

## **PROSPECT THEORY AND THE RISK–RETURN ASSOCIATION An Empirical Examination in 85 industries\***

Avi FIEGENBAUM

*The University of Michigan, School of Business Administration, Ann Arbor, MI 48109, USA*

Received March 1989, final version received October 1989

A new sample of 85 industries (about 3,300 firms) defined in terms of homogenous products provides strong evidence that prospect theory can explain the tradeoff between two of the most researched parameters in evaluating organizations, namely, risk and return. In particular, organizations below their target level are found to be risk-takers (H1) while organizations above their target level are risk-averters (H2); moreover, the below target tradeoff was generally steeper than the above target with a median below to above slope ratio of about 3:1 (H3).

### **1. Introduction**

Risk and return are probably the two single parameters most researched by the various and related disciplines of economics, finance, and management. Although each one of them has looked at these two parameters from different aspects and for different purposes, they have provided a wide understanding of these two factors in the context of the theory of the firm. The purpose of this study is to look closely at the relationship between these two important parameters in order to understand firm's competitive behavior, using the recent development in behavioral decision theory, namely, prospect theory [Kahneman and Tversky (1979)].

Although March (1988) has criticized the discipline of management for its later adaptation in considering risk elements for evaluating organization performance and decision making processes, recent studies [e.g., Bettis (1981), Rumelt (1974), Singh (1986), Jemison (1987) and Baird and Thomas (1986)] have paid considerable attention to risk aspects in evaluating the performance of firms. In general, these studies have concluded that the characteristics of the firms' environment, strategy, and implementation processes have significant and important influence on the firm's risk level and its associated rate of return.

Bowman (1980) has looked closely at 85 U.S. industries and explored the

\*This research was supported by a grant from the School of Business Administration, The University of Michigan.

relationship between firm risk and return. Surprisingly, Bowman found that for most industries that he studied, a negative relationship between risk and return existed. Bowman's study was the first study that observed and reported this anomaly at the organization level and he named it the 'paradox' since it runs counter to the well believed positive relationship expected by economists. Bowman has attributed his findings to two major factors. First, good managers can simultaneously increase returns and reduce risk (which causes the negative risk–return relationship). Decisions such as choosing the right environment, the right strategy and the right implementation procedures are the mechanism for creating this paradox. Indeed, studies by Bowman (1982), Bettis (1981), Bettis and Mahjan (1985), Singh (1986), Cool and Dierk (1988) and Jemison (1987) have tested and confirmed that different organizational mechanisms can cause the negative risk–return association. Second, managers are not risk averters as was mainly assumed by economists but, in fact, they are risk seekers.

Based on Bowman's second explanation, namely, managers' attitudes toward risk, Fiegenbaum and Thomas (1988) have used the recently developed behavioral decision theory, namely, 'prospect theory' [Kahneman and Tversky (1979)] to explain the risk–return association. In a simplified manner, prospect theory argues that individuals use target or reference points in evaluating risky choices. Further, individuals are not uniformly risk averse but adopt a mixture of risk-seeking when their outcomes are below the target level and risk-averting when their outcomes are above the target level.

Indeed, this behavior was confirmed by many studies where individuals and managers were the subjects [e.g., Kahneman and Tversky (1979), Crum et al. (1980), Fishburn and Kochenberger (1979), Laughhunn et al. (1980), Payne et al. (1980, 1981) and Puto (1987)]. In contrast, Fiegenbaum and Thomas's study was the first in which the prospect theory was tested in the context of organizational behavior. They have reported, in most of the 60 industries studied during the 1960–1979 time period, negative association between risk and return for firms below their target, and positive association for firms above their target.

It should be noted that the management discipline departs in two major ways from the economics and the financial economics disciplines when dealing with risk. First, the attitude toward risk has been reported on theoretical and empirical grounds as an explanation for the risk–return relationship. More specifically, the mixture of risk averse/risk-taker behavior is well accepted in the management discipline in contrast to most economics and financial economics studies that have assumed risk averse behavior. Second, management researchers have looked closely for the mechanism by which good managers can control their risk and return levels. Factors such as environment strategy and implementation were shown to control the risk–return levels.

In this study further examination of the risk–return association under prospect theory explanation will be taken. A detailed analysis examining the tradeoff between risk and return for the two different domains, namely, below and above industry target, will be executed and compared. A new data base is established containing 85 industries, to test empirically our hypotheses. Diversification contaminations are excluded from this data base which overcomes some of the problems that might arise in Bowman (1980) and Fiegenbaum and Thomas (1986, 1988) studies. In general, the empirical findings provide further support for the argument that prospect theory framework can explain the risk–return association.

## **2. Theoretical background and hypotheses**

Most of the earliest literature dealing with risk selection behavior developed around the expected utility model and it is summarized by Schoemaker (1982). The term ‘utility’ was originally named to describe the overall pain and benefit derived from a particular choice. This theory was an extension of the classical utility theory used by economists to describe the rational decision-maker. A key assumption of the utility models is that decision-makers are risk averse. That assumption and the model have been a basic premise of much research in business, finance, economics and management science.

In terms of utility theory, the assumption implies that a decision-maker has a utility function that is uniformly concave or that individuals depart from risk averse behavior only under unusual circumstances. Indeed, based on this model and assumption, the studies of Conrad and Plotkin (1968), Fisher and Hall (1969), Cootner and Holland (1970), Neuman et al. (1979) have reported a positive relationship between organization risk and return levels. However, many researchers [e.g., Friedman and Savage (1948), Grayson (1959), Markowitz (1952) and Swalm (1966)] have questioned the assumption of global risk aversion on both theoretical and empirical grounds.

The recent advances in behavioral decision theory were integrated into the prospect theory [Kahneman and Tversky (1979)] framework. The theory has emphasized the role of reference, or target, in the analysis of risky choices. It is called prospect theory because a decision-maker first reduces each alternative in a decision problem to a series of prospects, and then evaluates each prospect according to a value function which was hypothesized to be ‘S’ shaped, or centered on the reference point.

The reference point is a critical element in this theory since the theory predicts that most individuals exhibit a mixture of risk-seeking and risk-averting behavior when the outcome is either below or above the reference

point respectively. An example from Kahneman and Tversky (1979) will illustrate this point.

One group of subjects was told that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative courses were offered to combat the disease. According to the first alternative, Option I would definitely save 200 lives while Option II offered a  $1/3$  probability that 600 people would be saved and a  $2/3$  probability that no one would be saved. Only 28% chose Option II while the majority, 72%, chose Option I. The other alternative which was offered to the second group was told a similar scenario except the options were stated differently. Option I would definitely cause 400 people to die. Option II offered a  $1/3$  probability that nobody would die and a  $2/3$  probability that 600 people would die. The majority of the people (78%) in this group chose Option II.

The two examples are equivalent; yet they were framed differently as lives saved with the first group and lives lost with the second group. The fact that the majority of the people preferred the prospect of the certainty of saving 200 lives rather than a risky prospect of equal expected value but with higher risk indicates that the decision-makers of this judgment were risk averse. In contrast, that the certain death of 400 people was less acceptable than the  $1/3$  chance that 600 will die indicate that the decision-maker behaved as a risk-taker. This kind of behavior was reported with different examples. However, space limitation precludes a thorough presentation of prospect theory. The interested reader is directed to the original papers summarized in Kahneman and Tversky (1979) and Tversky and Kahneman (1981, 1986).

Four major hypotheses are made in prospect theory regarding the shape of the value function. First, the importance of a reference point for choice decision. Second, individuals are risk averse when outcomes are associated with gains. Third, individuals are risk-seekers when outcomes are associated with losses. And, fourth, the function that describes the risk-taking behavior for below target return is steeper than the risk-averting function that describes the above target performers. Indeed, empirical support for this theory has been found in individual decision-makers and it is reported in Fishburn (1977), Fishburn and Kochenberger (1979), Laughhunn et al. (1980) and Puto (1987).

In contrast to previous studies that looked at prospect theory from the individual's decision making perspectives, Fiegenbaum and Thomas (1988) have looked at the theory at the organizational level and explored the relationships between organization risk and return levels. Using a correlation test, Fiegenbaum and Thomas found that in most industries negative and positive risk–return correlation exist for firms below and above their reference point respectively. Results were confirmed when the same test was performed for different time periods between 1960–1979.

This study builds upon the Fiegenbaum and Thomas approach which uses

prospect theory to explain the risk–return association. However, this study is different from their study in two important manners. First, it attempts to estimate the tradeoff between risk and return rather than confirming that it obeys the risk averse and risk-seeking behavior. Second, a new data set is established in which a finer classification of industries is defined. In Fiegenbaum and Thomas the industries were defined in the broad terms of SIC (Standard Industrial classification) 2 digits. This contains diversified firms which are assigned to one major industry although they are participating in different industries. This procedure may bias results in terms of the way that the reference point or target level is calculated and perceived by the firms. In this study, the data base is conceptually similar to the PIMS and FTC data bases which focus on business level competition.

Given the above description, the formal hypotheses can be stated as:

*Hypothesis 1: A negative association between risk and return exists for organizations facing below their target return.*

*Hypothesis 2: A positive association between risk and return exists for organizations facing above their target return.*

*Hypothesis 3: The relationship between risk and return is steeper for organizations facing below their industry target returns than their counterpart (above target).*

### **3. Methodology**

#### *3.1. Data and sample*

The COMPUSTAT BUSINESS SEGMENT tape is used to develop a research data base of firms and industries. This tape contains firms' segment data as reported by publicly traded firms in their 10-K and annual report. According to Financial Accounting Standard No. 14 [FASB (1976)] each firm has to provide supplementary information about its business segment, which is defined as any group of related businesses that comprises at least 10 percent of consolidated revenues, profits or assets. This procedure indicates the various firms' activity in terms of markets represented by SIC 4 digits. After firm activities are broken down into industry segments, we pooled firm segments that had reported activity in the same industry. In this way we created an industry data base which includes information only about the industry. Diversification 'contamination' was removed from this data set.

Two rules of thumb were made in order to determine our sample. First, only firm segments that have at least five years of data (compustat business

segment contains information for only the 1977–1984 time period) were used in our sample. The reason for this is to be consistent with previous studies [e.g., Bowman (1980), Fiegenbaum and Thomas (1988)] as well as to minimize the bias of the measures. Second, only industries that had twenty or more companies reporting were kept in our sample in order to retain sufficient degrees of freedom for our estimation tests. Following these two criteria the sample includes 85 industries, with an average of about 40 firms in an industry.

### *3.2. Measures*

Two measures have been operationalized: Namely, firm rate of return and risk levels. For the return measure we have used the average segment's return on asset (ROA) for the time period explored (1977–1984). As a risk measure we have used the variance of segment return on asset for the same time period. This approach is similar to many studies including Bowman (1980), Fiegenbaum and Thomas (1986, 1988), Jemison (1988), Woo (1987) and Cool and Dierickx (1987). It should be noted that modern portfolio theory, a branch of financial economics, has developed sophisticated methods for understanding the relationships among risk, return, and diversification at the security market and it is conceptualized in the CAPM model [e.g. Lintner (1965) and Sharp (1964)].

However, several reasons have led Organization Theory and Strategic Management researchers to focus on accounting data rather than market data as mentioned by Bettis and Mahajan (1985). First, accounting data is more directly under managerial control regardless of the level of analysis (corporate vs. business). Second, accounting level data is utilized by regulatory agencies. Third, in any business such as private firms and state owned, firms have only accounting measures of performance. Fourth, for divisions of firms only accounting measures are relevant. It should be noticed that the studies by Beaver et al. (1970) and the later one by Bowman (1979) have proved that market risk and accounting risk are correlated which provides theoretical justification for accounting measures.

### *3.3. Determining target level*

A key issue in the operationalization of prospect theory is to identify a measure for a target level. As mentioned by Kahneman and Tversky (1979) there is no general rule in which a target or reference point can be determined, but it depends on the specific situation. In this study we will

follow the procedure developed by Fiegenbaum and Thomas (1988) based on the traditional literature of financial statement analysis and industrial organization economics. The literature of industrial organization economics [e.g. Bain (1956), Caves (1972) and Porter (1980)] investigates the nature of industrial competition. Firms are making competitive decisions based on the action/reaction decisions of the other industrial firms. In addition, potential newcomers are observing the entire industry and the overall performance of the industry will encourage/discourage them from joining the industry. Indeed, measures such as barriers to entry and product differentiation have been used to describe the average characteristics of the industry.

An additional evidence for the importance of the average industry performance is suggested by financial accounting. Lev (1969) suggested that firms adjust their performance levels to the industry average. The empirical findings of Lev confirmed his hypothesis about the industry average measure used as a reference point. Frecka and Lee (1983) confirmed the same kind of behavior on a different data base.

It should be noted that many magazines and reports about firms' performance indicate also the performance of the industry as a whole (e.g. *Fortune*, *Business Week*, *Forbes*). This indicates that managers, as well as other interested groups are forced to evaluate the firm performance in regard to the other industrial performers. For these reasons Fiegenbaum and Thomas (1988) considered the median industry return as a proxy for a given firm's target level and it will also be used in this study.

### 3.4. Modeling and statistical tests

Since the purpose of this study is to explore the characteristics of prospect theory in the context of firm behavior, a mathematical model is built in order to describe the relationship between firm and return. The model to be tested for the three hypotheses can be written as:

$$Risk_{ij} = a_j + b_j Return_{ij}, \quad (1)$$

where  $j$  stands for industry ( $j = 1, 2, \dots, 85$ ),  $i$  stands for firm segment ( $i = 1, 2, \dots, m$ ),  $a_j$  is the constant term for industry  $j$ ,  $b_j$  is the coefficient which measures the tradeoff between risk and return for industry  $j$ .

This model is run separately for each of the 85 industries, as well as for the two domains, namely, above and below the industry target level. In this way the different relationship between risk and return for these two domains can be estimated and evaluated. According to the first two hypotheses, the  $b_j$  sign should be negative for firms below their target (H1) and positive for firms above their target (H2). To test the third hypothesis, namely, that the

Table 1  
Summary table of model 1:  $Risk_{ij} = a_j + b_i Return_{ij}$ .

Characteristics	Below industry average			Above industry average		
	<i>a</i>	<i>b</i>	<i>R</i> <sup>2</sup>	<i>a</i>	<i>b</i>	<i>R</i> <sup>2</sup>
Mean	−2,127.7417	−267.4401	0.4700	−5,841.1048	136.4137	0.3302
Median	146.5613	−14.5098	0.4240	−11.0380	5.1320	0.2067
No. of negative coefficients	10	73		50	15	
No. of negative and significant coefficients ( $P \leq 0.10$ )	2	59		25	1	
No. of positive coefficients	75	12		35	70	
No. of positive and significant coefficients ( $P \leq 0.10$ )	57	2		7	47	

negative relationship is stronger than the positive one, we will compare the values of  $b_j$ 's for these different regimes.

#### 4. Results

Appendix 1 presents the detailed results for the estimation characteristics of model 1, while table 1 summarizes the main results for our three hypotheses.

The left side of table 1 describes the results for the below target firms. It can be seen that for most industries the below target risk–return association (measured as  $b$ ) was negative. More specifically, 73 coefficients were negative while only 12 were positive. In addition, 59 out of the 73 negative coefficients were negative and significant (at  $P \leq 0.10$ ) while only 2 out of the 12 positive coefficients were positive and significant. These results clearly support our first hypothesis which prospect theory will predict.

The right-hand side of table 1 describes the results for the above target returns. It can be seen that in 70 industries positive risk–return association was found while only 15 industries indicate a negative association. A closer look shows that out of the 70 industries, 47 indicated positive and significant relationships while only one industry shows a negative and significant relationship. Again, clear support for prospect theory prediction for above target returns described in H2.

In order to test the third hypothesis the  $b_j$ 's distribution of the above and below target returns is investigated. The median value is reported in table 1. It can be seen that the median value for the below target is −14.50 while for the above target is 5.13. (The  $t$  test indicates that the two slopes are

significantly different at  $P \leq 0.001$ .) This ratio of almost 3 to 1 clearly supports prospect theory characteristic which argues for a steeper association for risk–return relationships for below target performers.

## 5. Discussion and future directions

This study provides further evidence for a ‘partial’ risk–return paradox as was first observed and reported by Bowman (1980). However, the findings of this study can eliminate the paradox term since it is consistent with current development in the literature of decision science and psychology. More specifically, the relationships between organizational risk and return levels were examined under the viewpoint of prospect theory [Kahneman and Tversky (1979)] and the empirical findings have confirmed the validity of the theory to explain the explored phenomenon.

The first hypothesis confirmed the risk-seeking behavior of firms located below their target returns. This is indicated by the negative coefficient of the  $b$  coefficient of model 1 which estimates the tradeoff between risk and return. The median risk–return coefficient for the 85 industries was  $-14.50$ . The second hypothesis has confirmed the risk averse behavior of firms located above their return target. The median risk–return tradeoff for the 85 industries was approximately 5. The third hypothesis has confirmed another prediction of prospect theory which argues that the tradeoff between risk and return for the loss domain should be much steeper than for the gain domain. Indeed, the empirical findings have found that the ratio of the slopes for the median value of the industries was approximately 3:1 (below average over above average).

While previous studies have looked at some aspects of prospect theory to explain risk–return relationships at the organizational level, this is the first comprehensive study that looks at more detailed characteristics of the theory for a large sample. In addition, while Fiegenbaum and Thomas (1988) have confirmed a U-shape relationship between risk and return, they didn’t estimate the size of the tradeoff for the below and above target domains, and their sample contains industries at the SIC 2 digits which contain information about firms not competing directly. It should be noted that Fishburn and Kochenberger (1977) have estimated the ratio of the tradeoff for utility functions for *individuals* of below and above targets. They found that the majority of below target functions were risk seeking and the majority of above target functions were risk averse and the below target utility was generally steeper than above target utility with a median below to above slope ratio of about 4.8. It is very interesting to find that this aspect of the theory which is captured in hypothesis 3 has found the same ratio to be 3:1 which is very close to Fishburn and Kochenberger findings.

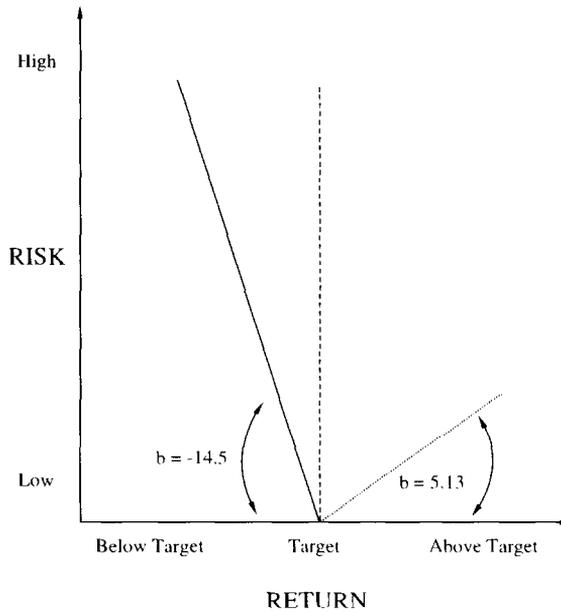


Fig. 1

The sample chosen for this study has several advantages. First, it has a large data base which covers 85 industries representing different sectors of the economy. Second, the industry is defined in terms of firms or division of firms that produce similar products. In contrast to previous large data base study [e.g., Bowman (1980), Fiegenbaum and Thomas (1986, 1988)] diversification 'contaminations' were eliminated from the data base.

The findings of this study are summarized graphically in fig. 1.

Several directions can be taken in future research in order to understand how risk aspects can be considered in organizational studies. First, researchers should understand the mechanism which determines the organizational levels of risk and its associated return. Baird and Thomas (1986) have separated these components into elements such as, general environment, industry, organization, problem indicators, and decision-maker indicators. If the relative impact of these various elements is known, then strategic planner can control their output in terms of risk and return. It should be noted that several studies have taken this approach. For example, Bettis (1981) and Bettis and Mahjan (1985) have looked at the industry characteristics and organizational diversification aspects to explain risk–return tradeoff for diversified companies. Studies such as Jemison (1987), Cool and Dierick (1988), Aaker and Jacobson (1987), and Woo (1987) have looked at business

level strategy and have estimated the impact of industry and organizational elements on the risk–return tradeoff.

Second, future studies can explore different risk measures. It should be noticed that in this study we have considered firms' total risk. However, the discipline of financial economics that has looked at the firms from an investor standpoint has considered systematic risk as the relevant measure. The argument we make is that different measures of risk describe different aspects of the firm behavior. We encourage further study on systematic risk in the context of prospect theory. It will be very interesting to see if an assumption of risk averse behavior holds for the entire regime of the CAPM model.

Third, an important area for applying the findings of this study is in the context of the well-known industrial organization economics paradigm, namely, structure-conduct-performance. According to this paradigm [e.g., Scherer (1980)] firm performance is determined by the characteristics of the industry and the strategy of the firm. Although previous studies have mentioned that performance might influence firm strategy, none of the studies have linked it in a consistent way. According to prospect theory and the findings of this study, the performance of the firm will influence firm strategy in such a way that firms below their target will be risk-takers and those above their target will be risk averse.

In terms of the model (model 1) we would suggest the following. First, that the target level can be determined in different ways. For example, deviation from a trend or deviation from expectation can be considered. It is well known that firms report this information in their annual report and hence, they might consider it as a target level. Another approach can be attributed to the recent development in the strategic group literature [e.g., Hunt (1972), Schendel and Patton (1978), Porter (1980), Cool and Schendel (1987), Harrigan (1985) and Fiegenbaum and Thomas (forthcoming)]. According to this literature, industrial firms can be clustered into strategic groups, namely, groups of firms that have similar strategies. In this case, we will hypothesize that the target level will be the level of the group since the strategic group members are the close competitors of the firms [Porter (1980)].

A special issue of the *Journal of Business* (1986), organized by Robin M. Hogarth and Melvin W. Reder, devoted its focus toward the behavioral foundations of economic theory. Initially, these studies were conducted mainly by psychologists, but recently, also by an increasing number of economists. Based on recent theoretical development and empirical findings in the psychology/decision science disciplines, evidence of documented violations of the rational behavior assumption of economists have been reported. However, economists were criticized that when faced with evidence opposed to their belief of rational choice they argued for the irrelevance of the empirical findings [Grether and Plott (1979)]. In this regard, this study

provides further evidence for a nontraditional belief made by economists. We hope that the findings of this study, as well as others, will provide further stimulus for future dialogue between the traditional/non-traditional approaches in economics and management research.

## **6. Conclusion**

This study attempts to explore in a detailed manner the association between organizational risk and return levels, based on recent research in behavioral decision theory, namely, prospect theory [Kahneman and Tversky (1979)]. We use a new data base called COMPUSTAT BUSINESS SEGMENT in which a sample of 85 industries (about 3,300 firms) is explored. The empirical findings provide further support for prospect theory to explain the risk–return association as was reported by Fiegenbaum and Thomas (1988). First, the importance of a target level in evaluating risky choices was found in most industries. Second, for industrial firms performing below their target level, the association between risk and return was negative, indicating that organizations are risk seekers. Third, for the complementary group, namely, firms who perform above their target, positive association between risk and return was found, indicating that organizations are risk averters. Fourth, the below target risk–return association was generally steeper than above target, with a median below to above slope ratio of 3 to 1. Thereafter, the implications of these findings of the studying of competitive strategy are then discussed.

Appendix

Table A.1  
Risk-return association for below and above target return.<sup>a</sup>

SIC number	Industry name	Above target			Below target			R-square
		No. of firms	a	b	No. of firms	a	b	
1 1211	Bituminous Coal	25	-791.0974**	60.3239***	25	337.3971	-8.6268	0.0023
2 1311	Crude Petroleum	183	-35,883.9473***	1,997.3600***	183	-126,130.0464***	-7,699.7685***	0.9645
3 1381	Drilling Oil	32	180.9316	4.3614	33	909.8139	-341.8798***	0.7323
4 1389	Oil & Gas Field Services	12	126.2045	0.8179	12	302.5258***	-30.7385***	0.4240
5 2451	Mobile Homes	11	166.5352	-2.1994	12	173.1878***	-14.4376**	0.3796
6 2621	Paper Mills	18	7.4272	1.2310	18	18.1007	1.5613	0.0399
7 2631	Paperboard Mills	10	40.8737*	-1.3953	10	73.2721***	-7.8370***	0.6936
8 2721	Periodicals Publishing	11	-250.7247	14.4747*	11	490.6965***	-26.2950***	0.7809
9 2731	Books Publishing	10	-11.0380	1.7521	10	96.6980***	-6.0718***	0.9361
10 2821	Plastic Materials	10	11.8398	1.1099	10	22.2520	0.5841	0.0245
11 2834	Pharmaceutical Preparations	24	7.6536	2.7180	24	373.3041***	-19.5072***	0.3734
12 2844	Perfume Preparations	13	211.8651	-3.0379	14	1,038.7737***	-91.2686***	0.9344
13 2899	Chemical Preparations	15	-112.8065	6.2952*	15	317.8854***	-25.3827***	0.5382
14 2911	Petroleum Refining	24	-10.7540	5.0609	24	201.1492***	-17.1155**	0.2194
15 3079	Miscellaneous Plastics	48	-22.9991	4.7846***	48	1,629.9561***	-212.0500***	0.9950
16 3312	Blast Furnaces	21	11.5286	10.1947*	21	87.5520**	-28.2372***	0.6797
17 3443	Fabricated Plate Work	11	57.5405	2.6338	11	115.1987**	-12.3869	0.2394
18 3452	Bolts	10	200.3261	-1.5869	11	117.2221***	-4.3504*	0.2850
19 3499	Fabricated Metal Products	10	-103.5049	7.7367	11	166.1863***	-8.5797**	0.3792
20 3523	Farm Machinery	10	57.3144	2.7947	11	293.5547*	-29.4274***	0.7235
21 3531	Construction Machinery	11	-225.1180	25.0900***	11	155.8381***	-14.5098***	0.6256
22 3533	Oil Field Machinery	17	148.4780	9.1113	17	453.6751***	-18.0564	0.1674
23 3559	Special Industrial Machinery	24	-1,007.2758***	64.7896***	24	246.3555***	-12.2635***	0.4480
24 3569	General Industrial Machinery	16	26.3214	1.9306	16	341.8120***	-22.5223***	0.8431
25 3621	Motors and Generators	11	573.2741	-7.7422	11	199.2630***	-13.3016***	0.7128
26 3651	Radio & TV Sets	11	-631.9820	46.8107*	12	87.0218***	-4.3258	0.1878
27 3661	Telephone Apparatus	16	-72.3615	10.3537	16	578.7759***	-52.2777***	0.9042
28 3663	Electronics	30	-11,748.3613***	571.1017***	30	1,763.3543	-44.2291	0.0052

Table A.1 (continued)

SIC number	Industry name	Above target				Below target				R-square
		a	b	R-square	No. of firms	a	b	R-square	No. of firms	
29 3664	Electronics	-3,151,8270***	138,5903***	0.9265	17	204,5733***	-9,7707*	0.2054	17	
30 3674	Semiconductors	-1,124,0607***	71,1590***	0.9969	20	883,2047	-83,0740***	0.4473	20	
31 3679	Electronic Components	-168,5588**	12,0964***	0.4706	36	301,6527***	-4,5064	0.0050	36	
32 3681	Computers-Mainframe	-310,8612	-4,5396	0.0036	12	-712,9602	-204,6108***	0.9279	12	
33 3683	Computer Terminals	365,1974	-11,3264	0.0889	13	426,9120	-65,9430***	0.6779	13	
34 3689	Computer Equipment	421,7976	-13,1518	0.0813	12	285,9271***	-15,5526	0.2425	12	
35 3693	Radiograph	195,4300**	-6,4863	0.1610	11	-420,2244	-83,1184	0.1992	11	
36 3714	Motor Vehicle Parts	-1,071,8338***	59,9674***	0.9536	28	112,9535***	-6,6826*	0.1286	28	
37 3728	Aircraft parts	-1,257,7651***	50,8682***	0.8484	12	42,1330	0.1297	0.0003	12	
38 3811	Engineering Lab	-163,8804	16,3497***	0.5343	17	682,6798***	-82,2597***	0.9943	17	
39 3823	Indus Instruments	67,7390	11,6657	0.0252	20	245,1272***	-23,7433***	0.9541	20	
40 3825	Instruments for Meas.	21 10,5074	3,9148*	0.1540	21	1,565,2380***	-151,4009***	0.9712	21	
41 3829	Measuring Devices	18,7475	1,6502*	0.3125	13	-531,8055	112,7978	0.0874	13	
42 3832	Optical Instruments	10 93,8746*	-0,0302	0.0000	10	1,008,9268***	-101,7254***	0.9730	10	
43 3841	Surgical Apparatus	-46,6308	5,3228**	0.2827	16	246,7722***	-21,4679***	0.8543	16	
44 3842	Orthopedic Appliances	-9,8408	7,0537	0.2067	11	3,133,9111*	-499,6242***	0.9993	11	
45 3861	Photographic Equipment	109,0712	0,6586	0.0001	17	180,3720***	-31,3881***	0.8498	17	
46 4011	Railroads	-28,3004*	4,5877**	0.4316	14	29,4976***	-6,9285***	0.6004	14	
47 4213	Trucking	76,1834	-0,2761	0.0002	23	170,6492*	-17,5635**	0.1826	23	
48 4511	Air Transportation	35,1485**	-0,3944	0.0055	19	38,1543**	-25,1535***	0.5923	19	
49 4811	Telephone Communication	-31,4777***	2,7530***	0.2619	46	-0,8148	0.3237	0.0184	46	
50 4833	Television Broadcasting	-256,9860	13,7021	0.0594	11	61,5385	-0,7254	0.0113	11	
51 4891	Cable Television	-32,1839	5,1320**	0.4067	11	26,0173	9,7394***	0.7129	11	
52 4911	Electric Services	-3,5081	0,7848**	0.1003	59	-0,1801	0.3666	0.0132	59	
53 4922	Natural Gas Transmission	-160,4935***	11,7221***	0.9694	16	28,2015**	-1,9366	0.1717	16	
54 4923	Natural Gas Distribution	-225,3922***	15,5849***	0.9220	14	6,0087	0.1776	0.0063	14	
55 4924	Natural Gas Distribution	-47,5880**	5,0274***	0.1600	43	58,7615***	-5,6006***	0.7100	43	
56 4941	Water Supply	-8,7550	1,2255*	0.2555	14	1,4184	0.4817	0.0124	14	
57 5051	Motor Service Centers	-142,1485***	12,5296***	0.9750	11	242,8950***	-27,3904***	0.6282	11	
58 5065	Electronic Parts	53,6914*	-0,1869	0.0038	10	146,5613	-9,6199	0.1007	10	
59 5311	Department Stores	-8,6024	1,0936*	0.2203	17	73,3317***	-8,1009***	0.3647	17	

60	5331	Variety Stores	13	-5.3612	1.1890	0.1623	14	61.3038***	-5.3762***	0.5072
61	5411	Grocery Stores	23	6.5560	0.1659	0.0027	23	25.4008***	-1.3197***	0.3106
62	5812	Eating Places	41	-17.3419	3.4180**	0.1149	41	92.1817***	-6.0033***	0.1064
63	6153	Business Credit Institutions	15	59.0401**	-4.0323*	0.2560	15	0.6409	0.2863*	0.2487
64	6211	Security Brokers	11	121.2251	0.8827	0.0017	12	73.9342**	-7.9910	0.1942
65	6311	LifeInsurance	23	-27.1802	8.6549***	0.2945	24	6.6752**	-2.5651*	0.1448
66	6331	Casualty Insurance	17	10.4919***	-0.4834	0.0693	18	34.2140***	-11.4585**	0.2462
67	6411	Insurance Agents	11	123.2355	6.4484	0.2128	11	177.0243***	-25.4786***	0.9015
68	6512	Operators of Buildings	21	68.8299	4.1624	0.0636	21	124.6131***	-37.5459***	0.9627
69	6532	Real Estate Agents	12	-475.3787	42.1281***	0.6000	12	113.8037**	-7.5781	0.0639
70	6552	Subdividers and Developers	53	-977.1073***	87.8730***	0.7274	54	305.4906	-665.1454***	0.9133
71	6792	Oil Traders	16	-44.606.4228*	423.7122***	0.6428	17	-1.582.8313	-252.1081***	0.7899
72	6794	Patent Owners	11	-47.525.8639**	795.4804***	0.9694	12	266.9129	-38.5445***	0.9585
73	6795	Patent Owners	12	-239.237.9686*	4.317.2850***	0.9702	13	811.6787	2.8518	0.0002
74	6798	Real Estate Investment	40	-1.6933	1.5299*	0.0700	41	52.8999***	-6.8852***	0.4025
75	6799	Investors, NEC	11	-210.8270**	28.0550***	0.6770	12	-63.307.4050	-10.492.9517***	0.9994
76	7011	Hotels	24	-39.5532	5.3205***	0.3813	24	111.0320***	-11.8488**	0.1755
77	7372	Computer Programming	27	-456.2482***	34.5820***	0.7410	28	-7.326.6929	-463.9288***	0.7297
78	7374	Data Processing Services	19	-1.545.8796***	88.9440***	0.6718	20	374.6605**	-62.7848***	0.5937
79	7391	Research & Development Labs	16	-5.087.1825***	460.1560***	0.9917	16	-6.667.0438*	-329.5348***	0.8651
80	7392	Management Consulting	18	-100.311.7297***	1.945.3282***	0.9775	18	1.197.8774*	-92.3090**	0.2576
81	7394	Photofinishing Labs	10	-1.097.6391**	64.9172***	0.6378	10	245.8353***	-23.8282**	0.5049
82	7399	Business Services	13	-117.4705	10.4711**	0.4465	14	103.7226	6.0391	0.0390
83	7948	Racing	10	-71.9679	8.5062	0.1885	11	96.4934***	-10.9569***	0.6695
84	7999	Amusement Services	10	52.7942	0.8941	0.0031	11	214.0573**	-9.9703	0.1003
85	8911	Engineering Services	20	102.1796	5.6538***	0.5964	21	537.2640***	-48.2967***	0.3696

<sup>a</sup>  $a$  and  $b$  are the constant and the slope coefficients of the model  $Risk = a + b \text{ Return}$ , where  $\text{Return}$  is return on assets (ROA),  $Risk$  is the variance of ROA for the 1977–1984 time period, target return is the industry median ROA.

\*\*\* $P \leq 0.01$ ; \*\* $P \leq 0.05$ ; \* $P \leq 0.10$

## References

- Aaker, D.A. and R. Jacobson, 1987, The role of risk in explaining differences in profitability, *Academy of Management Journal* 30, no. 2, 277–296.
- Bain, J.S., 1956, *Barriers to new competition* (Harvard University Press, Cambridge, MA).
- Baird, I.S. and H. Thomas, 1986, Toward a contingency model of strategic risk-taking, *Academy of Management Review* 10, 230–244.
- Beaver, W., P. Kettler and M. Schools, 1970, The association between market determined and accounting determined risk measures, *The Accounting Review*, Oct., 654–682.
- Bettis, R.A., 1981, Performance differences in related and unrelated diversified firms, *Strategic Management Journal* 2, 379–393.
- Bettis, R.A. and V. Mahjan, 1985, Risk/return performance of diversified firms, *Management Science* 31, 785–799.
- Bowman, E.H., 1980, A risk/return paradox for strategic management, *Sloan Management Review* 21, no. 3, 17–31.
- Bowman, E.H., 1982, Risk seeking by troubled firms, *Sloan Management Review* 23, no. 4, 33–42.
- Bowman, R.G., 1979, The theoretical relationship between systematic risk and financial (accounting) variables, *The Journal of Finance* 34, no. 3, 617–630.
- Conrad, G.R. and I.H. Plotkin, 1968, Risk return: U.S. industry pattern, *Harvard Business Review* 46, no. 2, 90–99.
- Cool, C.O. and D. Schendel, 1987, Strategic group formation and performance: The case of the U.S. pharmaceutical industry, 1963–1982, *Management Science* 33, no. 9, 1102–1124.
- Cool, K. and I. Dierickx, 1987, Negative risk return relationships in business strategy: The case of U.S. pharmaceutical industry, 1963–1982, Jan., INSEAD, working paper.
- Cootner, P.H. and D.M. Holland, 1970, Rate of return and business risk, *Bell Journal of Economics* 1, 211–226.
- Crum, R., D.J. Laughhunn and J.W. Payne, 1980, Risk preference: Empirical evidence and its implications for capital budgeting, in: F.G.J. Derkindren and R.L. Crum, eds., *Financing issues in corporate project selection* (Martinus Nyhoff, Boston, MA) 99–117.
- Fiegenbaum, A. and H. Thomas, 1986, Dynamic and risk measurement perspectives on Bowman's risk–return paradox for strategic management: An empirical study, *Strategic Management Journal* 7, 395–407.
- Fiegenbaum, A. and H. Thomas, 1988, Attitudes toward risk and the risk return paradox: Prospect theory explanations, *Academy of Management Journal* 31, no. 1, 85–106.
- Fiegenbaum, A. and H. Thomas, *Strategic group and performance: The U.S. insurance industry*, *Strategic Management Journal*, forthcoming.
- Fishburn, P.C., 1977, Mean-risk analysis with risk associated with below target returns, *American Economic Review* 67, 116–126.
- Fishburn, P.C. and G.A. Kochenberger, 1979, Two-piece Von Neumann–Morgenstern utility functions, *Decision Sciences* 10, 503–518.
- Fisher, I.N. and G.R. Hall, 1969, Risk and corporate rates of return, *Quarterly Journal of Economics* 83, 79–92.
- Frecka, T.J. and C.F. Lee, 1983, Generalized financial ratio adjustment processes and their implications, *Journal of Accounting Research* 21, 308–316.
- Friedman, M. and L.J. Savage, 1948, The utility analysis of choices involving risk, *Journal of Political Economy* 56, 279–304.
- Grayson, C.J., 1959, *Decisions under uncertainty: Drilling decisions by oil and gas companies* (Harvard University Press, Boston, MA).
- Grether, D.M. and C.R. Plott, 1979, Economic theory of choice and the preference reversal phenomenon, *American Economic Review* 69, 623–638.
- Harrigan, K.R., 1985, An application of clustering for strategic groups, *Strategic Management Journal* 6, 55–73.
- Hunt, M.S., 1972, *Competition in the major home appliance industry, 1960–1970*, Unpublished Ph.D. dissertation, Harvard University.
- Jemison, D., 1987, Risk and the relationship among strategy organizational processes, and performance, *Management Science* 33, no. 9, 1087–1101.
- Journal of Business*, 1986, Special issue devoted to the Behavioral Foundations of Economic Theory 59, no. 4.

- Kahneman, D. and A. Tversky, 1979, Prospect theory: An analysis of decisions under risk, *Econometrica* 47, 262–291.
- Laughunn, D.J., J.W. Payne and R. Crum, 1980, Managerial risk preferences for below target returns, *Management Science* 26, no. 12, 1238–1249.
- Lev, B., 1969, Industry averages as targets for financial ratios, *Journal of Accounting Research* 7, 290–299.
- Lintner, J., 1965, The valuation of risk assets and the selection of risky investment in stock portfolios and capital budgets, *Review of Economics and Statistics* 47, 13–37.
- March, J.G., 1988, Variable risk preferences and adaptive aspirations, *Journal of Economic Behavior and Organization* 9, 5–24.
- Markowitz, H., 1952, *Portfolio selection* (John Wiley & Sons, New York).
- Neumann, M., I. Bobel and A. Haid, 1979, Profitability, risk, and market structure in West German industries, *Journal of Industrial Economics* 27, 227–242.
- Payne, J.W., D.J. Laughunn and R. Crum, 1980, Translation of gambles and aspiration level effects in risky choice behavior, *Management Science* 26, no. 10, 1039–1060.
- Payne, J.W., D.J. Laughunn and R. Crum, 1981, Further tests of aspiration level effects in risky choice behavior, *Management Science* 27, no. 8, 953–958.
- Porter, M.E., 1980, *Competitive strategy* (The Free Press, New York).
- Puto, C.P., 1987, The framing of buying decisions, *Journal of Consumer Research*, Dec.
- Rumelt, R.P., 1974, *Strategy, structure and economic performance* (Harvard University Press, Cambridge, MA).
- Schendel, D.E. and R.G. Patton, 1978, A simultaneous equation model of corporate strategy, *Management Science* 24, 1611–1621.
- Scherer, F.M., 1980, *Industrial market structure and economic performance*, 2nd ed. (Rand McNally College Publishing Company, Chicago, IL).
- Schoemaker, P.J., 1982, The expected utility model: Its variants, purpose, evidence and limitations, *Journal of Economic Literature* 20, 529–563.
- Sharpe, W., 1964, Capital asset prices: A theory of market equilibrium under conditions of risk, *Journal of Finance* 19, 425–442.
- Singh, J.V., 1986, Performance, slack, and risk taking in organizational decision making, *Academy of Management Journal* 29, 562–585.
- Swalm, R.O., 1966, Utility theory – Insights into risk taking, *Harvard Business Review* 44, 123–136.
- Tversky, A. and D. Kahneman, 1981, The framing of decisions and the psychology of choice, *Science* 211, 453–458.
- Tversky, A. and D. Kahneman, 1986, Rational choice and the framing of decisions, *Journal of Business* 59, no. 4, S251–S278.
- Woo, C.W., 1987, Path analysis of the relationship between market share, business lend conduct and risk, *Strategic Management Journal* 8, 149–168.