RISK AND ADVERTISING IN AN OLIGOPOLY GAME

By

PAULINE HAAF WEBER

Bachelor of Arts
Nebraska Wesleyan University
Lincoln, Nebraska
1969

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1973

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Thesis Approved:

Joseph M. Jadlow
Thesis Adviser

Gerald M Lage

Robert L Landmeyer

Dean of the Graduate College

PREFACE

This study is concerned with the effect which varied levels of risk, achieved through results of advertising expenditures, have on subjects in an oligopoly game situation. The primary objective is to determine statistically the differences in response to the game of subjects with different attitudes toward risk under the varied levels of risk.

The author wishes to express her appreciation to her major adviser Dr. Joseph Jadlow, for his guidance and assistance throughout this study. Appreciation is also expressed to the other committee members, Dr. Gerald Lage, Dr. Robert Sandmeyer, and Dr. Elliot Weiner, for their invaluable assistance in the preparation of the final manuscript.

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CHAPTER I

INTRODUCTION

Motivation for the Study

Do subjects with different attitudes toward risk choose different strategies in an oligopoly business game? How do subjects with different attitudes toward risk react under varied levels of risk? These are the questions to which this study is addressed.

Sherman (26) states that:

> Most oligopoly theories can be separated into two parts, one involving a choice structure which specifies payoffs for alternative actions, and another dealing with the behavior of those who face that choice and payoff structure (p. 91).

Each of the two questions posed above relates to a part of this definition of oligopoly theory. An examination of choices by subjects with different risk attitudes is concerned with the behavior of subjects, while varied levels of risk within a game is realted to the choice structure of the situation.

Sherman (26) goes on to say that "... it is easy to see that behavior cannot be predicted in a deterministic way; social psychology and experimental economics have a useful role to play" (p. 4).

Differences in levels of risk is only one of a wide range of market aspects which could be investigated. Risk is an important variable on two levels. First, economists seem to agree that the

level of risk faced by firms in different market structures varies. Scherer (23) quotes J.R. Hicks as having said, "The best of monopoly profits is a quiet life" (p. 32).

Secondly, when dealing with oligopolistic market structures, risk attitudes of individuals may be important in determining market behavior. However, this is true only if individuals with different risk attitudes react differently in a market situation. Experimental economics provides a method of investigating this matter. Also, empirical tests of levels of risk faced by firms are difficult to conduct.

Varied returns to advertising expenditures was chosen as the vehicle to achieve different levels of risk within the game for two reasons. First, expenditures on advertising are an important component in the U.S. economy. Scherer (23, p. 329) states that $17 billion, 2 percent of GNP, were spent on advertising in the U.S. in 1968. The second reason concerns problems encountered in treating advertising in price theory. Price theory allows for determination of optimal advertising expenditures, at least in a partial equilibrium sense (22, pp. 64-66). However, some economists feel that advertising decisions are not adequately dealt with in such analysis (16). Therefore, it seems that consideration of advertising expenditures from a variety of viewpoints is useful.

Experimental Economics

Experimental economics differs from most economic analysis in that in an economic experiment an attempt is made to set up a controlled situation within which subjects are asked to participate by making the remainder constant. Behavior of the subjects with respect to the simulated situation can be observed as some elements are changed.

A defense of experimental economics appears in James Friedman's "Individual Behavior in Oligopolistic Markets: An Experimental Study" which was published in 1963 (8). Experiments may be particularly helpful, he says, in examining those economic theories concerning simplified situations. The experimenter can set up a similar situation, and test the behavior of subjects against the theory under consideration. Other advantages of the experimental method listed by Friedman are the difficulty of getting empirical data from industries, the fact that such data is not always in the form needed by the economist, and the ability of the experimenter to design a situation containing only those elements in which he is interested.

Experiments in economics also entail some disadvantages. Questions concerning motivation of subjects and their time horizon compared with that of businessmen can be raised. Other differences between typical subjects (usually students) and businessmen may be important.

Sherman (26) feels that the main advantage of experimental economics is that "... their results can be accumulated...so with time, elaborations of oligopoly behavior which are closer approximations of the real world may also be exposed to experimental investigations, part by part" (p. 5). He also states that experimental economics is the only method available to examine psychological influences on oligopolistic behavior (26, p. 11).

The Experiment

The Game

An experiment and its results are reported here. Using the Kogan-Wallach Social Risk Preference test (19)* risk attitudes of subjects are determined. Then subjects are asked to participate in a business game with price and advertising budget as decision variables.

Two versions of the same game are played. In the first, subjects are faced with a given profit table. In the second version, amount of profits received by the subject varies at times, in part according to level of advertising and in part at random. Thus, in the second version, the level of risk faced by the subject is increased through a varied payoff structure. A measure of cooperativeness, S, will be computed from data for each subject in each round of play.

The data obtained will allow differences between S values, advertising budgets, prices, and profits to be examined under four

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*This test is described at length below, and is reproduced in Appendix A.

situations: between high and low risk game for risk lovers; between high and low risk game for risk averters; between risk lovers and risk averters in the high risk game; and between risk lovers and risk averters in the low risk game.

The Hypotheses

Three hypotheses will be considered. In general terms, the first hypothesis states that subjects will be able to make some sense out of the game. The second hypothesis is that risk averters will play more cooperatively and will choose higher advertising budgets than will risk lovers. The final hypothesis is that both risk averters and risk lovers playing in the high risk game will have significantly different advertising budgets and S values than those of subjects playing in the low risk game.

Findings

The statistical results of the study indicate that subjects were able to handle the relatively complicated game. The Social Risk Preference test was successful in discriminating between subjects who behaved differently as far as prices, advertising choices, and profits were concerned in the low risk game, but only in the case of prices in the high risk game. Social Risk Preference test scores did not discriminate between different S values for either the high or low risk game.

Outline of Study

Chapter II presents a survey of the literature dealing with experimental oligopoly research. Chapter III discusses the framework of oligopoly, risk, and advertising within which the experiment is designed. The experiment, the model from which it is drawn, and the hypotheses which the experiment is to test are described in Chapter IV. Chapter V explains the procedures for the experiment, while Chapter VI reports the statistical results of the experiment and their application to the hypotheses. Chapter VII summarizes the study and contains conclusions, suggestions for further work, and suggestions for help in organizing experiments.

CHAPTER II

LITERATURE SURVEY

Early Development

Chamberlin

Experimental games have been used in economics, as well as in other social sciences, increasingly in the past twenty-five years. In 1948, Chamberlin (3) reported the results of an experiment he had run in the classroom. This article is considered to be the first published report of an economic experiment (8). He noted that the social scientist who would like to study the effects of certain forces felt obliged to experiment through general reasoning applied to abstract models. The purpose of his article, he said, was to make "a very tiny breach in this position" (3, p. 95). His experiment dealt with bargaining in buying and selling on an imperfect market.

For several years, experimental economics dealt with utility problems. Because this study is concerned with experimental oligopoly, work in other areas of experimental economics will not be reported here. In the late 1950's work directly concerned with oligopoly market situations began to be reported.

Hoggatt

Hoggatt (13) in 1959 reported on an experimental business game designed to test the predictive ability of the Cournot model in a simulated economic situation. He used faculty members of the School of Business Administration, University of California, as subjects in a quantity choice experiment. Subjects were not rewarded for their performance, and no control over communication between subjects was exercised.

The Cournot model refers to a market containing two or more firms. Under Cournot's assumption that each firm expects others to produce the same amount in each period as in the last period, individual firm profit maximization results. Hoggatt hypothesized that short run Cournot-type behavior would result from his experiment, rather than either Cournot behavior with a longer time horizon or joint profit maximization. Industry outputs close to damped, irregular oscillations around the short run Cournot quantity levels were found.

Fouraker and Siegel

Fouraker and Siegel (6) did much of the early work in the area of experimental economics. Their first book on the subject, published in 1960, refined the experimental techniques of predecessors. Subjects were paid their profits, and communication between subjects was controlled. This book dealt with bilateral monopoly. The principal hypotheses tested were: that the subjects would be more apt to choose the Cournot solution under imperfect information than under

perfect information, and that variability of decisions of subjects would be greater under complete information than under incomplete information situations.*

James Friedman

James Friedman (8) reported the results of some experiments in oligopolistic markets in 1963. His work merits more discussion here than others since his method is somewhat similar to that used in this study. Also his procedures are representative of many of the studies for which results are reported here.

Friedman set up a carefully controlled situation. Subjects were undergraduates recruited through the financial aids office. The games were held in a room arranged so that communication between subjects was impossible. Games varied in length from 22 to 26 periods and subjects were paid the profit they earned on each period. Each subject was given a set of instructions, a set of small sheets used to record their price decisions and identifying numbers, and payoff matrices which recorded both the subject's profits and the average of his opponents' profits for each possible combination of price decision of the subject and average price decision of his opponents.

Variables with which Friedman's hypotheses were concerned included amount of information given the subjects, number of players

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*Incomplete information refers to the situation where the subject does not know what sort of profit function his opponent faces. Under complete information, the subject is given the profit data which his opponent or opponents face.

in each market, and differences in structure of games. He also compared competitiveness of behavior* of subjects with that of their opponents. Many of his results agreed with those of Fouraker and Siegel's 1960 book (28). In a later article (9) he criticized his own work by noting that he had tried to allow as much as possible to vary, and therefore got few clear cut results for any of his variables.

Fouraker and Siegel

Fouraker and Siegel's (6) second book, Bargaining Behavior, appeared in 1963. This work reported results of experiments in oligopoly markets of various sizes, using experimental techniques similar to those used in their earlier work. They varied the number of subjects, the number of transactions, and the level of payoff. In some games, price was the decision variable, while in others quantity was the choice variable.

Fouraker and Siegel categorized behavior of subjects as maximizing individual profits or as joint profit maximization, using classical oligopoly models as comparison. Under conditions of incomplete information they found the individual profit maximization solution prevailed, while under complete information conditions, a variety of results was obtained.

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*Cooperative behavior refers to a subject's decisions which result in profits in that industry which are near the joint profit maximization. Competitive behavior is characterized by a subject's decisions resulting in individual profit maximization instead of joint maximization of profits.

Murphy

In 1966 Murphy (21) published the results of a replication of Fouraker and Siegel's Bargaining Behavior work. The main difference between Murphy's work and that of Fouraker and Siegel was that Murphy included the possibility of losses in the profit tables given to subjects. Murphy found more cooperative behavior as a result of including possible losses.

Summary

The work discussed thus far is representative of one type of experimental oligopoly game. Interest is centered on allowing variation in a few aspects of the game, primarily the number of subjects in a market and the level of information. Two points emerge from this work. First, subjects' behavior is more cooperative under complete information than under incomplete. Second, as the number of subjects in a game increases, behavior becomes more competitive.

Later Development

Work done after that reported above tended to accept the results of these earlier experiments, and to move toward considering more complex variables, particularly those of a psychological nature. Friedman had looked at the responses of subjects in terms of the type of behavior exhibited by opponents in previous rounds. More of this type of research followed.

Also of interest was a movement away from characterizing behavior of subjects according to classical oligopoly models, such as those of Pareto, Bowley, or Cournot. Instead behavior came to be most often classified as cooperative or competitive, and sometimes as rivalistic. In some studies a numerical index of competitiveness of behavior was developed (7 and 14).

Johnson and Cohen

A few examples of this more complicated work will illustrate the variables to which interest was turned. Johnson and Cohen (15) reworked Fouraker and Siegel's Bargaining Behavior experiments, using business, law, and theology students as subjects. A study of values test, measuring the relative strength of six motives or value outlooks in personality, was administered to all subjects. Results pointed to a difference in behavior which was partly related to chosen career. Business students were more cooperative than were law and theology students. The results from the value preference test were somewhat inconclusive, although usually differences were in the expected direction.

Harnett, Cummings, and Hughes

Harnett, Cummings, and Hughes (11) used the Kogan Wallach Social Risk Preference test to try to explain variation in profit levels and willingness to yield from an initial position in a bargaining situation. Their results showed that profits were not related to Social Risk Preference test scores, but some negative relation did exist between risk-taking propensity and cooperative behavior.

Carlson and O'Keefe

Two empirical articles appeared in the October, 1969, Review of Economic Studies, along with a review article by Friedman (9) of earlier experimental oligopoly games. Carlson and O'Keefe (2) designed an experiment in which subjects were given a set selling price for their product along with varying costs of units of goods produced and of goods held in inventory. Subjects were business majors, but had had no formal training in inventory theory. Results showed that subjects were able to do fairly well with the problem, but that movement toward any optimal rule of inventory size was slow and sometimes nonexistant.

Sherman

Sherman's (27) "Risk Attitude and Cost Variability in a Capacity Choice Experiment" is representative of several of his experiments reported in Oligopoly (26). Subjects chose a long-run capacity size, represented by choice of a particular prisoner's dilemma matrix from several, and then chose courses of action within that game matrix. These choices, within the matrix, represented short-run decisions. Subjects were given the Kogan Wallach Social Risk Preference test. Sherman found a tendency for subjects tolerant of risk to compete more than those subjects who were more risk averse. Results from this experiment have been published in The Journal of Psychology as well (25).

Summary

This outline of previous work in experimental oligopoly games, while not exhaustive, gives the reader an idea of the direction of development. Design of experiments has been growing in complexity as well as becoming more refined. A wider range of variables within the framework of the experiment has been considered.

This Study Compared to Earlier Studies

This study deals with an oligopoly experiment in terms of price and advertising budget decisions under different levels of risk. Price as a decision variable has been common, while advertising budget has not been used.

Attempts have been made to find relationships between risk attitudes and decision variables. Other studies have also attempted to find a relationship. However, no experiments have been reported in which subjects have faced varied levels of risk.

A direct relationship can be traced from James Friedman's "An Experimental Study of Cooperative Duopoly" (8) and Roger Sherman's work with risk attitudes and capacity choice (25 and 26) to the present study. For instance, the mathematical model used in this paper is an expanded version of the model used by Friedman. Also, the manner in which the Social Risk Preference test is used is similar to Sherman's method.

CHAPTER III

FRAMEWORK OF THE EXPERIMENT

This chapter is a discussion of three important economic constructs. Oligopoly, risk, and advertising make up the framework in which the experiment reported here takes place.

Oligopoly

Importance of Reactions in Oligopoly

Needham (22) defines oligopoly as a market situation in which "... the demand conditions confronting the individual firm depend upon the firm's assumptions regarding the way in which other firms will react to its own policies..." (p. 51). He makes the point that the number of firms is unimportant, by itself, in determining whether or not a market situation is oligopolistic. Rather, the important determinant is the firms' assumptions about rivals' reactions. "Therefore, whether numbers influence behavior depends on whether numbers themselves influence each firm's expectations regarding the behavior of its rivals" (Emphasis is Needham's) (22, p. 83).

Scherer (23) expands on the importance of assumed reactions of rival firms. He states that the uncertainties which make demand curve estimation difficult interact with "... the problems of predicting oligopolistic rival reactions in a manner which undermines

the operational utility of the orthodox profit maximization calculus" (23, p. 149). The effect of actions and reactions of rivals on an oligopolistic firm's demand curve and the constant motion of the firm's environment work together to cause problems with economic theory.

Variables in Oligopoly

Regarding the theory of oligopoly pricing, Scherer (23) concludes that in order to make workable predictions, a much richer theory is needed in the study of oligopoly than for pure monopoly or pure competition. Variables which are irrelevant in the cases of pure monopoly and pure competition must be included.

Market Situation in this Study

The market situation used in this study is that of duopoly, a subset of oligopoly. All markets in which subjects participate are made up of only two firms. The feature of the experiment which makes the market situation one of oligopoly is the interdependence of a firm's decisions with that of its rival.

Risk

Risk in Early Economics

The second important element in the experimental framework presented here is the construct of risk. Discussions of the effect of risk in economics were easy to find earlier in this century. In particular, Knight's Risk, Uncertainty and Profit (18), first

published in 1921, is well known. Economists are familiar with the distinction he made between uncertainty and risk. However, according to Stigler (18), in the introduction to the latest edition of Knight's book, "Modern analysis no longer views the two classes as different in kind" (p. xiv).

Definition of Risk

An elementary level text in insurance, Greene's Risk and Insurance (10), defines risk as "the uncertainty as to the occurrence of an economic loss" (p. 2). According to this definition, risk is measured in terms of the degree of variation that actual events bear to probable events. The extent of risk is determined by the amount of possible variability of the event under consideration. Thus, an event with widely variable possible outcomes is considered to be more risky than one with less variable probable outcomes. This definition is the working definition of risk used in this study. The terms risk and uncertainty are used interchangeably.

Within price theory, economists have done little empirical work on different levels of risk which can be faced by firms under different conditions. However, within the realm of monetary economics, differentiation has been made between risk averters (those who tend to overvalue uncertain losses and to undervalue uncertain gains) and risk lovers (those who tend to overvalue uncertain gains and to undervalue uncertain losses), particularly in portfolio adjustment theories (1, p. 50).

Risk in Psychology

Psychologists have done some work in the area of determining which people are risk averters and which are risk lovers. However, much of their work is somewhat inapplicable to economics, as it deals with situations in which subjects are asked to take risks on the performance of physical acts in experiments where no reward is given.

Kogan and Wallach (19) have developed a psychological test, the Social Risk Preference Test (SRP test), which determines which subjects are risk averters and which are risk lovers. This test was used in the experiment reported here and is discussed in detail in Chapter V.

Psychology and Economics

The area of risk is one in which economists and psychologists could profitably cooperate. During the second decade of this century, there were indications that psychologists and economists would be working together on a variety of subjects. J.M. Clark (4) and Wesley C. Mitchell (20) both published articles in major economic journals urging such cooperation. Clark (4) wrote:

> The economist may attempt to ignore psychology, but it is a sheer impossibility for him to ignore human nature, for his science is a science of human behavior. Any conception of human nature that he may adopt is a matter of psychology, and any conception of human behavior that he may adopt involves psychological assumptions, whether these be explicit or no. If the economist borrows his conception of man from the psychologist, his constructive work may have some chance of remaining purely economic in character.

> But if he does not he will not thereby avoid psychology. Rather he will force himself to make his own, and it will be bad psychology (p. 4).

Little in the way of cooperation between economists and psychologists resulted.

George Katona (17) took up the idea later in the century. However, his work has centered primarily on macroeconomics, with specific emphasis on consumer behavior in the macro sense.

As far as price theory is concerned, experimental economics seems to have restored the thread of cooperation between psychologists and economists. Under experimental conditions, the effects, for example, of varied levels of risk on the behavior of risk lovers and risk averters can be studied.

Advertising

Advertising is the third construct which makes up the framework for this experiment. According to Needham (22), advertising is one of a variety of ways in which a firm can achieve product differentiation. Advertising, however, differs from style changes and research and development activities in that "Advertising is a strategy for influencing the shape or the position of the demand curve for a firm's product without changing the physical characteristics of the product" (22, p. 63).

Advertising and Oligopoly

Scherer (23) states that, on a priori grounds, one can expect to find higher levels of advertising under oligopoly than under

other market situations. However, he says, mutual interdependence of oligopolistic firms might appear to keep advertising expenditures down, as any gain from a firm's advertising expenditures might be wiped out by matching expenditures from other firms in the market. But, empirical evidence suggests that this aspect of oligopoly does not seem to hold down advertising expenditures in oligopoly. Scherer points to the difference between price and advertising strategies as a possible reason. First, it takes weeks or months to instigate a new advertising strategy, but price changes can be matched almost at once. Also, the outcome of a change in an advertising strategy is more unsure than that from a change in pricing strategy. Finally, formulating a successful advertising strategy may be more difficult than formulating price strategy.

Advertising and Risk

Not only are oligopoly and advertising closely related, but risk and advertising are also complementary ideas. Jones-Lee and Davenport (16) have published a theoretical model of advertising decision making under uncertainty. The impetus for their paper came from discussions with advertising executives in the confectionary industry. They noted that in their discussions it became clear to them that

> ... the existing body of theory concerning the promotional expenditure decision is almost completely incapable of accommodating the extensive uncertainty which is an integral part of the promotional decision in a market such as that under consideration (16, p. 261).

In Chapter IV of this study an economic experiment is described which investigates responses to varying levels of risk, attained through varying advertising results, in an oligopoly market situation. The three concepts discussed in this chapter underlie the simulated business situation in which the experiment takes place.

CHAPTER IV

EXPERIMENTAL DESIGN

Social Risk Preference Test

Recruited subjects will be* given the Kogan Wallach Social Risk Preference test** which is reproduced in Appendix A. This is a test designed to measure tolerance for risky situations on the part of subjects. The test is made up of twelve situations, each presenting a risky and a safe alternative course of action. The same alternative results in a smaller reward than does the risky alternative. The subjects are asked to state what level of probability of success they would have to be sure of in order to recommend the risky course of action. Scoring is done by averaging the probabilities of success required to accept the risky alternative from all twelve situations. Low scores indicate an acceptance of risk, while high scores indicate risk aversion.

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*The future tense is used in discussing the experiment in this chapter while in Chapter V the past tense is used. This practice is followed to indicate that those items discussed in this chapter were procedures decided upon before any part of the experiment was undertaken. Chapter V describes how the experiment actually was administered.

**Permission to use the Social Risk Preference Test was granted by Professor Michael A Wallach.

The Model

Information given subjects, as well as a measure of cooperation, are derived from the following duopoly model:

$$X_1 = a P_1 + b P_2 + d A_1 + e A_2 + f \quad (1)$$

$$C_1 = g X_1 + A_1 \quad (2)$$

$$R_1 = P_1 X_1 - C_1 \quad (3)$$

$$X_2 = a P_2 + b P_1 + d A_2 + e A_1 + f \quad (4)$$

$$C_2 = g X_2 + A_2 \quad (5)$$

$$R_2 = P_2 X_2 - C_2 \quad (6)$$

X_1 and X_2 are the quantities of X produced by firms 1 and 2 respectively. C_1 and C_2 are costs of firms 1 and 2. R_1 and R_2 are profits of firms 1 and 2. P_1 and P_2 are prices charged by firms 1 and 2. A_1 and A_2 are advertising expenditures of firms 1 and 2. Constants are represented by a, b, d, e, f, and g with a and e less than 0, and b, d, g, and f greater than 0.

A measure of cooperation S is derived from the first order conditions for maximization of industry profits, maximization of individual firm profits, and maximization of the difference between the profits of the two firms. Consider:

$$\frac{\partial (R_1 + S R_2)}{\partial P_1} = 0 \quad (7)$$

$$\frac{\partial (R_1 + S R_2)}{\partial A_1} = 0 \quad (8)$$

$$\frac{\partial (R_2 + S\ R_1)}{\partial P_2} = 0 \tag{9}$$

$$\frac{\partial (R_2 + S\ R_1)}{\partial A_2} = 0 \tag{10}$$

Equations (7) through (10) result in the following four equations:

$$\partial(aP_1^2 + bP_1P_2 + dP_1A_1 + eP_1A_2 + fP_1 - gaP_1 - gbP_2 - gdA_1 - geA_2 - gf - A_1 + S(aP_2 + bP_1P_2 + dA_2P_2 + eA_1P_2 + fP_2 - gaP_2 - gbP_1 - geA_1 - gf - A_2)) / P_1 = 0 \tag{11}$$

$$\partial(aP_1^2 + bP_1P_2 + dP_1A_1 + eP_1A_2 + fP_1 - gaP_1 - gbP_2 - gdA_1 - geA_2 - gf - A_1 + s(aP_2 + bP_1P_2 + dA_2P_2 + eA_1P_2 + fP_2 - gaP_2 - gbP_1 - geA_1 - gf - A_2)) / A_1 = 0 \tag{12}$$

$$\partial(aP_2^2 + bP_1P_2 + dP_2A_2 + eP_2A_1 + fP_2 - gaP_2 - bgP_2 - gdA_2 - geA_1 - gf - A_1 + S(aP_1 + bP_2P_1 + dA_1P_1 + eA_2P_1 + fP_1 - gaP_1 - gbP_2 - geA_2 - gf - A_1)) / P_2 = 0 \tag{13}$$

$$\partial(aP_2 + bP_1P_2 + dP_2A_2 + eP_2A_1 + fP_2 - gaP_2 - bgP_2 - gdA_2 - gdA_1 - gf - A_1 + S(aP_1 + bP_2P_1 + dA_1P_1 + eA_2P_1 + fP_1 - gaP_1 - gbP_2 - geA_2 - gf - A_1)) / A_2 = 0 \tag{14}$$

Equations (11) through (14), when the partials are taken, result in the following four equations:

$$2aP_1 + bP_2 + dA_1 + eA_2 + f - ag + S(bP_2 - bg) = 0 \tag{15}$$

$$dP_1 - gd - 1 + S(eP_2 - ge) = 0 \tag{16}$$

$$2aP_2 + bP_1 + dA_2 + eA_1 = f - ag + S(bP_1 - bg) = 0 \tag{17}$$

$$dP_2 - gd - 1 + S(eP_1 - ge) = 0 \tag{18}$$

Letting S = 1 results in the first order conditions for joint industry profit maximization. This situation will be referred to as the cooperative solution. Where S = 0, the first order conditions for individual firm profit maximization are obtained. This is the competitive solution. Letting S = -1 results in first order conditions for maximizing the difference between profits of the two firms or the rivalistic solution. Thus, S becomes an index of cooperative or competitive behavior (8).*

As mentioned in Chapter II, joint profit maximization for the industry, where S = 1, corresponds with the Pareto oligopoly model. The individual firm profit maximization solution, where S = 0, is equivalent to the Cournot model (12, p. 228). The use of S as an index of behavior allows classification of behavior on a continuum instead of restricting classification to polar cases.

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*A similar index of behavior was used by Hoggatt (12) in an experiment in which subjects played against computers. The computer was set to play a given level of behavior, a given level of S, throughout the game.

The Experiment

Preparation

Subjects for the experiment will be recruited from junior and senior level business courses. After SRP test scores are computed pairings will be made with high, medium and low scorers playing against subjects from each of the classes so tests of the behavior of one risk class will include play against partners of all risk classes. Subjects will be divided into 2/5 high scorers, 2/5 low scorers, and 1/5 medium scorers. An equal number of the following games will be played: high scorer with high scorer, high scorer with medium scorer, high scorer with low scorer, low scorer with medium scorer, and low scorer with low scorer.

Administration of the Game

At the time of the experiments, subjects will be given a profit matrix derived from the model in equations (1) through (6), along with instructions and reporting materials. (See Appendix C through Appendix G). Subjects will be asked not to discuss what they are doing among themselves. In the instructions, an attempt will be made to avoid the use of words such as game, play, competition, or rivals.

The matrix which will be given to each subject tells him what his profits will be depending on his choice of price and advertising budget and his rival's choice of price and advertising budget. The subjects choose a price and advertising budget simultaneously

with their opponent. Subjects who are in the same market will be in different rooms. These choices are collected, and profits for each subject are computed. The outcome of their decisions is then communicated back to the subjects and they are asked to make new price and advertising budget choices. The process will be repeated about twenty times with an expected time for the entire game being 90 minutes to 120 minutes. Data from approximately the eighth to the eighteenth rounds will be used in testing hypotheses in order to control for learning effects and end effects.

After the games have been completed, S values can be computed for each round of the game. The value of S for player one can be obtained by substituting the appropriate values for P_1, P_2, A_1, and A_2 in equation (15) and then solving for S.

$$S = \frac{2\,A\,P_1 + b\,P_2 + d\,A_1 + e\,A_2 + f - a\,g}{-\,b\,(P_2 - g)} \,. \qquad (19)$$

Low and High Risk Games

Games will be held on two different evenings. On the first evening, the game will proceed as described above. On the second evening, an element of risk will be added. The subjects will be told that there is a chance for any given advertising campaign to be very successful or very unsuccessful. Rounds of these games will be chosen at random in which profits will be higher or lower than is indicated by the subject's profit matrix. Subjects will be informed of this possibility in their instruction sheets. The proportion of increase or decrease in profits will be determined in

part by the advertising budget chosen for that round by the subject and in part by chance.

To summarize, two versions of the same game will be played: one with no risk except that presented by a competitor and one with additional risk added through success or failure of advertising campaigns. Subjects with high, medium, and low SRP scores will participate in both types of games.

Hypotheses

The first hypothesis to be considered is that S values for each player will converge to some value between -1 and +1, against the null hypothesis that S will take on any possible value at random. In general terms, this hypothesis simply states that subjects will be able to make some sense out of the game, as S values which are less than -1 or greater than +1 are not rational.

The second hypothesis is that risk averters will have higher S values and higher advertising budgets than risk lovers, against the null hypothesis that advertising budgets and S values will not be related to SRP scores. Those subjects who dislike taking risks can be expected to play the game in a more cooperative manner than those who are willing to take risks. By playing with higher S values, risk averters are insuring against retaliation from their competitor.

The relationship between attitude toward risk and level of advertising can be looked at in two different ways. It is possible that those who dislike taking risks may be unwilling to gamble making large advertising expenditures, as they may feel that if

their competitor also makes large advertising expenditures, gains from these large expenditures will be small. On the other hand, it is more likely that those who dislike risk may feel that, by always making large advertising expenditures, they are going to be able to minimize their competitor's profits while maximizing their own.

Risk lovers are more apt to be willing to take the chance that their competitor will outspend them on advertising. They are more willing to gamble low advertising budgets, the results of which are apt to be more variable.

The final hypothesis to be considered is that both risk averters and risk lovers playing in the high risk game will have significantly different advertising budgets and S values than those of subjects playing in the low risk game. The corresponding null hypothesis is that those subjects playing in the high risk game will have the same advertising budgets and S values as subjects playing in the low risk game. No directional change for S values and advertising budgets from the low to the high risk game is indicated. Little research has been done in this area on which to base reasoning behind a directional difference. A priori reasoning can lead one in both directions, with seemingly valid arguments in favor of a change in either direction.

This chapter has presented a general description of the design of the experiment. The actual procedures used in administering the experiment are described in the next chapter.

CHAPTER V

PROCEDURES

Before the Experiment

The Profit Table

The profit table (Appendix G) was derived from equations (1) through (6), p. 24, with a = -1,000, b = 600, d = 2, e = -1, f = 1,400, and g = 2. These constants were chosen, in part, by a trial and error method. The problem was to choose constants which resulted in non-negative values for P_1, P_2, A_1, and A_2 at relevant values of S. Also, P_1, P_2, A_1, and A_2 had to be reasonable in an economic sense. Values for P_1, P_2, and some of the constants were found by setting S equal to -1, 0, and 1 in equations (15) and (16). By experimenting with fixed values for A_1 and A_2, and the remainder of the constants, values were computed for P_1, P_2, and for some constants which were satisfactory.

Where the model yielded X_1 and X_2 less than 0, X = 0 was used. With this profit table, an average rate of return was expected to be between $1.50 and $2.00 an hour.

Table I presents prices and advertising budgets for three important values of S and for the constants given above.

TABLE I

PRICES AND ADVERTISING BUDGETS
FOR VALUES OF S

S	P_1	P_2	A_1	A_2
-1	2.3	2.3	0	0
0	2.5	2.5	100	100
1	3.0	3.0	200	200

Trial Run

After the profit table and other experimental materials (small reporting sheets, record sheet for the subject to keep trace of his profits and decisions, and instructions, reproduced in Appendix C through Appendix G) had been prepared, a trial run of the game was held, using eight volunteers. Ten rounds were completed in less than one hour, including time for explanations and instructions. Profits earned (although not paid) ranged from about one dollar an hour to a little over two dollars an hour. The participants felt that the game was easy to understand and was enjoyable to play.

Subjects

Subjects for the experiment were recruited from business classes, math classes, Accounting Club, and Business Administration Club at

Northeast Missouri State University. Recruiting was done by handing out announcements (Appendix B) at class meetings and club meetings. Students who wished to respond to the announcement were referred to an office on campus where they could pick up copies of the SRP test, sign up for one of the two evenings on which the experiment was to be administered, and return the SRP test. The SRP test was referred to as a questionnaire. SRP tests were to be returned by Friday preceding the week in which the experiment was to be administered.

Fifty students signed up, 30 for Monday when the low risk game was to be administered, and 20 for Wednesday when the high risk game was to be administered. Twenty-seven subjects reported on Monday and 16 on Wednesday. Fifteen of the subjects were female and 28 were male.

Pairings

From scores on SRP tests, pairings were made from high, medium and low scores. SRP scores from 6.33 up were called high. Those between 5.00 and 6.33 were called medium. A score of 5.00 or less was called low. Three each of the following pairings were set up for Monday evening as well as two each for Wednesday: high with high, high with medium, high with low, low with low, and low with medium.

The scores on the SRP test ranged from a high of 8.83 to a low of 3.33. The distribution of scores is given in Table II.

TABLE II

DISTRIBUTION OF SRP SCORES

Range	Number of Scores
8.00 - 9.00	2
7.00 - 8.00	8
6.00 - 7.00	16
5.00 - 6.00	8
4.00 - 5.00	14
3.00 - 4.00	2

After pairings were made, each subject's name was associated with a number on a master list of names with numbers one and two being competitors, three and four competing, and so on. Cards were made out with a number and room number, odd numbers being assigned to one room and even numbers to another.

Procedures

General Procedures

Subjects had been asked to report by 7 P.M. to the same office where they had returned their questionnaires. Previous to this, the class rooms where subjects were to be sent for the experiment had been set up with an instruction sheet, recording materials, and a profit table placed on each desk.

As subjects reported to the office, their names were crossed off the master list. They were given a card and told their number. They were sent to the appropriate room. When all subjects had reported, a monitor went to each room and asked them to sit in numerical order (1, 3, 5, ...) in order to facilitate collection of decisions. Subjects were then asked if they had read the instructions and if they had any questions. This was done simultaneously in the two rooms. The monitors who did this in the two rooms had discussed how to answer possible questions so that subjects in both rooms would be given comparable information. In addition to the information in the instruction sheets, subjects were reminded that they could not lose any of their own money, that they would be paid at the end of the game, and that their competitor was in a different room. Subjects were given an example of use of the profit table. They were told that the profit tables for the other firm in their market were similar to their own. Then subjects were asked to make their first decisions.

Computation of profits as well as picking up and returning reporting sheets was done by two students, a secretary, the author's spouse and the author, all referred to as monitors. After the pairings from the SRP tests had been made, five large record sheets had been prepared with spaces for two or three pairs of competitors. These sheets contained columns for price and advertising decisions, profits and a running total of profits for each competitor. Each of the five monitors was responsible for one sheet.

Subjects were not monitored at all times. However, they had been asked in the instructions not to discuss the game among themselves, and little discussion seemed to take place. This situation

is a middle ground between other experiments in which each subject was physically isolated from others (8) and those in which subjects were given materials several days before the actual experiment took place and were not cautioned in any way against discussing the experiment with other subjects (2).

After profits for the first round had been computed and recorded, the reporting slips showing the subject's profit and that of the other firm in his market were returned. Subjects were asked to make new choices and the process was repeated. At the end of the third round, subjects were asked if they had any questions. Subjects were paid their profits starting with the fourth round.

Low Risk Game Procedures

On Monday evening, an odd number of subjects reported, so one of the monitors played against one of the subjects. The information from this market was not used in the experiment, but the subject was treated like all other subjects and was paid. As not all of the subjects who had signed up for the experiment reported to play, a few changes in pairings had to be made at the last minute.

Subjects were told after the eighteenth round that the next round would be the final one. Play had lasted from about 7:15 until 8:45. After profits were computed for the last round, monitors took their record sheets into the rooms where subjects were waiting. Each of the monitors had been given signed checks made out to the subjects for whom they had been computing profits. Monitors checked profit totals with each of the subjects. If the subject had made profits of less than a dollar for the evening, his

check was made out for one dollar. Subjects were also told the number of their competitor.

High Risk Game Procedures

The high risk session on Wednesday evening followed the procedure for Monday evening. Instructions for the high risk session contained a paragraph not included in the instructions for the low risk game:

> To make this simulated business environment more realistic, you will occasionally encounter a situation in which your advertising campaign is very successful or very unsuccessful. In these cases your profits will be much higher or lower than is indicated on the profit sheet. There is no way of you knowing when such a situation will occur. In these cases, the difference between the profits you actually receive and those shown on the profit sheet is determined in part by the size of your advertising budget and in part by chance (Appendix C).

This aspect was emphasized in oral instructions given to the subjects. Other oral and written instructions to subjects were exactly like those given to subjects playing in the low risk game.

Again, a few changes had to be made in pairings at the last minute as not all subjects reported. However, an even number did report so that data from all subjects could be used.

The following rounds were chosen in which profits differed from those shown on the profit table: 2, 3, 7, 12, 16, 17, and 19. Profits received were computed by:

$$\text{profits received} = \text{profits shown} + r\,A \qquad (20)$$

with r taking the values 2, -7, 9, -4, 3, 7, -8, for rounds 2, 3, 7, 12, 16, 17, and 19 respectively. These values of r were chosen partly at random from integers from -10 to +10 and partly in such a way that, if subjects always chose the same value of A for these

rounds, the sum of profit deviations would be slightly greater than 0.

After the nineteenth round, subjects were told that the next round would be the last. Play lasted from about 7:15 until 8:30.

After the Game

Average payoff for the evening for the low risk game was $2.29 with a high of $3.48 and a low of $.57. Average payoff for the high risk game was $1.88 with a high of $4.62 and a low of $0.00. All checks were cashed within a few days, even those for one dollar.

Following the experiments, data was collected and sorted. Subjects had been asked to leave all materials in the rooms following the experiment, so several checks on accuracy of data were available, including monitor's work sheets, reporting slips, and subject's work sheets. Data was then recorded with each subject's information going on one sheet, including price decisions, advertising decisions, profits and S values for each round as well as SRP score and high or low risk game.

CHAPTER VI

STATISTICAL ANALYSIS

Nonparametric Statistics

The social scientist working with data from an experiment is faced with two broad types of statistical tests available for testing hypotheses: parametric and nonparametric. Data measured in nominal or ordinal scales should be analyzed by nonparametric methods in order to obtain valid conclusions. Data measured in interval or ratio scales may be analyzed using either parametric or nonparametric methods. In addition, parametric tests are derived from models specifying certain conditions about the parameters of the population from which the research sample is drawn. The meaningfulness of parametric tests depends, then, on the validity of assumptions which the researcher must make concerning parameters (29, p. 19).

Siegel (29) lists the conditions upon which a parametric statistical test is based:

> 1. The observations must be independent. That is, the selection of any one case from the population for inclusion in the sample must not bias the chance of any other case for inclusion, and the score which is assigned to any case must not bias the score which is assigned to any other case.
>
> 2. The observations must be drawn from normally distributed populations.

> 3. These populations must have the same variance (or, in special cases, they must have a known ratio of variances).
>
> 4. The variables involved must have been measured in at least an interval scale, so that it is possible to use the operations of arithmetic (adding, dividing, finding means, etc.) on the scores (p. 19).

For these reasons, (in particular number 4, but also to escape doubts about 1, 2, and 3) nonparametric tests have been used in testing the data derived from the experiment described in Chapter IV. Both the SRP scores and the restriction of advertising choices to $0, $100, and $200 tend to limit choice of tests to nonparametric methods.

Data Organization

Data sheets, one for each subject, were divided into four groups, according to SRP scores and high or low risk game. SRP scores of 6.00 or more were labeled high while those below 6.00 were called low. Nine subjects playing in the high risk game had high SRP scores. Seven subjects playing in the high risk game had low SRP scores. Of those subjects playing in the low risk game, twelve had high SRP scores and fourteen had low SRP scores. Data from round seven through round sixteen was used from both games.

Statistical Tests

Binomial Test

The first test made, using the binomial test, was to test whether or not S values between -1 and +1 occurred more frequently than did S values greater than +1 or less than -1. Table III contains the

information used in this test.

TABLE III

S VALUES

	S Between -1 and +1	S Less Than -1 or Greater Than +1	Total
Possible	329	571	900
Actual	329	91	420

According to the binomial test corrected for continuity, the probability of 329 of 420 S values between -1 and +1 occurring at random is less than .001 (29, pp. 41 and 247).

Chi Square Test

The chi-square test for k independent samples was used for the remaining statistical analysis. This test is used to determine the significance of the differences among k independent groups. Data frequencies are arranged in a k by r table. To test the null hypothesis that k samples of frequencies have come from the same or identical populations, the following formula is used:

$$X^2 = \frac{\sum_{i=1}^{k} \sum_{j=1}^{r} (O_{ij} - E_{ij})^2}{E_{ij}} \qquad (21)$$

where O_{ij} is the observed number of cases in the ith row of the jth column and E_{ij} is the number of cases expected. E_{ij} is computed by multiplying the appropriate marginal totals from the k by r table and dividing by the total number of cases. Degrees of freedom for the chi-square test are equal to (r - 1) (k - 1) (29, pp. 105 and 175).

The chi-square test may be used in cases where frequencies in the k by r table are not too small. Siegel cites the rule that where degrees of freedom are larger than one, fewer than 20 percent of the cells should have an expected frequency of less than five, and no cells should have an expected frequency of less than one. If these requirements are not met, categories must be combined in order to meaningfully apply the chi-square test (29, p. 110).

The chi-square test was applied to differences in price choices, advertising choices, S values, and profits between risk averters and risk lovers in the low risk game, between risk averters and risk lovers in the high risk game, between risk averters playing in the low risk game and the high risk game, and between risk lovers playing in the low risk game and the high risk game. Thus, sixteen tests were made, four each concerning profits, advertising budgets, S values, and prices.

Results

Tables IV through XI in Appendix H give information used in computing the chi-square statistic in each case, as well as the information presented in percentage form and significance levels for each situation.

Tables IV and V present the distribution of prices chosen by risk averters and risk lovers who played in the two games. In order to follow the rule concerning number of frequencies required per cell, price choices of 2.1, 2.2, and 2.3 were combined, as were those of 2.8, 2.9, and 3.0. The results indicate that risk averters and risk lovers did choose prices differently from each other, both in the high risk game and the low risk game. But prices chosen by risk averters were only slightly affected by the game in which subjects participated. This is also the case with risk lovers.

The same pattern does not hold true for advertising choices, as can be seen in Tables VI and VII, Appendix H. Here choice of advertising budget was significantly different at the .05 level between risk averters and risk lovers in the low risk game. Risk lovers made advertising choices which were significantly different at the .001 levels between the low risk and high risk games. Similarly risk averters chose advertising budgets differently between the two games, also with a significance level of .001. Thus, it seems that subjects treated advertising choices differently than price choices.

Tables VIII and IX in Appendix H deal with S values. Very little difference in S values computed from play of risk averters and risk lovers was found. Also, risk averters played in such a way as to result in only slightly different S value distributions in the low risk game versus the high risk game. However, risk lovers did change strategies, rather dramatically, in such a way to result in a difference, significant at the .01 level, in S values between the high and low risk games.

Tables X and XI refer to profits. First, it is interesting to note that the high risk game resulted in more widely dispersed profits for both risk lovers and risk averters than did the low risk game. In the low risk game, risk averters and risk lovers made profits which were significantly different at the .05 level. However, there was no significant difference in profits made by risk averters and risk lovers in the high risk game. There were large differences in profits between the two games for risk lovers, as there were for risk averters, both significant at a level of .001.

Interpretation of Results

Hypothesis One

How does this information relate to the hypotheses stated in Chapter IV? Hypothesis one is that S values will converge, for each player, to some level between -1 and +1. This hypothesis must be rejected. As a crude test of this hypothesis, it was found that no significant difference existed between the number of S values which were between -1 and +1 in the first half of round seven through round sixteen and the S values between -1 and +1 in the second half of those rounds, in either game. However, by far more values were between -1 and +1 proportionately, than were less than -1 or greater than +1.

Hypothesis Two

Hypothesis two was stated as follows: Risk averters will have higher S values and higher advertising budgets than risk lovers. As

far as S values are concerned, there is no significant difference between S values of risk lovers and risk averters in either the low risk game or the high risk game. In the high risk game, advertising choices were only slightly different between risk averters and risk lovers. In the low risk game, the distribution of advertising choices was significantly different, but not in the direction hypothesized. Rather, risk averters had more advertising choices of $0 and $200, while risk lovers had more advertising choices of $100.

Hypothesis Three

Hypothesis three, that both risk averters and risk lovers playing in the high risk game will have significantly different advertising budgets and S values than those of subjects playing in the low risk game can be more readily accepted. S values of risk lovers were significantly different in the two games, as were advertising choices. Risk averters' S values were only slightly different (the difference being significant at the .20 level) but their advertising choices were significantly different in the two games. For S values of risk lovers, the difference seems to be in the distribution, rather than in more high or low values. Both risk lovers and risk averters had more advertising choices of $200 in the low risk game than in the high risk game.

Additional Information

Some additional useful information can be gleaned from the data. First, subjects did seem to be able to handle the complicated format of the game. It is possible that their S values did not begin to

converge to any particular value because the subjects were not given time to play enough rounds of the game. On the other hand, it is possible that the game was such that subjects would continue to try to better their positions, thus, not settling on any one strategy, even after many rounds of play.

No hypotheses were formulated concerning prices. Risk averters chose lower prices, by far, than did risk lovers. In the low risk game, risk lovers chose prices of 2.6 or more 52% of the time, while risk averters chose prices of 2.6 or more 37% of the time. In the high risk game, prices of 2.6 or more were chosen by risk lovers in 41% of the cases, but only in 25% of the cases by risk averters.

Of the sixteen chi-square tests performed, nine were significant at the .05 level or better, while seven were not. Differences between risk averters and risk lovers in the low risk game were significant for prices, advertising choices, and profits. Price was the only variable with significant differences between risk lovers and risk averters in the high risk game. Risk lovers had significant differences in S values, advertising choices, and profits between the low and high risk games, while risk averters had significant differences in advertising choices and profits between the two games.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Summary

Do subjects with different attitudes toward risk choose different strategies in a business game? How do subjects with different attitudes toward risk react under varied levels of risk? These are the questions to which this study is addressed.

The business game used is a duopoly situation with subjects making price and advertising budget choices. The level of risk is varied through results of advertising budgets. An index of competitiveness, S, and a measure of risk attitude, SRP scores, are used.

Results

Some information was gained through statistical analysis of data generated by the experiment. First, subjects were able to handle the relatively complicated game. Second, the SRP test was successful in discriminating between subjects who behaved differently as far as prices, advertising choices, and profits were concerned in the low risk game. However, this discriminatory ability broke down in the high risk game in every case but that of prices. The SRP scores did not discriminate between different S values for either game. One possible reason is that pairings were made such

that both high and low SRP scorers played against each other. The values are computed using both the choices of the subject under question and those of his opponent.

One interesting possible conclusion which should be considered is that, as risk increases, subjects, both risk averters and risk lovers, tend to behave in a more erratic fashion. Both types of subjects significantly changed their advertising choices in the high risk game relative to the low risk game, while price choices did not significantly change between the two types of game of either risk lovers or risk averters.

Organization of Experiments

A researcher who wishes to work with experimental economics might benefit from some technical points apparent in this paper. First, hypotheses should have been formulated to follow more closely statistical methods available. Also, hypothesis one was not worded properly to reflect what was actually intended to be tested by it. The question of how detailed hypotheses formulation should be remains unclear.

From the conduct of this experiment it seems that the number of subjects participating in an experiment at any one time should be kept small in order to facilitate the administration of the experiment. Subjects should not be rushed in making decisions, but neither should they be forced to wait long periods of time between rounds. Amount of time needed to compute profits for each round varied significantly between the low risk game, with twenty-seven subjects, and the high risk game, with sixteen subjects, even though profit computation was

more complicated on several rounds in the high risk game. Many such problems can be solved only by repeated work in the area.

Suggestions for Further Work

This experiment opens up suggestions for further work in two areas. First, some additional research on the SRP test could be done. Some items need to be rewritten. For example, "Mr. C, a married man with two children, has a steady job that pays him about $6,000 per year," no longer implies that the man is making a comfortable wage. Also, additional situations should be constructed, and an attempt made to do an item analysis on the questions already in the test as well as new possibilities. Some other possible method of scoring the SRP test should be investigated. Presently, the only score is the mean of answers on the twelve questions. A possible topic for investigation is the distribution of each subject's answers on the test.

In the area of experimental economics, the experiment presented here could be repeated profitably with varied levels of risk in the high risk game, in the form of different distributions of rounds with results which vary from the profit table, as well as different distributions of possible profit deviations.

Many other types of economic experimental games could be investigated. One intriguing possibility if a game designed to test differences in the behavior of subjects acting as managers and as owners in making decisions. Another possibility is an investigation, on a subject-by-subject basis, of types of strategies used in a simple economic game compared with game theory strategies.

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APPENDIX A

SOCIAL RISK PREFERENCE TEST

NAME_____

This questionnaire is made up of twelve different situations. You are to read each situation and "advise" the person who is faced with the situation by answering a multiple choice type question. There are no "right" or "wrong" answers.

Please answer each of the twelve questions. Give only one answer. Consider each situation separately from the others. Take your time. There is no time limit.

1. Mr. A, an electrical engineer, who is married and has one child, has been working for a large electronics corporation since graduation from college five years ago. He is assured of a lifetime job with a modest, though adequate, salary, and liberal pension benefits upon retirement. On the other hand, it is very unlikely that his salary will increase much before he retires. While attending a convention, Mr. A is offered a job with a small, newly founded company which has a highly uncertain future. The new job would pay more to start and would offer the possibility of a share in the ownership if the company survived the competition of the larger firms.

Imagine that you are advising Mr. A. Listed below are several probabilities or odds of the new company's proving financially sound.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. A TO TAKE THE NEW JOB.

____ The chances are 1 in 10 that the company will prove financially sound.

____ The chances are 3 in 10 that the company will prove financially sound.

____ The chances are 5 in 10 that the company will prove financially sound.

____ The chances are 7 in 10 that the company will prove financially sound.

____ The chances are 9 in 10 that the company will prove financially sound.

____ Place a check here if you think Mr. A should not take the new job no matter what the probabilities.

2. Mr. B, a 45 year-old accountant, has recently been informed by his physician that he has developed a severe heart ailment. The disease would be sufficiently serious to force Mr. B to change many of his strongest life habits--reducing his work load, drastically changing his diet, giving up favorite leisure-time pursuits. The physician suggests that a delicate medical operation could be attempted which, if successful, would completely relieve the heart condition. But its success could not be assured, and in fact, the operation might prove fatal.

Imagine that you are advising Mr. B. Listed below are several probabilities or odds of the operation being a success.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. B TO UNDERGO THE OPERATION.

____ Place a check here if you think Mr. B should not undergo the operation no matter what the probabilities.

____ The chances are 9 in 10 that the operation will succeed.

____ The chances are 7 in 10 that the operation will succeed.

____ The chances are 5 in 10 that the operation will succeed.

____ The chances are 3 in 10 that the operation will succeed.

____ The chances are 1 in 10 that the operation will succeed.

3. Mr. C, a married man with two children, has a steady job that pays him about $6000 per year. He can easily afford the necessities of life, but few of the luxuries. Mr. C's father, who died recently, carried a $4000 life insurance policy. Mr. C would like to invest this money in stocks. He is well aware of the secure "blue-chip" stocks and bonds that would pay approximately 6% on his investment. On the other hand, Mr. C has heard that the stocks of a relatively unknown company X might double their present value if a new product currently in production is favorably received by the buying public. However, if the product is unfavorably received, the stocks would decline in value.

Imagine that you are advising Mr. C. Listed below are several probabilities or odds of the product being favorably received.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. C TO BUY STOCK IN COMPANY X.

____ The chances are 1 in 10 that the product is favorably received.

____ The chances are 3 in 10 that the product is favorably received.

____ The chances are 5 in 10 that the product is favorably received.

____ The chances are 7 in 10 that the product is favorably received.

____ The chances are 9 in 10 that the product is favorably received.

____ Place a check here if you think Mr. C should not buy the stock in company X no matter what the probabilities.

4. Mr. D is the captain of College S's football team. College S is playing its traditional rival, College R, in the final game of the season. The game is in its final seconds, and Mr. D's team, College S, is behind in the score. College S has time to run one more play. Mr. D, the captain, must decide whether it would be best to settle for a tie score with a play which would be almost certain to work; or, on the other hand, should he try a more complicated and risky play which could bring victory if it succeeded, but defeat if not.

Imagine that you are advising Mr. D. Listed below are several probabilities or odds of the complicated play succeeding.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. D TO CHOOSE THE COMPLICATED PLAY.

____ Place a check here if you think Mr. D should not choose the complicated play no matter what the probabilities.

____ The chances are 9 in 10 that the complicated play will succeed.

____ The chances are 7 in 10 that the complicated play will succeed.

____ The chances are 5 in 10 that the complicated play will succeed.

____ The chances are 3 in 10 that the complicated play will succeed.

____ The chances are 1 in 10 that the complicated play will succeed.

5. Mr. E is president of a light metals corporation in the United States. The corporation is quite prosperous, and has strongly considered the possibilities of business expansion by building an additional plant in a new location. The choice is between building another plant in the United States, where there would be a moderate return on the initial investment, or building a plant in a foreign

country. Lower labor costs and easy access to raw materials in that country would mean a much higher return on the initial investment. On the other hand, there is a history of political instability and revolution in the foreign country under consideration. In fact, the leader of a small minority party is committed to nationalizing, that is, taking over all foreign investments.

Imagine that you are advising Mr. E. Listed below are several probabilities or odds of the foreign country's political situation remaining stable.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. E TO BUILD THE PLANT IN THE FOREIGN COUNTRY.

____ The chances are 1 in 10 that the country will remain stable.

____ The chances are 3 in 10 that the country will remain stable.

____ The chances are 7 in 10 that the country will remain stable.

____ The chances are 9 in 10 that the country will remain stable.

____ Place a check here if you think Mr. E should not build the plant in the foreign country no matter what the probabilities.

6. Mr. F is currently a college senior who is very eager to pursue graduate study in chemistry leading to the Ph.D. degree. He has been accepted by both University X and University Y. University X has a world-wide reputation for excellence in chemistry. While a degree from University X would signify outstanding training in this field, the standards are so very rigorous that only a fraction of the degree candidates actually receive the degree. University Y, on the other hand, has much less of a reputation in chemistry, but

almost everyone admitted is awarded the Ph.D. degree, though the degree has much less prestige than the corresponding degree from University X.

Imagine that you are advising Mr. F. Listed below are several probabilities or odds of Mr. F successfully completing his studies at University X.

PLEASE CHECK THE LOWEST PROBABILITY YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. F TO ATTEND UNIVERSITY X.

____ Place a check here if you think Mr. F should not attend University X no matter what the probabilities.

____ The chances are 9 in 10 that Mr. F will get a Ph.D. degree at University X.

____ The chances are 7 in 10 that Mr. F will get a Ph.D. degree at University X.

____ The chances are 5 in 10 that Mr. F will get a Ph.D. degree at University X.

____ The chances are 3 in 10 that Mr. F will get a Ph.D. degree at University X.

____ The chances are 1 in 10 that Mr. F will get a Ph.D. degree at University X.

7. Mr. G, a competent chess player, is participating in a national chess tournament. In an early match he draws the top-favored player in the tournament as his opponent. Mr. G has been given a relatively low ranking in view of his performance in previous tournaments. During the course of his play with the top-favored man, Mr. G notes the possibility of a deceptive though risky maneuver

which might bring him a quick victory. At the same time, if the attempted maneuver should fail, Mr. G would be left in an exposed position, and defeat would almost certainly follow.

Imagine you are advising Mr. G. Listed below are several probabilities or odds of the maneuver being successful.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. G TO ATTEMPT THE MANEUVER.

____ The chances are 1 in 10 of the maneuver being successful.

____ The chances are 3 in 10 of the maneuver being successful.

____ The chances are 5 in 10 of the maneuver being successful.

____ The chances are 7 in 10 of the maneuver being successful.

____ The chances are 9 in 10 of the maneuver being successful.

____ Place a check here if you think Mr. G should not try the maneuver no matter what the probabilities.

8. Mr. H, a college senior, has studied the piano since childhood. He has won amateur prizes and given small recitals, suggesting that Mr. H has considerable musical talent. As graduation approaches, Mr. H has the choice of going to medical school to become a physician, a profession which would bring certain prestige and financial rewards, or entering a conservatory of music for advanced training with a well-known pianist. Mr. H realizes that even upon completion of his piano studies, which would take many more years and a lot of money, success as a concert pianist would not be assured.

Imagine that you are advising Mr. H. Listed below are several probabilities or odds of Mr. H "making it big" as a musician.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER

ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. H TO PURSUE A CAREER IN MUSIC.

____ Place a check here if you think Mr. H should not pursue a career in music no matter what the probabilities.

____ The chances are 9 in 10 that Mr. H will make it big as a musician.

____ The chances are 7 in 10 that Mr. H will make it big as a musician.

____ The chances are 5 in 10 that Mr. H will make it big as a musician.

____ The chances are 3 in 10 that Mr. H will make it big as a musician.

____ The chances are 1 in 10 that Mr. H will make it big as a musician.

9. Mr. J is an American captured by the enemy in World War II and placed in a prisoner-of-war camp. Conditions in the camp are quite bad, with long hours of hard physical labor and a barely sufficient diet. After spending several months in this camp, Mr. J notes the possibility of escape by concealing himself in a supply truck that shuttles in and out of camp. Of course, there is no guarantee that the escape would prove successful. Recapture by the enemy could well mean execution.

Imagine that you are advising Mr. J. Listed below are several probabilities or odds of Mr. J not getting caught.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. J TO ATTEMPT THE ESCAPE.

____ The chances are 1 in 10 that Mr. J will not get caught.

____ The chances are 3 in 10 that Mr. J will not get caught.

____ The chances are 5 in 10 that Mr. J will not get caught.

____ The chances are 7 in 10 that Mr. J will not get caught.

____ The chances are 9 in 10 that Mr. J will not get caught.

____ Place a check here if you think Mr. J should not attempt to escape no matter what the probabilities.

10. Mr. K is a successful businessman who has participated in a number of civic activities of considerable value to the community. Mr. K has been approached by the leaders of his political party as a possible congressional candidate in the next election. Mr. K's party is a minority party in the district, though the party has won occasional elections in the past. Mr. K would like to hold political office, but to do so would involve a serious financial sacrifice, since the party has insufficient campaign funds. He would also have to endure the attacks of his political opponents in a hot campaign.

Imagine that you are advising Mr. K. Listed below are several probabilities or odds of Mr. K winning the election.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. K TO RUN FOR OFFICE.

____ Place a check here if you think Mr. K should not run for office no matter what the probabilities.

____ The chances are 9 in 10 that Mr. K will win the election.

____ The chances are 7 in 10 that Mr. K will win the election.

____ The chances are 5 in 10 that Mr. K.will win the election.

____ The chances are 3 in 10 that Mr. K will win the election.

____ The chances are 1 in 10 that Mr. K will win the election.

11. Mr. L, a married 30-year-old research physicist, has been given a 5-year appointment by a major university laboratory. As he contemplates the next 5 years, he realizes that he might work on a difficult long-term problem which, if a solution could be found,

would resolve basic scientific issues in the field and bring scientific honors. If no solution were found, however, Mr. L would have little to show for his 5 years in the laboratory, and this would make it hard for him to get a good job afterwards. On the other hand, he could, as most of his professional associates are doing, work on a series of short-term problems where solutions would be easier to find, but where the problems are of lesser scientific importance.

Imagine that you are advising Mr. L. Listed below are several probabilities or odds of Mr. L solving the long-term problem.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. L TO TRY THE LONG-TERM PROBLEM.

____ The chances are 1 in 10 that Mr. L will solve the long-term problem.

____ The chances are 3 in 10 that Mr. L will solve the long-term problem.

____ The chances are 5 in 10 that Mr. L will solve the long-term problem.

____ The chances are 7 in 10 that Mr. L will solve the long-term problem.

____ The chances are 9 in 10 that Mr. L will solve the long-term problem.

____ Place a check here if you think Mr. L should not try to solve the long-term problem no matter what the probabilities.

12. Mr. M is contemplating marriage to Miss T, a girl whom he has known for a little more than a year. Recently, however, a number of arguments have occurred between them, suggesting some sharp differences of opinion in the way each views certain matters. Indeed, they decide to seek professional advice from a marriage counselor as to whether it would be wise for them to marry. On the basis of these meetings with a marriage counselor, they realize that a happy marriage, while possible, would not be assured.

Imagine that you are advising Mr. M. Listed below are several probabilities of their marriage being a happy one.

PLEASE CHECK THE LOWEST PROBABILITY THAT YOU WOULD CONSIDER ACCEPTABLE TO MAKE IT WORTHWHILE FOR MR. M TO MARRY MISS T.

____ Place a check here if you think Mr. M should not marry Miss T no matter what the probabilities.

____ The chances are 9 in 10 that the marriage will be happy.

____ The chances are 7 in 10 that the marriage will be happy.

____ The chances are 5 in 10 that the marriage will be happy.

____ The chances are 3 in 10 the marriage will be happy.

____ The chances are 1 in 10 the marriage will be happy.

APPENDIX B

SUBJECT RECRUITING NOTICE

WANTED: PEOPLE INTERESTED IN PARTICIPATING IN A RESEARCH PROJECT IN DECISION MAKING

PARTICIPANTS WILL BE PAID. The amount you receive will depend on your decisions.

REQUIREMENTS: 1. Fill out a questionnaire and return it ahead of time.

2. Participate in the project for approximately two hours.

Questionnaires can be picked up in VH 286 from Dr. Weber. Return them to VH 286 by March 22, at the latest.

The actual project will be carried out Monday, March 25, 7 to 9 p.m., and Wednesday, March 27, 7 to 9 p.m.

Participants have their choice of dates. When you return the questionnaire, sign up for the date you prefer.

Report to VH 286 by 7 p.m. on Monday or Wednesday. Participants will be given a simulated business environment and will be asked to make choices between various simple pricing and advertising policies.

If you have questions, call 665-5121, ext. 2758, or 665-5023.

APPENDIX C

INSTRUCTIONS FOR LOW RISK GAME

INSTRUCTIONS

You are about to take part in a project which has been designed to allow you to earn an appreciable amount of money. The amount you earn will be determined by how carefully you follow instructions, and by your decisions in a number of situations. You will keep all the money you earn. You cannot lose your own money, but poor decisions will result in little or no profit to you.

You are going to be in the role of a businessman, and we are going to provide you with a simulated business environment. You and one other businessman are producers of similar products which you sell in the same market. In each time period you and the other seller in your market must make decisions as to the price you want to charge for your product and the amount of money you want to spend on advertising.

You have been given a profit table which shows the amount of money you will earn for each price and advertising budget combination you choose. Notice that the amount you earn depends not only on your price and advertising budget decisions, BUT ALSO ON THOSE OF THE OTHER SELLER IN YOUR MARKET. For example, if you choose an advertising budget of $100 and a price of 2.3, your profit will be 11¢ if the other seller in your market chooses an advertising budget of $100 and a price of 2.5. But your profit will be 1¢ if he chooses an advertising budget of $200 and a price of 2.1.

We will go through two practice rounds, for which there will be no profit or loss, to make sure you understand what you are to do. You may ask questions at any time during these rounds. Then we will go through approximately twenty rounds. You will be notified of your profits at the end of each round.

After you have made a decision as to price and advertising budget, record them on the small sheets and also on your master record sheet. The small sheets will be picked up, profits computed, and you will be informed of your profits at the end of each round. You are to record the amount of profit for each round on your master sheet also. Then the process will be repeated.

When all rounds are completed you will be paid your profits in cash. You are to turn in all small sheets and your master record sheet at the end of the project.

Please do not talk about your decisions with anyone else in the room. The other students in this room are selling in different markets. The other seller in your market is in another room.

Please do not discuss the project with any of your friends. Projects will be running all week. These projects are different. Information you give anyone else may only confuse them and keep them from earning money.

Are there any questions?

APPENDIX D

INSTRUCTIONS FOR HIGH RISK GAME

INSTRUCTIONS

You are about to take part in a project which has been designed to allow you to earn an appreciable amount of money. The amount you earn will be determined by how carefully you follow instructions, and by your decisions in a number of situations. You will keep all the money you earn. You cannot lose your own money, but poor decisions will result in little or no profit to you.

You are going to be in the role of a businessman, and we are going to provide you with a simulated business environment. You and one other businessman are producers of similar products which you sell in the same market. In each time period you and the other seller in your market must make decisions as to the price you want to charge for your product and the amount of money you want to spend on advertising.

You have been given a profit table which shows the amount of money you will earn for each price and advertising budget combination you choose. Notice that the amount of money you earn depends not only on your price and advertising budget decisions, BUT ALSO ON THOSE OF THE OTHER SELLER IN YOUR MARKET. For example, if you choose an advertising budget of $100 and a price of 2.3, your profit will be 11¢ if the other seller in your market chooses an advertising budget of $100 and a price of 2.5. But your profit will be 1¢ if he chooses an advertising budget of $200 and a price of 2.1.

To make this simulated business environment more realistic, you will occasionally encounter a situation in which your advertising campaign is very successful or very unsuccessful. In these cases your profits will be much higher or much lower than is indicated on the profit sheets. There is no way of your knowing when such a situation will occur. In these cases, the difference between the profits you actually receive and those shown on the profit sheet is determined in part by the size of your advertising budget and in part by chance.

We will go through two practice rounds, for which there will be no profit or loss, to make sure you understand what you are to do. You may ask questions at any time during these rounds. Then we will go through approximately twenty rounds. You will be notified of your profits at the end of each round.

After you have made a decision as to price and advertising budget, record them on the small sheets and also on your master record sheet. The small sheets will be picked up, profits computed, and you will be informed of your profits at the end of each round. You are to record the amount of profit for each round on your master sheet also. Then the process will be repeated.

When all rounds are completed you will be paid your profits in cash. You are to turn in all small sheets and your master record sheet at the end of the project.

Please do not talk about your decisions with anyone else in the room. The other students in this room are selling in different markets. The other seller in your market is in another room.

Please do not discuss the project with any of your friends. Projects will be running all week. These projects are different. Information you give anyone else may only confuse them and keep them from earning money.

Are there any questions?

APPENDIX E

DECISION REPORTING SHEET

Round No. ____ Your No. ____

Advertising expenditure ____

Price ____

Your profits ____

Other seller's profits ____

APPENDIX F

SUBJECT'S RECORD SHEET

MASTER RECORD SHEET

Round No.	Advertising Expenditure	Price	Your Profits	Other Seller's Profits
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Round No.	Advertising Expenditure	Price	Your Profits	Other Seller's Profits
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

APPENDIX G

PROFIT TABLE

YOUR PROFIT TABLE WHEN YOUR ADVERTISING BUDGET = $0

Your Price	Other Seller's Advertising	Other Seller's Price 2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
2.1	0	6	6	7	7	8	9	9	10	10	11
2.1	100	5	5	6	6	7	8	8	9	9	10
2.1	200	4	4	5	5	6	7	7	8	8	9
2.2	0	9	10	12	13	14	15	16	18	19	20
2.2	100	7	8	10	11	12	13	14	16	17	18
2.2	200	5	6	8	9	10	11	12	14	15	16
2.3	0	11	13	14	16	18	20	22	23	25	27
2.3	100	8	10	11	13	15	17	19	20	22	24
2.3	200	5	7	8	10	12	14	16	17	19	21
2.4	0	10	13	15	18	20	22	25	27	30	32
2.4	100	6	9	11	14	16	18	21	23	26	28
2.4	200	2	5	7	10	12	14	17	19	22	24
2.5	0	8	11	14	17	20	23	26	29	32	35
2.5	100	3	6	9	12	15	18	21	24	27	30
2.5	200	0	1	4	7	10	13	16	19	22	25
2.6	0	4	7	11	14	18	22	25	29	32	36
2.6	100	0	1	5	8	12	16	19	23	26	30
2.6	200	0	0	0	2	6	10	13	17	20	24
2.7	0	0	1	6	10	14	18	22	27	31	35
2.7	100	0	0	0	3	7	11	15	20	24	28
2.7	200	0	0	0	0	0	4	8	13	17	21
2.8	0	0	0	0	3	8	13	18	22	27	32
2.8	100	0	0	0	0	0	5	10	14	19	24
2.8	200	0	0	0	0	0	0	2	6	11	16
2.9	0	0	0	0	0	0	5	11	16	22	27
2.9	100	0	0	0	0	0	0	2	7	13	18
2.9	200	0	0	0	0	0	0	0	0	4	9
3.0	0	0	0	0	0	0	0	2	8	14	20
3.0	100	0	0	0	0	0	0	0	0	4	10
3.0	200	0	0	0	0	0	0	0	0	0	0

YOUR PROFIT TABLE WHEN YOUR ADVERTISING BUDGET = $100

Your Price	Other Seller's Advertising	Other Seller's Price 2.1	2.2	2.4	2.4	2.5	2.6	2.7	2.8	2.9	3.0
2.1	0	-2	-2	-1	-1	0	1	1	2	2	3
2.1	100	-3	-3	-2	-2	-1	0	0	1	1	2
2.1	200	-4	-4	-3	-3	-2	-1	-1	0	0	1
2.2	0	3	4	6	7	8	9	10	12	13	14
2.2	100	1	2	4	5	6	7	8	10	11	12
2.2	200	-1	0	2	3	4	5	6	8	9	10
2.3	0	7	9	10	12	14	16	18	19	21	23
2.3	100	4	6	7	9	11	13	15	16	18	20
2.3	200	1	3	4	6	8	10	12	13	15	17
2.4	0	8	11	13	16	18	20	23	25	28	30
2.4	100	4	7	9	12	14	16	19	21	24	26
2.4	200	0	3	5	8	10	12	15	17	20	22
2.5	0	8	11	14	17	20	23	26	29	32	35
2.5	100	3	6	9	12	15	18	21	24	27	30
2.5	200	-2	1	4	7	10	13	16	19	22	25
2.6	0	6	9	13	16	20	24	27	31	34	38
2.6	100	0	3	7	10	14	18	21	25	28	32
2.6	200	-6	-3	1	4	8	12	15	19	22	26
2.7	0	1	5	10	14	18	22	26	31	35	39
2.7	100	-6	-2	3	7	11	15	19	24	28	32
2.7	200	-10	-9	-4	0	4	8	12	17	21	25
2.8	0	-5	0	4	9	14	19	24	28	33	38
2.8	100	-10	-8	-4	0	4	8	12	17	21	25
2.8	200	-10	-10	-10	-7	-2	3	8	12	17	22
2.9	0	-10	-8	-3	3	8	13	19	24	30	35
2.9	100	-10	-10	-10	-6	-1	4	10	15	21	26
2.9	200	-10	-10	-10	-10	-10	-5	1	6	12	17
3.0	0	-10	-10	-10	-6	0	6	12	18	24	30
3.0	100	-10	-10	-10	-10	-10	-4	2	8	14	20
3.0	200	-10	-10	-10	-10	-10	-10	-8	-2	4	10

YOUR PROFIT TABLE WHEN YOUR ADVERTISING BUDGET = $200

Your Price	Other Seller's Advertising	Other Seller's Price 2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
2.1	0	-10	-10	-9	-9	-8	-7	-7	-6	-6	-5
2.1	100	-11	-11	-10	-10	-9	-8	-8	-7	-7	-6
2.1	200	-12	-12	-11	-11	-10	-9	-9	-8	-8	-7
2.2	0	-3	-2	0	1	2	3	4	6	7	8
2.2	100	-5	-4	-2	-1	0	1	2	4	5	6
2.2	200	-7	-6	-4	-3	-2	-1	0	2	3	4
2.3	0	3	5	6	8	10	12	14	15	17	19
2.3	100	0	2	3	5	7	9	11	12	14	16
2.3	200	-3	-1	0	2	4	6	8	9	11	13
2.4	0	6	9	11	14	16	18	21	23	26	28
2.4	100	2	5	7	10	12	14	17	19	22	24
2.4	200	-2	1	3	6	8	10	13	15	18	20
2.5	0	8	11	14	17	20	23	26	29	32	35
2.5	100	3	6	9	12	15	18	21	24	27	30
2.5	200	-2	1	4	7	10	13	16	19	22	25
2.6	0	8	11	15	18	22	26	29	33	36	40
2.6	100	2	5	9	12	16	20	23	27	30	34
2.6	200	-4	-1	3	6	10	14	17	21	24	28
2.7	0	5	9	14	18	22	26	30	35	39	43
2.7	100	-2	2	7	11	15	19	23	28	32	36
2.7	200	-9	-5	0	4	8	12	16	21	25	29
2.8	0	1	6	10	15	20	25	30	34	39	43
2.8	100	-7	-2	2	7	12	17	22	26	31	36
2.8	200	-15	-10	-6	-1	4	9	14	18	23	28
2.9	0	-6	0	5	11	16	21	27	32	38	43
2.9	100	-15	-9	-4	2	7	12	18	23	29	34
2.9	200	-20	-18	-13	-7	-2	3	9	14	20	25
3.0	0	-14	-8	-2	4	10	16	22	28	34	40
3.0	100	-20	-18	-12	-6	0	6	12	18	24	30
3.0	200	-20	-20	-20	-16	-10	-4	2	8	14	20

APPENDIX H

STATISTICAL TABLES

TABLE IV

DISTRIBUTION OF PRICE FREQUENCIES

Low Risk Game

		Prices						
		2.1-2.3	2.4	2.5	2.6	2.7	2.8-3.0	Totals
Risk Averters	Observed	10	27	38	28	11	6	120
	Expected	10	23	32	41	12	3	
Risk Lovers	Observed	12	23	32	60	12	1	140
	Expected	12	17	38	47	11	4	
	Totals	22	50	70	88	23	7	260

Significant difference in distributions at .01 level

High Risk Game

		Prices						
		2.1-2.3	2.4	2.5	2.6	2.7	2.8-3.0	Totals
Risk Averters	Observed	10	31	26	13	9	1	90
	Expected	13	23	24	29	9	1	
Risk Lovers	Observed	14	10	17	21	7	1	70
	Expected	11	18	19	15	7	1	
	Totals	24	41	43	34	16	2	160

Significant difference in distributions at .05 level

Risk Averters

		Prices						
		2.1-2.3	2.4	2.5	2.6	2.7	2.8-3.0	Totals
Low Risk Game	Observed	10	27	38	28	11	6	120
	Expected	11	33	37	23	11	4	
High Risk Game	Observed	10	31	26	13	9	1	90
	Expected	9	25	27	18	9	3	
	Totals	20	58	64	41	20	7	210

Significant difference in distributions at .20 level

TABLE IV (Continued)

Risk Lovers

		Prices						
		2.1-2.3	2.4	2.5	2.6	2.7	2.8-3.0	Totals
Low Risk Game	Observed	12	23	32	60	12	1	140
	Expected	17	22	33	54	13	1	
High Risk Game	Observed	14	10	17	21	7	1	70
	Expected	9	11	16	27	6	1	
	Totals	26	33	49	81	19	2	210

Significant difference in distributions at .30 level

TABLE V

PERCENTAGE DISTRIBUTION OF
PRICE FREQUENCIES

Low Risk Game

	Prices					
	2.1-2.3	2.4	2.5	2.6	2.7	2.8-3.0
Risk Averters	.08	.22	.32	.23	.09	.05
Risk Lovers	.09	.16	.23	.42	.09	.01

High Risk Game

	Prices					
	2.1-2.3	2.4	2.5	2.6	2.7	2.8-3.0
Risk Averters	.11	.34	.29	.14	.10	.01
Risk Lovers	.20	.14	.24	.30	.10	.01

Risk Averters

	Prices					
	2.1-2.3	2.4	2.5	2.6	2.7	2.8-3.0
Low Risk Game	.08	.22	.32	.23	.09	.05
High Risk Game	.11	.34	.29	.14	.10	.01

Risk Lovers

	Prices					
	2.1-2.3	2.4	2.5	2.6	2.7	2.8-3.0
Low Risk Game	.09	.16	.23	.42	.09	.01
High Risk Game	.20	.14	.24	.30	.10	.01

TABLE VI

DISTRIBUTION OF ADVERTISING BUDGET FREQUENCIES

Low Risk Game

		Advertising Choices			
		$0	$100	$200	Totals
Risk Averters	Observed	33	19	68	120
	Expected	27	27	66	
Risk Lovers	Observed	26	40	74	140
	Expected	32	32	76	
	Totals	59	59	142	260

Significant difference in distributions at .02 level

High Risk Game

		Advertising Choices			
		$0	$100	$200	Totals
Risk Averters	Observed	25	40	25	90
	Expected	22	45	23	
Risk Lovers	Observed	14	40	16	70
	Expected	17	35	18	

Significant difference in distributions at .25 level

Risk Averters

		Advertising Choices			
		$0	$100	$200	Totals
Low Risk Game	Observed	33	19	68	120
	Expected	33	34	53	
High Risk Game	Observed	25	40	25	90
	Expected	25	25	40	
	Totals	58	59	93	210

Significant difference in distributions at .001 level

TABLE VI (Continued)

Risk Lovers

		Advertising Choices			
		$0	$100	$200	Totals
Low Risk Game	Observed	26	40	74	140
	Expected	27	53	60	
High Risk Game	Observed	14	40	16	70
	Expected	13	27	30	
	Totals	40	80	90	210

Significant difference in distributions at .001 level

TABLE VII

PERCENTAGE DISTRIBUTION OF
ADVERTISING FREQUENCIES

Low Risk Game

	Advertising Choices		
	$0	$100	$200
Risk Averters	.27	.16	.57
Risk Lovers	.19	.29	.53

High Risk Game

	Advertising Choices		
	$0	$100	$200
Risk Averters	.28	.44	.28
Risk Lovers	.20	.57	.23

Risk Averters

	Advertising Choices		
	$0	$100	$200
Low Risk Game	.27	.16	.57
High Risk Game	.28	.44	.28

Risk Lovers

	Advertising Choices		
	$0	$100	$200
Low Risk Game	.19	.29	.53
High Risk Game	.20	.57	.23

TABLE VIII

DISTRIBUTION OF S FREQUENCIES

Low Risk Game

		S Values Between:						
		< -1	-1 -.5	-.5 0	0 .5	.5 1	> 1	Totals
Risk Averters	Observed	9	15	35	39	8	15	120
	Expected	7	14	36	37	12	13	
Risk Lovers	Observed	7	16	43	42	18	14	140
	Expected	9	17	41	44	14	16	
	Totals	16	31	77	81	26	29	260

Significant difference in distributions at .40 level

High Risk Game

		S Values Between:						
		< -1	-1 -.5	-.5 0	0 .5	.5 1	> 1	Totals
Risk Averters	Observed	11	18	18	20	7	16	90
	Expected	13	15	16	18	10	17	
Risk Lovers	Observed	13	9	11	12	10	15	70
	Expected	10	12	13	14	7	14	
	Totals	24	27	29	32	17	31	160

Significant difference in distributions at .40 level

Risk Averters

		S Values Between:						
		< -1	-1 -.5	-.5 0	0 .5	.5 .	> 1	Totals
Low Risk Game	Observed	9	15	34	39	8	15	120
	Expected	11	19	39	34	9	18	
High Risk Game	Observed	11	18	18	20	7	16	90
	Expected	9	14	22	25	6	13	
	Totals	20	33	52	59	15	31	210

Significant difference in distributions at .20 level

TABLE VIII (Continued)

Risk Lovers

		S Values Between: < -1	-1 -.5	-.5 0	0 .5	.5 1	> 1	Totals
Low Risk Game	Observed	7	16	43	42	18	14	140
	Expected	13	17	36	36	19	19	
High Risk Game	Observed	13	9	11	12	10	15	70
	Expected	7	8	18	18	9	10	

Significant difference in distributions at .01 level

TABLE IX

PERCENTAGE DISTRIBUTION OF
S FREQUENCIES

Low Risk Game

	S Values Between:					
	< -1	-1 -.5	-.5 0	0 .5	.5 1	> 1
Risk Averters	.075	.125	.28	.325	.07	.125
Risk Lovers	.05	.11	.31	.30	.13	.10

High Risk Game

	S Values Between:					
	< -1	-1 -.5	-.5 0	0 .5	.5 1	> 1
Risk Averters	.12	.20	.20	.22	.08	.18
Risk Lovers	.19	.13	.16	.17	.14	.21

Risk Averters

	S Values Between:					
	< -1	-1 -.5	-.5 0	0 .5	.5 1	> 1
Low Risk Game	.075	.125	.28	.325	.07	.125
High Risk Game	.12	.20	.20	.22	.08	.18

Risk Lovers

	S Values Between:					
	< -1	-1 -.5	-.5 0	0 .5	.5 1	> 1
Low Risk Game	.05	.11	.31	.30	.13	.10
High Risk Game	.19	.13	.16	.17	.14	.21

TABLE X

DISTRIBUTION OF PROFIT FREQUENCIES

Low Risk Game

		Profits				
		<0	0 to .10	.10 to .20	≥.20	Totals
Risk Averters	Observed	5	11	97	7	120
	Expected	4	14	89	14	
Risk Lovers	Observed	4	19	94	23	140
	Expected	5	16	103	16	
	Totals	9	30	191	30	260

Significant difference in distributions at .05 level

High Risk Game

		Profits Between:						
		< 0	0 .10	.10 .20	.20 .30	.30 .40	> .40	Totals
Risk Averters	Observed	8	15	43	11	3	10	90
	Expected	9	14	42	11	2	12	
Risk Lovers	Observed	8	10	31	9	1	11	70
	Expected	7	11	32	9	2	9	
	Totals	16	25	74	20	4	21	160

Significant difference in distributions at .75 level

Risk Averters

		Profits				
		<0	0 to .10	.10 to .20	>.20	Totals
Low Risk Game	Observed	5	11	97	7	120
	Expected	7	15	80	18	
High Risk Game	Observed	8	15	43	24	90
	Expected	6	11	60	13	
	Totals	13	26	140	31	210

Significant difference in distributions at .001 level

TABLE X (Continued)

Risk Lovers

		Profits					
		< 0	0 to .10	.10 to .20	.20 to .30	> .30	Total
Low Risk Game	Observed	4	19	94	22	1	140
	Expected	8	19	83	21	9	
High Risk Game	Observed	8	10	31	9	12	70
	Expected	4	10	42	10	4	
	Totals	12	29	125	31	13	210

Significant difference in distributions at .001 level

TABLE XI

PERCENTAGE DISTRIBUTION OF
PROFIT FREQUENCIES

Low Risk Game

	Profits			
	< 0	0 to .10	.10 to .20	> .20
Risk Averters	.04	.09	.80	.06
Risk Lovers	.03	.14	.67	.15

High Risk Game

	Profits Between:					
	<0	0 to .10	.10 to .20	.20 to .30	.30 to .40	>.40
Risk Averters	.09	.17	.48	.12	.03	.11
Risk Lovers	.11	.14	.44	.13	.01	.16

Risk Averters

	Profits			
	<0	0 to .10	.10 to .20	> .20
Low Risk Game	.01	.10	.81	.06
High Risk Game	.09	.17	.48	.26

Risk Lovers

	Profits				
	<0	0 to .10	.10 to .20	.20 to .30	>.30
Low Risk Game	.03	.14	.67	.16	.01
High Risk Game	.11	.14	.44	.17	.17

VITA

Pauline Haaf Weber

Candidate for the Degree of

Doctor of Philosophy

Thesis: RISK AND ADVERTISING IN AN OLIGOPOLY GAME

Major Field: Economics

Biographical:

Personal Data: Born in Creston, Iowa, December 30, 1946, the daughter of Mr. and Mrs. Leonard Keith Haaf.

Education: Graduated from Greenfield High School, Greenfield, Iowa, in May, 1965; received Bachelor of Arts degree in Economics from Nebraska Wesleyan University, Lincoln, Nebraska, in 1969; received Master of Science degree in Economics from Oklahoma State University in 1973; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in December, 1974.

Professional Experience: Graduate assistant, Oklahoma State University, College of Business Administration, 1970-72; Teaching assistant, Oklahoma State University, College of Business Administration, 1972-73.