models specified and to make statistical inferences about the superiority of one model over another, three models for predicting savings

office choice and three models for predicting checking office choice were run on the validation interviews.

For each service the first model run used distance as the only predictor of patronage, assuming that the respondent's choices of office were rank-ordered by the office's distance from his home.

The next model used the knowledge of which office the respondent used for the companion service (checking for the savings models and savings for the checking models) as a predictor, along with other variables (including distance).

The third model used a restricted set of predictors, only those that would be available before the opening of a proposed new office.

Three sets of statistics are presented for each model. First, the plot of the predicted rank of the bank actually used by the respondent. If the model predicted with no error, all offices actually used would be predicted at rank one. In the case of random assignment, the graph would show a uniform distribution. The cumulative distribution of ranks is shown, and was used to compute a Kolmogorov-Smirnov statistic testing the difference between the distributions obtained from each model.

The next result presented for each model is an analysis of variance testing the hypothesis that the probability of patronage assigned to offices actually used did not differ from the probability assigned to offices not used.

Finally, an analysis of variance of rank between offices used and offices not used is presented. The F statistic shown tests the hypothesis that the average rank of offices used and that of offices not used is equal.

Validation of the Savings Model

Table 34 shows the results of an analysis of variance on the two regression models and the distance alone model for savings. The offices not used by the respondents in the validation sample were coded one and the offices actually used were coded two. In each case, the hypothesis of random assignment may be strongly rejected.

TABLE 34

ANALYSIS OF VARIANCE RESULTS: SAVINGS MODELS

Analysis of Variance on Predicted Probability of Use of Office by Actual Use, All Bank Office Variables and Location of Checking

Univariate 1-WAY ANOVA
Analysis of Variance of 1.PRBSV N=13542 out of 13542

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	.39067 -1	.39067 -1	2958.0	0.
Within	13540	.17882	.13207 -4		
Total	13541	.21789	(Random effects statistics)		

ETA=.4234 ETA-Sqr=.1793 (Var Comp=.82829 -4
%Var Among=86.25)

IFSV	N	Mean	Variance	Std Dev
(1)	13302	.13285 -1	.12118 -4	.34810 -2
(2)	240	.26159 -1	.73826 -4	.85922 -2
Grand	13542	.13514 -1	.16091 -4	.40114 -2

TABLE 34--Continued

Analysis of Variance on Rank Assigned to Office by Actual Use, All Bank Office Variables and Location of Checking

Univariate 1-WAY ANOVA
Analysis of Variance of 5.RNKSV N=13542 out of 13542

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	.21892 +6	.21892 +6	497.38	0.
Within	13540	.59596 +7	440.15		
Total	13541	.61785 +7	(Random effects statistics)		

ETA=.1882 ETA-Sqr=.0354 (Var Comp=463.38 %Var Among=51.29)

IFSV	N	Mean	Variance	Std Dev
(1)	13302	38.040	444.55	21.084
(2)	240	7.5667	195.09	13.967
Grand	13542	37.500	456.28	21.361

Analysis of Variance on Predicted Probability of Use of Office by Actual Use, Restricted Variable Set

Univariate 1-WAY ANOVA
Analysis of Variance of 1.PRBSV N=13542 out of 13542

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	.10400 -1	.10400 -1	690.06	0.
Within	13540	.20406	.15071 -4		
Total	13541	.21447	(Random effects statistics)		

ETA=.2202 ETA-Sqr=.0485 (Var Comp=.22026 -4 %Var Among=59.37)

IFSV	N	Mean	Variance	Std Dev
(1)	13302	.13396 -1	.14872 -4	.38564 -2
(2)	240	.20038 -1	.26184 -4	.51170 -2
Grand	13542	.13514 -1	.15838 -4	.39797 -2

TABLE 34--Continued

Analysis of Variance on Rank Assigned to Office by Actual Use, Restricted Variable Set

Univariate 1-WAY ANOVA
Analysis of Variance of 5.RNKSV N=13542 out of 13542

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	.16580 +6	.16580 +6	373.37	0.
Within	13540	.60127 +7	444.07		
Total	13541	.61785 +7	(Random effects statistics)		

ETA=.1638 ETA-Sqr=.0268 (Var Comp=350.71
%Var Among=44.13)

IFSV	N	Mean	Variance	Std Dev
(1)	13302	37.970	447.78	21.161
(2)	240	11.450	237.45	15.409
Grand	13542	37.500	456.28	21.361

Analysis of Variance on Predicted Probability of Use of Office by Actual Use, Distance Alone

Univariate 1-WAY ANOVA
Analysis of Variance of 1.PRBSV N=13542 out of 13542

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	.54764	.54764	299.01	.0000
Within	13540	24.799	.18315 -2		
Total	13541	25.346	(Random effects statistics)		

ETA=.1470 ETA-Sqr=.0216 (Var Comp=.11576 -2
%Var Among=38.73)

IFSV	N	Mean	Variance	Std Dev
(1)	13302	.12659 -1	.17059 -2	.41303 -1
(2)	240	.60857 -1	.88226 -2	.93929 -1
Grand	13542	.13514 -1	.18718 -2	.43265 -1

TABLE 34--Continued

Analysis of Variance on Rank Assigned to Office by Actual Use, Distance Alone

Univariate 1-WAY ANOVA
Analysis of Variance of 5.RNKSV N=13542 out of 13542

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	.11299 +6	.11299 +6	252.21	.0000
Within	13540	.60656 +7	447.97		
Total	13541	.61785 +7	(Random effects statistics)		

ETA=.1352 ETA-Sqr=.0183 (Var Comp=238.68
%Var Among=34.76)

IFSV	N	Mean	Variance	Std Dev
(1)	13302	37.888	451.69	21.253
(2)	240	15.996	241.03	15.525
Grand	13542	37.500	456.28	21.361

Figure 7 shows a graph of the cumulative probability density functions of each of the savings office choice models.[1] The Kolmogorov-Smirnov test for the difference between two distributions is appropriate for testing if two sample populations actually differ.[2] The computation involves finding the maximum difference (D) between two cumulative probability density functions and comparing this value with a critical value for a given level of confidence. Table 35 shows the maximum differences between each of the curves and the critical values of D.

[1]A complete listing of the values used to construct this graph is shown in the appendix.

[2]Bernard W. Lindgren, Statistical Theory, 2d ed. (New York: MacMillan Publishing Co., Inc., 1968), pp. 329, 335.

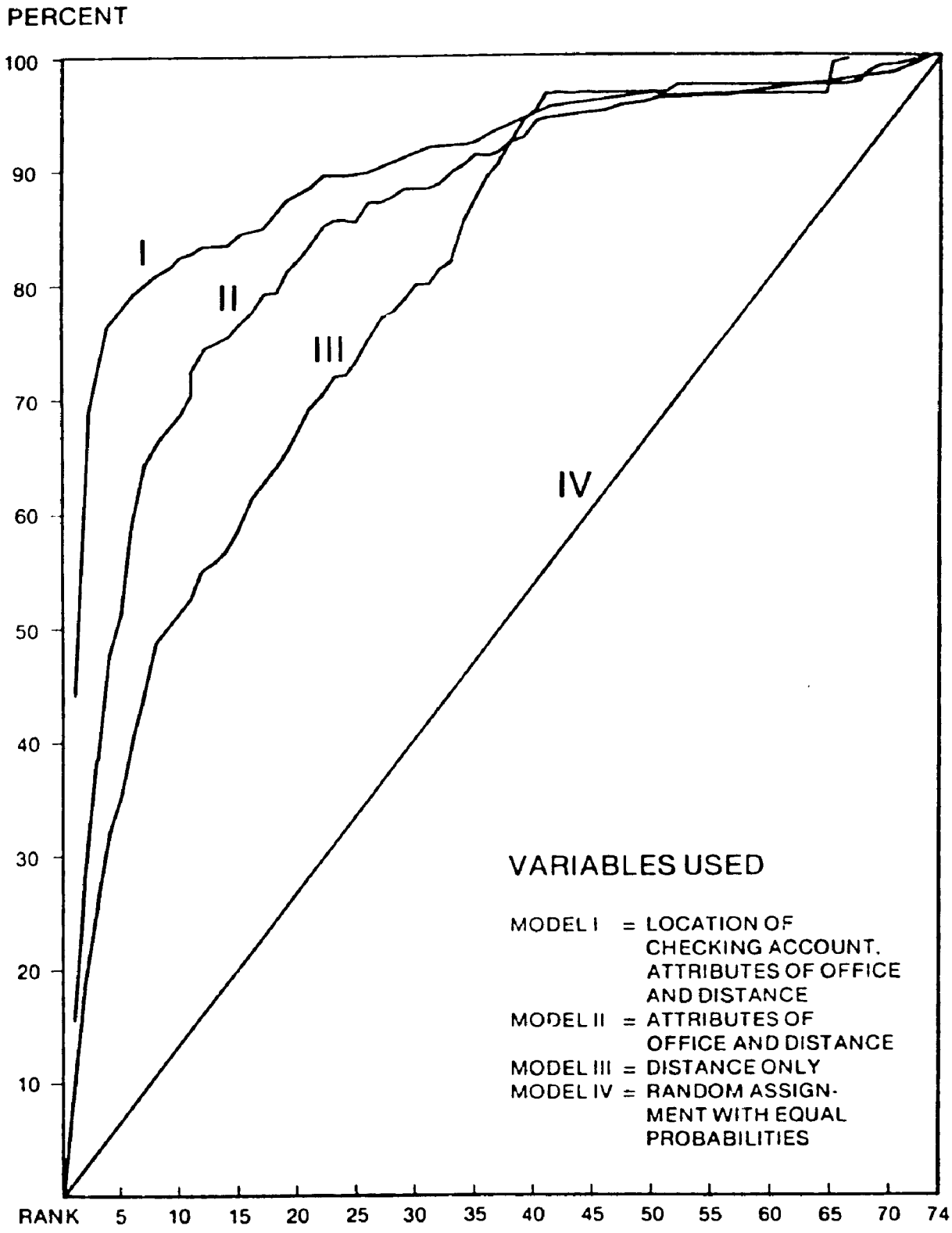


Fig. 7. RANK OF BANK ACTUALLY USED FOR SAVINGS (CUMULATIVE PERCENTAGES)

TABLE 35

KOLMOGOROV-SMIRNOV TESTS

	Value of D			
	I	II	III	IV
Model I	-	-.505	-.204	.411
Model II		-	.409	.715
Model III			-	.584
Model IV				-

All values significant at the .01 level.

NOTE: For sample sizes n_1 and n_2 of 183, the critical absolute value of D at a .01 level of significance is .170. This value is pertinent for testing Models I, II, and III against each other. For tests of these models against the theoretical random distributions (Model IV), the critical absolute value of D is .120.[1]

The power of the first three models is in the same relative order as the explained variance of the regressions used to calibrate the models.

Validation of the Checking Model

Table 36 shows the results of an analysis of variance on the estimated probabilities and assigned ranks for the checking models, using the same coding scheme as the savings models. Again, the hypothesis of random assignment may be rejected strongly.

---

[1] Ibid., pp. 486-87.

TABLE 36

ANALYSIS OF VARIANCE RESULTS: CHECKING MODELS

Analysis of Variance on Predicted Probability of Use of Office by Actual Use, All Bank Office Variables and Location of Checking

Univariate 1-WAY ANOVA
(1) IFCK:1 FSB:2 (2) IFCK:2 FSB:2
Analysis of Variance of 9.PRBCK N=8601 out of 8601

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	.45969 -1	.45969 -1	2310.3	0.
Within	8599	.17110	.19897 -4		
Total	8600	.21707	(Random effects statistics)		

ETA=.4602 ETA-Sqa=.2118 (Var Comp=.14722 -3
%Var Among=88.09)

Strata	N	Mean	Variance	Std Dev
(1)	8442	.20959 -1	.18308 -4	.42788 -2
(2)	159	.38122 -1	.10479 -3	.10237 -1
Grand	8601	.21277 -1	.25240 -4	.50240 -2

Analysis of Variance on Rank Assigned to Office by Actual Use, All Bank Office Variables and Location of Checking

Univariate 1-WAY ANOVA
(1) IFCK:1 FSB:2 (2) IFCK:2 FSB:2
Analysis of Variance of 10.RNKCK N=8601 out of 8601

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	71697.	71697.	408.05	0.
Within	8599	.15109 +7	175.71		
Total	8600	.15826 +7	(Random effects statistics)		

ETA=.2128 ETA-Sqr=.0453 (Var Comp=229.14
%Var Among=56.60)

Strata	N	Mean	Variance	Std Dev
(1)	8442	24.396	178.53	13.362
(2)	159	2.9623	24.568	4.9566
Grand	8601	24.000	184.02	13.565

TABLE 36--Continued

Analysis of Variance on Predicted Probability of Use of Office by Actual Use, Restricted Variable Set

Univariate 1-WAY ANOVA
(1) IFCK:1 FSB:2 (2) IFCK:2 FSB:2
Analysis of Variance of 9.PRBCK N=8601 out of 8601

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	.43243 -1	.43243 -1	696.26	0.
Within	8599	.53406	.62107 -4		
Total	8600	.57730	(Random effects statistics)		

ETA=.2737 ETA-Sqr=.0749 (Var Comp=.13835 -3
%Var Among=69.02)

Strata	N	Mean	Variance	Std Dev
(1)	8442	.20969 -1	.60294 -4	.77649 -2
(2)	159	.37615 -1	.15898 -3	.12609 -1
Grand	8601	.21277 -1	.67128 -4	.81932 -2

Analysis of Variance on Rank Assigned to Office by Actual Use, Restricted Variable Set

Univariate 1-WAY ANOVA
(1) IFCK:1 FSB:2 (2) IFCK:2 FSB:2
Analysis of Variance of 10.RNKCK N=8601 out of 8601

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	55085.	55085.	310.10	.0000
Within	8599	.15275 +7	177.64		
Total	8600	.15826 +7	(Random effects statistics)		

ETA=.1866 ETA-Sqr=.0348 (Var Comp=175.92
%Var Among=49.76)

Strata	N	Mean	Variance	Std Dev
(1)	8442	24.347	180.12	13.421
(2)	159	5.5597	44.881	6.6998
Grand	8601	24.000	184.02	13.565

TABLE 36--Continued

Analysis of Variance on Predicted Probability of Use of Office by Actual Use, Distance Alone

Univariate 1-WAY ANOVA
Analysis of Variance of 9.PRBCK N=8783 out of 8783

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	2.9927	2.9927	782.32	0.
Within	8781	33.591	.38254 -2		
Total	8782	36.583	(Random effects statistics)		

ETA=.2860 ETA-Sqr=.0818 (Var Comp=.95134 -2
%Var Among=71.32)

Strata	N	Mean	Variance	Std Dev
(1)	8623	.18321 -1	.33102 -2	.57535 -1
(2)	160	.15635	.31761 -1	.17821
Grand	8783	.20836 -1	.41657 -2	.64542 -1

Analysis of Variance on Rank Assigned to Office by Actual Use, Distance Alone

Univariate 1-WAY ANOVA
Analysis of Variance of 10.RNKCK N=8783 out of 8783

Source	DF	Sum of Sqrs	Mean Sqr	F-Sta	Signif
Between	1	57698.	57698.	311.30	.0000
Within	8781	.16275 +7	185.35		
Total	8782	.16852 +7	(Random effects statistics)		

ETA=.1850 ETA-Sqr=.0342 (Var Comp=183.06
%Var Among=49.69)

Strata	N	Mean	Variance	Std Dev
(1)	8623	24.846	187.71	13.701
(2)	160	5.6812	57.363	7.5738
Grand	8783	24.497	191.90	13.853

Figure 8 shows a graph of the cumulative probability density functions for each of these models, and Table 37 shows the D values for these functions and the results of the Kolmogorov-Smirnov tests on the checking models.

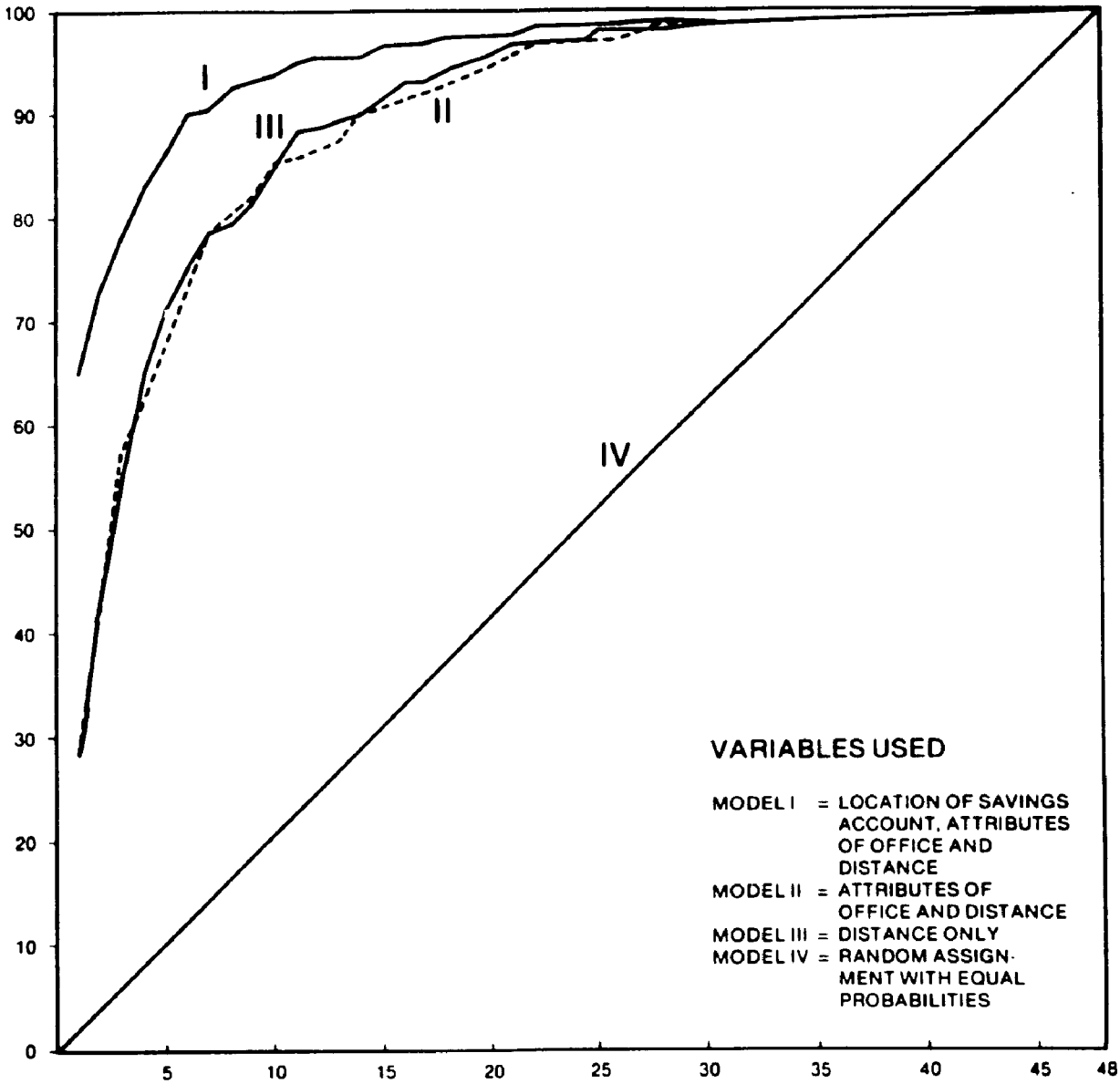


Fig. 8 **RANK OF BANK ACTUALLY USED FOR CHECKING (CUMULATIVE PERCENTAGES)**

TABLE 37

KOLMOGOROV-SMIRNOV TESTS: CHECKING

	Value of D			
	I	II	III	IV
Model I	-	-.362*	.033	.652*
Model II		-	.362*	.775*
Model III			-	.642*
Model IV				-

*Significant at the .01 level.

NOTE: For sample sizes n_1 and n_2 of 160, the critical absolute value of D at a .01 level of significance is .182. This value is pertinent for testing Models I, II, and III against each other. For tests of these models against the theoretical random distribution (Model IV) the critical absolute value of D is .129.[1]

[1] Ibid.

Summary

Any final judgment of the power of the models presented should be made using a nonparametric test, since the parameters of the consumer choice process are unknown. The Kolmogorov-Smirnov test results and the graphic presentation of the cumulative probability density function allow some determination of predictive power to be made.

The two regression models and the distance alone model, for both savings and checking, are more powerful than random assignment. Again, for both services, the model that uses knowledge of the location of the complimentary service is clearly superior in predictive power.

For the models using only knowledge available before the opening of an office, the situation is not as clear. For savings services, this model is clearly superior to distance alone as a predictor, probably because the model includes knowledge of the type of competitor. For checking, where all competitors are commercial banks, this model shows no superiority over distance alone. Evidently, commercial bank offices compete for checking customers on an equal footing.

In Chapter 8, the implications of these findings are discussed and a technique for application of this methodology to the location choice process by bank marketing decision makers is suggested.

CHAPTER VIII

CONCLUSIONS

A basic question underlying this research was "Can a mathematical model successfully predict banking office patronage?" The results of this research indicate that it can. The techniques used in this research may be used to determine an efficient set of predictors of banking office use and to specify the coefficients of the model selected.

Review of the Models

Three actual models of patronage were specified for both checking and savings office patronage, and a theoretical random assignment model was assumed.

Two of the models indicate the bounds of the predictive efficiency of the techniques used. The best set of predictions, because of the high likelihood of holding both major services at the same bank branch, was based on a set that included knowledge of the location of the office where the complimentary service was held. This model has little practical applicability, but does set an upper boundary for the predictive power of the technique. The opposite boundary for predictive power was set by the random assignment model which we would expect to better. For that model, an equal

probability of patronage was arbitrarly assigned to each banking office. The model was not actually run against the validation sample, but rather the expected long-run frequencies were calculated and recorded. In no case would we expect to do as poorly in predicting patronage as the random model; its value lies merely in supplying a lower boundary for our expectations.

The other two models are felt to be realistic. The distance-alone model is the simplest, merely ranking preference in direct order of closeness to the respondent's home. In actual practice, this model would assign all households to the closest banking office that offered the service desired. Unless significant improvement can be shown over this model, it probably should be used because it is so simple. That was the situation in the Farmington market for checking services; the model incorporating several bank branch attributes and the distance from the respondent's home to the branch showed no improvement in predictive power over the distance-alone model.

That was not the case for savings patronage, however. The model of savings office choice that incorporated knowledge of several banking office attributes and the distance from the respondent's home to the banking office was significantly more effective as a predictor of patronage for that service. That increase in predictive power was largely the result of incorporating knowledge of type of institution into the model. That variable carries information about the range of services

offered at the office in question. The strong tendency of users of both checking and savings in this market to hold both services at the same office gave this variable considerable predictive value, even without knowledge of the exact branch used for checking.

The model results are consistent with the assumption that, given two commercial bank offices equally distant from home, a potential checking patron would be indifferent between them. Given a commercial bank branch and an office of a thrift institution, both the same distance from home, the potential savings customer would tend to choose the commercial bank branch, even at the cost of lost interest on his savings balances. That behavior underscores the primacy of convenience to the bank customer. The ability to hold the two major consumer services at the same office is a stronger influence than the interest differential offered by thrift institutions.

Implementation of the Models

The purpose of this research was to produce a set of models that would be useful in predicting the share of market to be expected by a newly opened banking office. To do this, several steps must be taken by bank marketers and bank regulators.

The data reported here were gathered in Farmington, Michigan. Any use of the reported coefficients outside of that area involves the assumption that the Farmington market environment and bank patron are typical of the market

environment and bank patron in the area of interest. If that assumption cannot be made, a survey of households in the area of interest must be made, and a model of patronage representative of the new area must be calibrated.

The distance from each household to each potential bank was used to calibrate the models in this research. For most markets, such exact location is not available. Census tract data on population can be used by assuming that all households in a tract are located at the center of the tract. That assumption is less critical for closely spaced, small areas. If that assumption is not appropriate, some technique must be used to assign smaller groups of households to a number of locations.

The banking offices in the relevant market area must also be assigned coordinates and their attributes recorded.

Finally, the question of interpreting the effect of changes of these attributes upon patronage must be addressed. This research proposed a classification scheme which divided the attributes of a banking office into three categories: those that show the most variance between offices of commercial banks and thrift institutions (Category I); those that show the most variance between offices of different parent institutions (Category II); and those with variance not explained by either of those factors (Category III).

In the Farmington market, it is appropriate to use type of institution as a surrogate for the Category I variables in predicting savings patronage. That distinction

is not necessary for predicting checking patronage, however, because all competitors for checking accounts are commercial bank branches. In those markets where thrift institutions compete for demand deposits, the information carried by this variable might be substantially different.

The interpretation of the Category II variables, those representative of the policy of the parent institution, is somewhat clouded by the substantial correlations between those variables. For instance, a negative sign attached to the variable representing the number of hours a banking office is open during a week might be interpreted as indicating that fewer hours of access are better. In fact, a branch open zero hours per week would appear best under the model. That interpretation is incorrect. In the data used to build the model, no banking office was open fewer than thirty-two hours per week, so any value for this parameter less than thirty-two represents an extrapolation beyond the valid range of the model. Probably the best set of values for Category II variables is the set of mean values for the particular parent institution. In that way, their interpretation as indicating the institution-wide policy of the parent institution is preserved.

The use of the Category III variables in a predictive model is straightforward. Fortunately, distance from the potential customer's residence, which showed the greatest practical predictive power, falls into this category. The actual value of the variables in this class may be used to estimate patronage of a new banking office.

The Transition from a Model of Individual Choice to a Model of Group Choice

As models of individual choice, the models specified in this research assign probabilities of patronage to each institution in the relevant market. The institution with the greatest probability of patronage is predicted as the one that would be chosen by the individual potential patron.

The absolute magnitude of those probabilities is affected by the choice of transformation of the dummy dependent variable. For predictions with grouped data, the probabilities should predict the proportion of the group that will bank at each office in the relevant market. It is not clear that the transformation chosen for this research will produce the most efficient estimates on grouped data. In the implementation of a model of this type, bank marketers and bank regulatory agencies would use data on the number of accounts actually held at several banking offices in the market to determine the transformation of the dummy dependent variable which would produce the best estimates on grouped data.

Implications for Further Research

This research has indicated several areas of further research that may prove rewarding. Although the model, as formulated, has significant predictive power, the problem of a highly multicollinear predictor set diminishes the utility of the model for predicting the effect of changes in some of the attributes of a banking office. Statistically removing

the influence of type of institution and parent institution from the attributes of a banking office would allow the assessment of the unique effects of those predictors, not just their total affect on market share. Further experimentation in this area should be done.

Possibilities for improving prediction by some changes in the dummy dependent variable also exist. Although the transformation of the dummy dependent variable that was used was consistent with past research, it was not the only transformation that could have been used. Possible alternatives that might increase the efficiency of the model are the logit transformation and the probit transformation.[1] Those transformations are not directly interpretable by the theory underlying this research (Luce's Choice axiom), but their predictive efficiency should be tested.

A practical test of the predictive power of the model would be to test its ability to predict the success of newly opened banking offices in the Farmington area. That test would require data that were not available at the time of this research, but which should become available as soon as a new charter is granted in this market.

The high extent to which households in the sample chose to hold checking and savings at the same institution indicates that a model with the capability of predicting patronage for the entire group of services held by a

---

[1]Henri Theil, Economics and Information Theory (Chicago: Rand McNally, 1967), pp. 71-73.

household simultaneously should have merit. Such a model could first predict the services needed by a particular household or group of households, then allocate those services to the group of banking offices likely to be patronized, preserving the probabilities of holding multiple services at the same office.

Finally, this type of model could be used to investigate the effects of changes in the legal structure of banking. The research indicates the importance of type of institution upon savings patronage, presumably because of the patron's ability to hold the two major services at the same office. If thrift institutions were allowed to accept demand deposits, and if Federal regulations allowing differential interest rates on savings accounts were eliminated, the effect of type of institution on patronage would presumably diminish or vanish. The effects of such changes in policy on the market shares of the institutions in a sample could be simulated by setting the type of institution variable equal to a constant and noting the effect on individual institutions' estimated market shares. Data from the sample indicate a relatively slow account turnover, so the effect of such a change in legal environment on any given banking office would probably be gradual.

APPENDIX

CONSUMER QUESTIONNAIRE

BANKING OFFICE QUESTIONNAIRE

CUMULATIVE PROBABILITY DENSITY FUNCTION
FOR SAVINGS MODELS

CUMULATIVE PROBABILITY DENSITY FUNCTION
FOR CHECKING MODELS

Starting Time: _____ Card # 1-1
Finish Time: _____ 2-
Questionnaire # 3-
4-

FARMINGTON BANKING SURVEY
YMA #75-383

RESPONDENT NAME: _____

RESPONDENT ADDRESS: _____ CITY: _____

RESPONDENT PHONE: _____

INTERVIEWER INITIALS: _____ DATE: _____ VALIDATED BY: _____

INTRODUCTION: Hello! My name is _____. I represent the firm of Yee/Minard & Associates, a local public opinion polling company. We're conducting a marketing opinion survey among people in your community. I'd like to take eight to ten minutes of your time to ask you a few questions about stores you shop and places of business you normally use.

A graduate student writing his doctoral dissertation is sponsoring this survey under a special grant from the government. The results of this survey on consumer shopping behavior will help businessmen understand consumers so they can better serve them in the future. All of your responses in this survey are totally confidential and we appreciate your cooperation in conducting this survey.

A. First of all, does anyone in your immediate household presently work for a bank, a savings and loan association, a credit union or any marketing research or advertising agency connected with these types of financial institutions?

TERMINATE ← ( ) Yes ( ) No → CONTINUE TO Q. B

B. Do you or anyone in your household presently use a bank, credit union or savings and loan association?

CONTINUE TO Q. C ← ( ) Yes ( ) No → TERMINATE, VERIFY NAME AND ADDRESS AND RECORD ON TALLY SHEET

C. And are you the person in your household who shares at least one-half the responsibility for handling the household banking or financial business, or does someone else do most of it?

( ) Yes, responsible for handling at least half of the household banking or financial business

( ) No, someone else is responsible

IF RESPONDENT DOES MOST, OR SHARES EQUALLY, CONTINUE.

IF ANOTHER PERSON DOES MOST, ASK TO INTERVIEW HIM/HER AND REPEAT INTRODUCTION BEFORE CONTINUING WITH QUALIFIED PERSON.

YMA #75-383 Page 2

1a. First I'd like to talk about weekly, bi-weekly, or even monthly grocery shopping -- when you buy most of your household's groceries, probably at the supermarket. What is the name and location of the grocery store where you buy most of your household's groceries? (RECORD NAME OF STORE AND CROSS STREET LOCATION. DO NOT READ LIST. MULTIPLE MENTION PERMITTED.)

GREAT SCOTT
01( ) 10 Mile, Orchard Lake
02( ) 14 Mile, Orchard Lake
03( ) 8 Mile, Beech Daly

A & P
04( ) Farmington, Grand River
05( ) 13 Mile, Orchard Lake

FARMER JACK
06( ) 12 Mile, Farmington
07( ) Farmington, Grand River

CHATHAM
08( ) 11 Mile, Middlebelt

OTHERS (WRITE IN NAME AND LOCATION)

_____ 5-

_____ 6-

_____ 7-

8-

1b. About how frequently do you normally shop at the grocery store you just mentioned? Would you say . . . (READ LIST, ASK FOR MAIN STORE OR FIRST MENTIONED STORE IF MULTIPLE MENTION.)

9-1( ) More than once a week
-2( ) About once a week
-3( ) About once every other week
-4( ) Longer than every other week

2. In general, how satisfied are you with the convenience of the grocery stores in your area. That is, are you satisfied with the closeness of grocery stores to your home? Would you say . . . (READ LIST)

10-1( ) Very satisfied with the closeness of grocery stores
-2( ) Generally or pretty satisfied
-3( ) Generally or pretty dissatisfied
-4( ) Very dissatisfied

3. Next I'd like to talk about shopping for items other than groceries. By this I mean shopping trips you make when you need to pick up things for the house or family -- things like housewares or clothes. Where do you usually do this kind of shopping? (MULTIPLE RESPONSE PERMITTED. PLACE MAY BE A SHOPPING CENTER OR GENERAL LOCATION LIKE "Near the interesection of Eight Mile and Grand River." DO NOT READ LIST.)

01( ) Livonia Mall
02( ) Northland
03( ) Wonderland
04( ) Demerey's, 12 Mile, Farmington
05( ) Tel-Twelve Mall
06( ) Downtown Farmington
07( ) Farmington Plaza, Grand River, Orchard Lake
08( ) Between 13 and 14 Mile on Orchard Lake Road
09( ) K-Mart, 8 Mile and Beech Daly
10( ) Chatham Square, 11 Mile, Middlebelt

11-
12-
13-
14-

WRITE IN OTHER NAMES AND LOCATIONS BELOW

_____ 15-

_____ 16-

4. Thinking about all the shopping facilities that are available to you -- that is, the malls and the local stores -- how satisfied are you with their convenience in being close to your home? Would you say you're . . . (READ LIST)

17-1( ) Very satisfied with their convenience in being close to your home
-2( ) Generally or pretty satisfied
-3( ) Generally or pretty dissatisfied
-4( ) Very dissatisfied

READ: Now I'd like to ask you a few questions about your overall usage of banks and other financial institutions.

5. First of all, how would you describe when the banking is usually done in your household? Do you do your banking . . . (READ LIST, MULTIPLE RESPONSE PERMITTED.)

-1( ) When shopping for groceries
-2( ) While doing nongrocery shopping 18-
-3( ) While traveling to or from work
-4( ) During work hours at a bank near work 19-
-5( ) Do you tend to make special trips to the bank whenever the need arises 20-
( ) Or, how would you describe it in your own words?

_____

6. Do you or anyone in your household presently have a checking account?

CONTINUE TO Q. 7 ← 21-1( ) Yes -2( ) No → SKIP TO Q. 15

7. How many different banks do you and other members of your household use for checking account services?

22-1( ) One -4( ) Four
-2( ) Two -5( ) Five or more
-3( ) Three

8. What is the name of the bank that you use for your household's primary checking account? By primary, I mean the checking account you use the most or the one you consider most important. (DO NOT READ LIST)

01( ) Bank of the Commonwealth
02( ) City National Bank
03( ) Detroit Bank & Trust 23-
04( ) Manufacturers National Bank
05( ) Michigan National Bank 24-
06( ) National Bank of Detroit
07( ) Metropolitan National Bank of Farmington
08( ) Security Bank of Novi
09( ) West Oakland Bank
10( ) Wayne Oakland Bank
11( ) National Bank of Southfield
12( ) Pontiac State Bank
13( ) Community National Bank of Pontiac
Others (SPECIFY) _____

_____

9. People are attracted to do business with one particular bank rather than another for a variety of reasons. Thinking about the bank you use for your household's primary checking account, please tell me all the reasons that cause you to use this particular bank for checking account services?

(PROBE FULLY INCLUDING: Can you think of any other reasons for using this particular bank for checking account services?)

25-

26-

10a. What is the specific location of the NAME OF PRIMARY CHECKING BANK IN Q. 8 office you use most for checking account services. (OBTAIN SPECIFIC LOCATION IN TERMS OF CROSS STREETS OR SPECIFIC NAME LIKE "MAIN OFFICE")

NATIONAL BANK OF DETROIT
001( ) Farmington Office
002( ) 12 Mile, Farmington
003( ) 14 Mile, Middlebelt
004( ) 11 Mile, Middlebelt
005( ) Grand River, Lakeway
006( ) Grand River, Eight Mile
007( ) West Maple, Cranbrook
008( ) Main Office
009( ) Uptown

DETROIT BANK & TRUST
010( ) Grand River, Middlebelt
011( ) 12 Mile, Orchard Lake
012( ) West Maple, Orchard Lake

MANUFACTURERS NATIONAL BANK
013( ) 13 Mile, Orchard Lake
014( ) 8 Mile, Farmington
015( ) Northwestern, Inkster
016( ) Grand River, Halstead

BANK OF THE COMMONWEALTH
017( ) 13 Mile, Orchard Lake
018( ) 10 Mile, Middlebelt

MICHIGAN NATIONAL BANK
019( ) 14 Mile, Orchard Lake
020( ) 10 Mile at Grand River
021( ) 8 Mile, 1 block W. of Grand River

METROPOLITAN BANK OF FARMINGTON
022( ) Grand River, Farmington 27-
023( ) 12 Mile, Farmington 28-

CITY NATIONAL BANK
024( ) 10 Mile, Orchard Lake 29-

WRITE IN OTHERS: _____
NAME AND LOCATION

10b. Approximately how many years have you used this particular office for checking account services? Would you say . . . (READ LIST)

30-1( ) 1 year or less
-2( ) About two years
-3( ) About 3 years
-4( ) About 4 or 5 years
-5( ) 6 to 10 years
-6( ) More than ten years

10c. How would you describe the location of this banking office. Would you say it is close to home, close to work, on the way going to or from work, or what?

31-1( ) Close to home
-2( ) Close to work
-3( ) On way going to or from work

OTHER: _____

_____

10d. Approximately how many miles would this banking office be from your home? Would you estimate that it is . . . (READ LIST)

32-1( ) Less than a mile from home
-2( ) About 1 mile
-3( ) About 2 miles
-4( ) About 3 miles
-5( ) About 4 or 5 miles
-6( ) Six to ten miles
-7( ) More than 10 miles from home

11. Besides keeping your primary checking account at NAME OF PRIMARY BANK which of the following additional services do you use there? . . . (READ LIST)

	YES	NO	
ASK Q. 12 IF "YES." OTHERWISE SKIP TO Q. 15 ←	33-1( )	-2( )	Savings account
	34-1( )	-2( )	Bank charge card
	35-1( )	-2( )	An installment loan during the past three years
	36-1( )	-2( )	A mortgage loan
	37-1( )	-2( )	A safe deposit box

12. You mention having a savings account at NAME OF PRIMARY CHECKING BANK. Is this same bank also your household's primary place of savings, or do you consider another institution as your household's primary place of savings?

ASK Q. 13a ← 38-1( ) Same bank also primary place of savings

SKIP TO Q. 16a ← -2( ) Another institution is primary place of savings

13a. Do you use the same branch office for savings services as you do for checking?

GO TO Q. 13c ← 39-1( ) Yes -2( ) No → ASK Q. 13b

13b. What is the location of the branch office you use for savings services? (OBTAIN SPECIFIC LOCATION IN TERMS OF CROSS STREETS AND WRITE IN)

40-

41-

42-

13c. And how long have you used the savings services at this particular office. Would you say . . . (READ LIST)

43-1( ) 1 year or less
-2( ) About 2 years
-3( ) About three years
-4( ) About 4 or 5 years
-5( ) Six to ten years
-6( ) More than 10 years

14a. Besides having savings at a commercial bank, do you or members of your household also save at a credit union or a savings and loan association?

ASK Q. 14b ← 44-1( ) Yes -2( ) No → SKIP TO Q. 20

14b. Would that be a savings and loan association, a credit union, or both?

ASK Q. 14c ← 45-1( ) Savings and loan association
SKIP TO Q. 20 ← -2( ) Credit union
-3( ) Both credit union and savings and loan

14c. In order to join a credit union you must belong to some type of group. Even though you don't use a credit union now, are you eligible to join one if you desired to do so?

SKIP TO Q. 20 ← 46-1( ) Yes
-2( ) No

15. Do you or any members of your household have a savings account with any commercial bank, credit union, or savings and loan association?

CONTINUE TO Q. 16a ← 47-1( ) Yes -2( ) No → SKIP TO Q. 21

16a. At which of the following institutions do you or members of your household have a savings account? . . . (READ LIST)

IF "CREDIT UNION" MENTIONED SKIP TO Q. 17. IF NOT ASK Q. 16b. ←

48-1( ) Credit union
-2( ) Bank
-3( ) Savings and loan

16b. In order to join a credit union you must belong to some type of group. Even though you don't use a credit union now, are you eligible to join one if you desired to do so?

49-1( ) Yes
-2( ) No

17. Among all the places you and members of your household save, what is the name of the institution that you consider your household's primary place of savings?

BANKS

01( ) Bank of the Commonwealth 50-
02( ) City National Bank
03( ) Detroit Bank and Trust 51-
04( ) Manufacturers National Bank
05( ) Michigan National Bank
06( ) National Bank of Detroit

07( ) Metropolitan National Bank of Farmington
08( ) Security Bank of Novi
09( ) West Oakland Bank
10( ) Wayne Oakland Bank

OTHER BANKS (SPECIFY) _____

SAVINGS AND LOAN ASSOCIATIONS

20( ) First Federal Savings and Loan
21( ) Standard Federal Savings and Loan
22( ) American Savings and Loan
23( ) Metropolitan Savings and Loan
24( ) Detroit and Northern Savings and Loan

OTHER SAVINGS AND LOANS (SPECIFY) _____

CREDIT UNIONS

(SPECIFY) _____

_____

18a. Thinking about your household's primary place of savings, what is the location of the branch office you use the most? (OBTAIN SPECIFIC LOCATION IN TERMS OF CROSS STREET OR VERY SPECIFIC NAME LIKE "MAIN OFFICE.")

NATIONAL BANK OF DETROIT
001( ) Farmington Office
002( ) 12 Mile, Farmington
003( ) 14 Mile, Middlebelt
004( ) 11 Mile, Middlebelt
005( ) Grand River, Lakeway
006( ) Grand River, Eight Mile
007( ) West Maple-Cranbrook
008( ) Main Office
009( ) Uptown

DETROIT BANK & TRUST
010( ) Grand River, Middlebelt
011( ) 12 Mile, Orchard Lake
012( ) West Maple, Orchard Lake

MANUFACTURERS NATIONAL BANK
013( ) 13 Mile, Orchard Lake
014( ) 8 Mile, Farmington
015( ) Northwestern, Inkster
016( ) Grand River, Halstead

BANK OF THE COMMONWEALTH
017( ) 13 Mile, Orchard Lake
018( ) 10 Mile, Middlebelt

MICHIGAN NATIONAL BANK
019( ) 14 Mile, Orchard Lake
020( ) 10 Mile at Grand River
021( ) 8 Mile, 1 block W. of Grand River

METROPOLITAN NATIONAL BANK OF FARMINGTON
022( ) Grand River, Farmington 52-
023( ) 12 Mile, Farmington 53-

CITY NATIONAL BANK
024( ) 10 Mile, Orchard Lake 54-

FIRST FEDERAL SAVINGS OF DETROIT
025( ) Farmington Road, Grand River
026( ) 12 Mile, Farmington

METROPOLITAN SAVINGS ASSOCIATION
027( ) Northwestern, Middlebelt

STANDARD FEDERAL SAVINGS
028( ) 11 Mile, Middlebelt

AMERICAN SAVINGS ASSOCIATION
029( ) Grand River, Halstead
030( ) Orchard Lake, 14 Mile Road

FIRST FARMINGTON SAVINGS AND LOAN
031( ) Orchard Lake Road

WRITE IN OTHERS _____
NAME AND LOCATION

18b. Approximately how many years have you used this particular office for savings account services. Would you say . . . (READ LIST)

55-1( ) 1 year or less
-2( ) About 2 years
-3( ) About 3 years
-4( ) About 4 or 5 years
-6( ) Six to 10 years
-7( ) More than ten years

18c. And how would you describe the location of this branch office. Would you say it is close to home, close to work, on the way going to or from work, or what?

56-1( ) Close to home
-2( ) Close to work
-3( ) On way going to or from work

OTHER: _____

_____

18d. Approximately how many miles would this branch office be from your home? Would you estimate that it is . . . (READ LIST)

57-1( ) Less than a mile from home
-2( ) About 1 mile
-3( ) About 2 miles
-4( ) About 3 miles
-5( ) About 4 or 5 miles
-6( ) Six to 10 miles
-7( ) More than 10 miles from your home

19. Besides using the office for savings, which of the following additional services do you use there? . ... (READ LIST)

YES	NO	
58-1( )	-2( )	Checking account
59-1( )	-2( )	Bank charge card
60-1( )	-2( )	An installment loan during the past three years
61-1( )	-2( )	A mortgage loan
62-1( )	-2( )	A safe deposit box

20. There are many reasons why people rely on one place to save rather than another. Thinking about your household's primary place of savings, please tell me all the reasons that cause you to make it your household's primary place of savings rather than some other institution? (PROBE FULLY INCLUDING "Can you think of any other reasons for using this particular institution as your household's primary place of savings?)

63-

64-

READ: I have just a few final questions for classification purposes. We use these to group people when it comes to tabulating the information on the computer.

21. First of all, how old is the head of your household. Is the household head . . . (READ LIST)

65-1( ) 18-24	-6( ) 45-49
-2( ) 25-29	-7( ) 50-54
-3( ) 30-34	-8( ) 55-59
-4( ) 35-39	-9( ) 60 to 64
-5( ) 40-44	-0( ) 65 or older

22. What is the marital status of the head of the household. Would that be married, single, separated, divorced, widowed or what?

66-1( ) Married
-2( ) Single
-3( ) Separated
-4( ) Divorced
-5( ) Widowed

23a. Are there any dependent children in your household at the present time?

ASK Q. 23b ← 67-1( ) Yes -2( ) No → SKIP TO Q. 24

23b. What is the number of dependent children in your household?

68-1( ) One -5( ) Five -9( ) Nine
-2( ) Two -6( ) Six -0( ) Ten
-3( ) Three -7( ) Seven -X( ) 11 or more
-4( ) Four -8( ) Eight

23c. And what is the age of the youngest dependent child in your household?

_____ 69-

70-

24. How long have you lived in your present community, either in your present home or in a previous home located nearby? Would you say . . . (READ LIST)

71-1( ) Less than one year
-2( ) 1 to 3 years
-3( ) 4 or 5 years
-4( ) 6 to 10 years
-5( ) More than 10 years

25. Is the head of your household presently employed, presently unemployed, retired, a student or what?

IF PRESENTLY UNEMPLOYED OR RETIRED AND Q. 26 IS "NONE" SKIP Q. 27

72-1( ) Presently employed
← -2( ) Presently unemployed
← -3( ) Retired/disabled
-4( ) Student
OTHER (SPECIFY) _____

26. In total, how many members of your immediate household are employed in wage earning capacities?

73-1( ) None -4( ) Three -7( ) More than Six
-2( ) One -5( ) Four
-3( ) Two -6( ) Five

27. Finally, in which community is the principal wage earner in your household employed

01( ) Dearborn 05( ) Highland Park 09( ) Novi
02( ) Farmington 06( ) Latnrup Village 10( ) Pontiac 74-
03( ) Farmington Hills 07( ) Livonia 11( ) Southfield
04( ) Hamtramck 08( ) Northville 12( ) Westland 75-

( ) Detroit -- Would that be -- 13( ) West of Woodward
14( ) East of Woodward, or
15( ) Downtown Detroit

OTHER COMMUNITIES (SPECIFY) _____

INTERVIEWER OBSERVATION: Respondent was:

76-1( ) Male -2( ) Female

THANK YOU VERY MUCH FOR YOUR COOPERATION IN THE SURVEY!
May I have your name and address please. This is in case my supervisor wants to see if I did the interview properly.

RECORD NAME AND ADDRESS ON FRONT.



Graduate School of Business Administration · The University of Michigan · Ann Arbor 48104

March 10, 1976

Dear Sir:

Mr. Lorman Lundsten, a doctoral candidate in marketing in this School is conducting a study of the banking behavior of suburban Detroit households. The study is being sponsored by the Department of Research and Analysis of the Comptroller of the Currency.

One objective of the study is to measure the effectiveness in obtaining patronage of the features and services available at a particular banking office. These features and services include the actual services available (checking, safe deposit, etc.), the hours at which they are available (Saturday hours, late hours, etc.), and the physical features of the building where they are offered (location, drive-up windows, parking available, etc.).

I am asking your cooperation in filling out and returning the enclosed questionnaire that summarizes these services and features for your banking office. Your responses will be kept confidential and will not be released or published except in summary form. If you have any questions about the study feel free to call Mr. Lundsten (home phone 313-461-9623, office phone 313-764-8263).

A summary of the results of this survey will be available to you upon request.

Sincerely yours,

Martin R. Warshaw

Martin R. Warshaw
Professor of Marketing
Chairman, Marketing Faculty

MRW:mts

Enclosure

BANKING OFFICE
ANALYSIS
QUESTIONNAIRE

OFFICE
NUMBER

NOTE: The purpose of this questionnaire is to gather information that would be available to prospective customers of your office. Information on individual banks will not be released. The data will be available only in summary form. A summary of the survey will be sent to you if you wish. If you have any questions about this study, please call

Lorman Lundsten

Home: 313-461-9623
University: 313-764-8263

(1) Institution type (check one).

☐ National Bank
☐ Savings and Loan Association
☐ State Bank
☐ Credit Union

(2) Building style (check one).

☐ Free Standing
☐ Temporary Quarters (trailer, etc.)
☐ Other
☐ Shopping Center
☐ Office Building Lobby

(3) Availability of Parking.

Parking available for approximately _____ cars.

(4) Drive-up or sidewalk banking. (if offered)

☐ Drive-up Banking.
_____Stations (fill in number)

☐ Walk-up Banking.
_____Stations (fill in number)

(5) "Automatic Banking" (if offered)

☐ Automatic Teller Machine at this location
  ☐ Available 24 hours a day
  ☐ Limited to certain hours
☐ Machine takes deposits, payments and gives cash
☐ Machine takes deposits, payments only
☐ Machine gives cash only
☐ Other (Explain) _____

(6) Hours (main banking floor only) Please enter opening and closing times

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
open	_____	_____	_____	_____	_____	_____
close	_____	_____	_____	_____	_____	_____

Hours (drive-up or walk-up windows)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
open	_____	_____	_____	_____	_____	_____
close	_____	_____	_____	_____	_____	_____

(7) Services Offered at this Location (Check those offered.)

☐ Checking ☐ Safe Deposit

Savings (Major Plans Only) Enter rate

"Regular Savings" _____ Interest Rate (for instance, Regular Passbook Savings)
"Premium Savings" _____ Interest Rate (interest penalty for early withdrawal)
Other Savings Plans _____ Interest Rate
(Explain)

☐ Personal Loans ☐ Auto Loans
☐ Mortgage ☐ Travel Services
☐ Other Services (Explain)

(8) Nearness to shopping (check one).

☐ This office is in a shopping center
☐ This office is close to a full range of shopping opportunities
☐ This office is close to a limited range of shopping opportunities
☐ This office is not close to shopping opportunities

(9) Promotional Activity (Advertising, etc.)

Within the last year, we had an active promotion using:

Bank Wide	This Office	
☐	☐	Newspaper Advertisements
☐	☐	Radio Commercials
☐	☐	Television Commercials
☐	☐	Consumer Promotions, Premiums, Give-aways
☐	☐	Celebrity Appearance
☐	☐	Other means (Explain) _____

(10) Staffing and Branch Size

This office has _____ teller stations.

On a typical busy day how many of these stations are open to serve customers?

(11) Years open. Please enter number of years.

This office has been open _____ years.

☐ I want a summary of the results of this survey. Send it to the attention of _____

☐ I don't want a summary of the results of this survey.

Thank you very much for your help in collecting this information.

CUMULATIVE PROBABILITY DENSITY FUNCTION
FOR SAVINGS MODELS
(74 competitors)

Competitors	I	II	III	IV
1	44.2	16.7	8.8	1.4
2	68.8	27.9	18.3	2.7
3	73.8	38.8	25.8	4.1
4	76.3	47.9	32.1	5.4
5	77.9	51.7	35.4	6.8
6	79.6	58.8	40.4	8.1
7	80.8	64.6	44.2	9.5
8	81.3	66.7	48.8	10.8
9	81.3	68.8	50.0	12.2
10	81.7	70.4	51.3	13.5
11	82.5	72.9	52.9	14.9
12	82.5	74.6	55.0	16.2
13	82.9	74.6	55.8	17.6
14	83.8	75.4	56.7	18.9
15	83.8	76.3	58.3	20.3
16	83.8	77.9	61.3	21.6
17	84.6	79.2	63.3	23.0
18	85.0	79.6	63.8	24.3
19	85.0	81.3	65.8	25.7
20	86.3	82.1	67.1	27.0
21	87.5	83.3	69.2	28.4
22	88.8	85.0	70.8	29.7
23	88.8	85.4	72.1	31.1
24	89.2	85.8	72.1	32.4
25	89.6	85.8	73.8	33.8
26	90.0	87.1	75.4	35.1
27	90.4	87.5	77.1	36.5
28	90.8	87.9	77.5	37.8
29	91.3	88.3	78.8	39.2
30	91.3	88.3	78.8	40.5

Competitors	I	II	III	IV
31	92.1	88.3	80.0	41.9
32	92.1	88.8	81.3	43.2
33	92.1	90.0	82.1	44.6
34	92.5	90.4	85.8	45.9
35	92.9	91.3	87.9	47.3
36	93.3	91.3	89.6	48.6
37	93.3	91.7	90.4	50.0
38	93.8	92.1	92.5	51.4
39	95.0	92.9	94.6	52.7
40	95.0	94.2	95.0	54.1
41	95.4	94.6	96.3	55.4
42	95.4	94.6	96.3	56.8
43	95.4	94.6	96.3	58.1
44	96.3	94.6	96.7	59.5
45	96.3	95.0	96.7	60.8
46	96.3	95.0	96.7	62.2
47	96.3	95.4	96.7	63.5
48	96.3	95.4	96.7	64.9
49	96.3	95.8	96.7	66.2
50	96.7	95.8	96.7	67.6
51	97.1	96.3	96.7	68.9
52	97.5	96.7	97.1	70.3
53	97.5	96.7	97.1	71.6
54	97.5	96.7	97.1	73.0
55	97.5	97.1	97.5	74.3
56	97.9	97.1	97.5	75.7
57	97.9	97.1	97.9	77.0
58	97.4	97.1	97.9	78.3
59	97.9	97.1	97.9	79.7
60	97.9	97.1	97.9	81.1
61	97.9	97.1	97.9	82.4
62	97.9	97.5	97.9	83.8
63	97.9	97.5	97.9	85.1

Competitors	I	II	III	IV
64	97.9	97.5	97.9	86.5
65	99.6	97.9	97.9	87.8
66	100.0	97.9	97.9	89.2
67		97.9	97.9	90.1
68		97.9	98.3	91.9
69		97.9	99.2	93.2
70		98.3	99.2	94.6
71		98.3	99.2	95.9
72		98.3	99.6	97.3
73		100.0	100.0	98.6
74				100.0

CUMULATIVE PROBABILITY DENSITY FUNCTION
FOR CHECKING MODELS
(48 competitors)

Competitors	I	II	III	IV
1	65.0	28.8	28.8	2.1
2	73.1	43.8	43.8	4.2
3	78.1	57.5	55.6	6.2
4	83.1	62.5	65.6	8.3
5	86.9	68.1	71.9	10.4
6	90.0	73.8	75.6	12.5
7	90.6	78.1	78.8	14.6
8	92.5	80.0	79.4	16.7
9	93.1	81.9	81.9	18.7
10	93.8	85.0	85.6	20.8
11	95.0	85.6	88.1	22.9
12	95.6	86.9	88.8	25.0
13	95.6	87.5	89.4	27.1
14	95.6	90.0	90.0	29.2
15	96.9	90.6	91.3	31.2
16	96.9	91.3	93.1	33.3
17	96.9	91.9	93.1	35.4
18	97.5	92.5	93.8	37.5
19	97.5	93.8	84.4	39.6
20	97.5	94.4	95.0	41.7
21	97.5	95.6	95.6	43.7
22	98.1	96.3	96.9	45.8
23	98.1	96.9	96.9	47.9
24	98.1	96.9	96.9	50.0
25	98.1	96.9	97.5	52.1
26	98.1	96.9	97.5	54.2
27	98.1	97.5	97.5	56.2
28	98.1	98.1	97.5	58.3
29	98.1	98.1	98.1	60.4
30	98.1	98.1	98.1	62.5

Competitors	I	II	III	IV
31	98.1	98.8	98.1	64.6
32	98.1	98.8	98.1	66.7
33	98.1	98.8	98.1	68.7
34	98.8	98.8	98.1	70.8
35	98.8	98.8	98.1	72.9
36	98.8	98.8	98.1	75.0
37	99.4	98.8	98.1	77.1
38	100.0	98.8	98.1	79.2
39		98.8	98.8	81.2
40		98.8	98.8	83.3
41		98.8	98.8	85.4
42		99.4	98.8	87.5
43		100.0	98.8	89.6
44			98.8	91.7
45			98.8	93.7
46			99.4	95.8
47			100.0	97.9
48				100.0

SELECTED BIBLIOGRAPHY

SELECTED BIBLIOGRAPHY

Books, Monographs, Handbooks

American Bankers Association. A Guide to Selecting Bank Locations. New York: American Bankers Association, 1968.

Andrews, Frank M. and Messenger, Robert C. Multivariate Nominal Scale Analysis. Ann Arbor, Mich.: Institute for Social Research, 1973.

Bennett, Rex O. Bank Location Analysis - Techniques and Methodology. Washington, D.C.: American Bankers Association, 1975.

Booz - Allen & Hamilton, Inc. The Challenge Ahead for Banking. New York: Booz - Allen & Hamilton, Inc., 1975.

Carey, H. C. Principles of Social Science. Philadelphia, Pa.: J. Lippincott, 1858-59. Quoted in Walter Isard. Methods of Regional Analysis: An Introduction to Regional Science. Cambridge, Mass.: M.I.T. Press, 1960.

Converse, P. D. "A Study of Retail Trade Areas in East Central Illinois." Business Studies - Number 2, University of Illinois, 1943.

Cooley, William W. and Lohnes, Paul R. Multivariate Data Analysis. New York: John Wiley & Sons, Inc., 1971.

Coombs, Clyde H.; Dawes, Robyn M.; and Tversky, Amos. Mathematical Psychology: An Elementary Introduction. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1970.

Credit Union National Association Yearbook. Madison, Wisc.: 1975.

Devaney, F. John. "A New Way to Choose Those Branch Locations." Bank Marketing, February 1973. Reprinted in Branch Location: A Handbook of Effective Technique and Practice.

Hoover, Edgar M. The Location of Economic Activity. New York: McGraw Hill, 1948.

Howard, John A. Marketing: Executive and Buyer Behavior. New York: Columbia University Press, 1963.

_____ and Sheth, Jagdish N. The Theory of Buyer Behavior. New York: John Wiley and Sons, Inc., 1969.

Huff, David L. "A Probabilistic Analysis of Consumer Spatial Behavior." In Emerging Concepts in Marketing. Edited by W. S. Decker. Chicago: American Marketing Association, 1962, pp. 443-61.

Hull, C. L. Principles of Behavior. New York: Appleton-Century, 1943.

Isard, Walter. Location and Space-Economy. Cambridge, Mass.: M.I.T. Press, 1956.

_____. Methods of Regional Analysis: An Introduction to Regional Science. Cambridge, Mass.: M.I.T. Press, 1960.

Jeglic, John M. "Statistical Approach to Locating New Branches." In James Littlefield et al. Bank Branch Location: A Handbook of Effective Technique and Practice. Chicago: Bank Marketing Association, 1973.

Johnston, John. Econometric Methods. 2d ed. New York: McGraw-Hill Book Co., 1972.

Kane, Edward J. Economic Statistics and Econometrics. New York: Harper & Row, 1968.

Katona, George; Mandell, Lewis; and Schmiedeskamp, Jay. 1970 Survey of Consumer Finances. Ann Arbor, Mich.: Survey Research Center, The University of Michigan, 1971.

Kotler, Philip. Marketing Decision Making, A Model Building Approach. New York: Holt, Rinehart and Winston, 1971.

Launhardt, Wilhelm. "Die Bestimmungdes zweckmässigsten standartes einer gewerblichen Anlage." Zeitschrift des Vereins deutscher Ingenieure 26 (1882).

Lindgren, Bernard W. Statistical Theory. 2d ed. New York: MacMillan Publishing Co., Inc., 1968.

Littlefield, James E.; Burney, G. Jackson; and White, William V. Bank Branch Location: A Handbook of Effective Technique and Practice. Chicago: Bank Marketing Association, 1973.

Lösch, August. The Economics of Location. New Haven, Conn.: Yale University Press, 1954.

Luce, R. D. Individual Choice Behavior. New York: John Wiley and Sons, 1959.

Nicosia, Francisco M. "Consumer Buying Behavior." In Robert G. Murdick, ed. Mathematical Models in Marketing. Scranton, Pa.: Intext Educational Publishers, 1971.

Palander, Tord. Beiträge zur Standortsthearie. Uppsala: Almqvist & Wiksells Boktrifckeri -A. -B., 1935.

Pratt, Robert W., Jr. "Measuring Purchase Behavior." In Robert Ferber, ed. Handbook of Marketing Research. New York: McGraw Hill Book Co., 1974, pp. 3-137.

Reilly, William J. "Methods for Study of Retail Relationships." Studies in Marketing, No. 4, 1929. Bureau of Business Research, University of Texas, Austin, 1959, reprint.

Rewoldt, Stewart H.; Scott, James D.; and Warshaw, Martin R. Introduction to Marketing Management. Homewood, Ill.: Richard D. Irwin, 1969.

Saunders, Lewis S. Techniques of Opening a Branch Bank. Boston: The Bankers Publishing Co., Bank Study Series, 1969.

Theil, Henri. Economics and Information Theory. Chicago: Rand McNally, 1967.

Tsai, L. S. "The Laws of Minimum Effort and Maximum Satisfaction in Animal Behavior." Monograph of the National Institute of Psychology (Peiping, China), I, 1932, abstracted in Psychological Abstracts, VI, No. 4329 (1932).

Zipf, George K. Human Behavior and the Principle of Least Effort. Cambridge, Mass.: Addison-Wesley, 1949.

Journals, Proceedings

Bell, David E.; Keeney, Ralph L.; and Little, John D. C. "A Market Share Theorem." Journal of Marketing Research 12 (May 1975): 136-41.

Clawson, C. Joseph. "Fitting Branch Locations, Performance Standards, and Marketing Strategies to Local Conditions." Journal of Marketing (January 1974), pp. 8-14.

Golledge, R. G. "Some Equilibrium Models of Consumer Behavior." Economic Geography 46 (1970): 417-23.

Healy, J. A. "ABLES: An Automated Branch Locations System." Paper presented to the URISA Conference, Fall 1972.

Heneman, Herbert G., III and Schwab, Donald P. "Evaluation of Research on Expectancy Theory Predictions of Employee Behavior." Psychological Bulletin 78 (June 1973): 2.

Hilliard, Jimmy E.; Vaughn, Ronald L.; and Reynolds, Fred D. "A Generalized Utility Model of Shopping Behavior." In Advances in Consumer Research. Edited by M. J. Schlinger. Chicago: Association for Consumer Research, 1975. Vol. 2.

Hlavic, Theodore E. and Little, John D. C. "A Geographic Model of an Urban Automobile Market." Proceedings, Fourth International Conference on Operations Research. New York: Wiley - Interscience, 1969.

Huff, David L. and Batsell, Richard R. "Conceptual and Operational Problems with Market Share Models of Consumer Spatial Behavior." In Advances in Consumer Research. Edited by M. J. Schlinger. Chicago: Association for Consumer Research, 1975. Vol. 2.

Kotler, Philip. "Competitive Strategies for New Product Marketing Over the Life Cycle." Management Science 12 (December 1965): 51-67.

Kramer, Robert L. "Forecasting Branch Bank Growth Patterns." Journal of Bank Research (Winter, 1971), p. 17.

Kuehn, Alfred A. and Weiss, Doyle L. "Marketing Analysis Training Exercise." Behavioral Science 10 (January 1965): 51-67.

Nakanishi, Masao and Cooper, Lee G. "Parameter Estimation for a Multiplicative Competitive Interaction Model--Least Squares Approach." Journal of Marketing Research 2 (August 1974): 303-11.

Ravenstein, Ernest G. "The Laws of Migration." The Journal of the Royal Statistical Society 48 (June 1885).

Shepard, D. "A Two-dimensional Interpolation Function for Irregularly Spaced Data." Proceedings, 1968 ACM National Conference, pp. 517-24.

Stewart, John Q. "Demographic Gravitation: Evidence and Applications." Sociometry 11 (February-May 1948): 34-35.

_____. "Empirical Mathematical Rules Concerning the Distribution and Equilibrium of Population." The Geographical Review 37 (July 1947): 481.

Stouffer, Samuel A. "Intervening Opportunities: A Theory Relating Mobility and Distance." American Sociological Review 5 (December 1940): 846-47.

Urban, Glen. "An On Line Technique for Estimating and Analyzing Complex Models." In Reed Moyer, ed. Changing Marketing Systems. Chicago: AMA, 1968), pp. 322-27.

_____. "Sprinter Mod III: A Model for the Analysis of Frequently Purchased Consumer Products." Operations Research 19 (September 1970): 805-54.

Magazines

Jessup, Paul F. and Bochnak, Mary. "Market Pricing Comes to Banking." The Bankers Magazine, Spring 1976, pp. 98-102.

Mandell, Lewis and Lundsten, Lorman L. "Market Potential Estimation: A New Approach." Bank Marketing, September 1973.

Moore, Phillip W. "An Outline of 12 Ways to Determine Branch Locations." Banking, September 1963, p. 48.

_____. "Nine Axioms of Branch Bank Location." Banking, February 1964, p. 61.

Smith, James E. and Dince, Robert R. "Consider the Banking Customer." The Bankers Magazine, Spring 1976, pp. 58-62.

Taylor, B. C. "Locating Profitable Office Sites." Banking, March 1965, p. 55.

Newspapers

"Florida Countrywide Branching Law, Effective Jan. 3, Having Less Impact Than Expected." American Banker, 5 August 1976.

Kramer, Robert L. "Modern Methods for Locating Branches Are Discussed." The American Banker, 24 March 1972, p. 9.

"Thrifts Checking Plans Appear To Be No Threat." Karen Pennar, The Journal of Commerce, 14 June 1976.

Interviews

Nystuen, John D., Professor of Geography. Ann Arbor, Michigan, University of Michigan. Interview, June 1975.

Other

Comptroller of the Currency. 1974 Annual Report. Washington, D.C., 1975. Table 3, p. 6.