This is to certify that the

dissertation entitled

Framing Effects in Asset Markets:
An Experimental Approach

presented by

Eugene R. Blue

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Accounting

Major professor

Date August, 1997

FRAMING EFFECTS IN ASSET MARKETS: AN EXPERIMENTAL APPROACH

By

Eugene R. Blue

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Accounting

1997

ABSTRACT

FRAMING EFFECTS IN ASSET MARKETS:
AN EXPERIMENTAL APPROACH

By

Eugene R. Blue

This study examines whether framing effects can induce bias in security prices in certain laboratory environments. Double oral auction experimental markets were used to determine if the manner in which information is presented to the markets would result in differential pricing of securities. Equivalent hypothetical scenarios were presented to parallel markets. One market received the information in a positive frame, the other market received the information in a negative frame. Prices from the two markets were compared for significant differences. The results suggest that the manner of presentation may effect market prices.

ACKNOWLEDGMENTS

This work would not have been possible without the patient assistance of the members of my committee. I therefore wish to give special thanks to Professors Luft, Ohmke, and Ramamorthi.

Matthew J. Anderson has been more than just the chairperson of my committee. He has been a true friend and mentor. His expertise and guidance have been crucial to the completion of this dissertation.

Finally, I wish to thank my mother, brother, niece, loving wife and family for their support. This process has required no small degree of personal sacrifice and encouragement from my dear loved ones.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 - INTRODUCTION

A fundamental assumption of accounting principles is that prices provide objective, verifiable evidence of value. The association between financial accounting information and market prices has long been established. The link between financial accounting information and market prices is in some sense a consequence of the economic system, as stated by Hendriksen (1977, page 126) "Following from the assumption of an exchange economy, it is logical that exchange prices (market prices) would be relevant to external reporting." Statement of Financial Accounting Concepts No. 1 in paragraph thirty-nine states "The market's assessment of an enterprise's expected success in generating favorable cash flows affects the relative market price of its securities" (Financial Accounting Standards Board, 1992). In part, the expectation of success is derived from careful analysis of information released to the market, including the financial statements.

Market prices are also of vital importance to accounting research. Market prices (or price relatives) are often the primary inputs in capital markets research. Certain assumptions regarding these prices are implicit in the acceptance of their use for accounting research purposes. One of the these assumptions is that prices are

an unbiased measure of market participants' response to available accounting information. Subsumed in this assumption is the notion that these prices are the result of a rational process. The Efficient Markets Hypothesis assumes rationality in the formation of market prices.

Accounting based capital markets research has traditionally ignored behavioral aspects of the market's response to information. It assumes that actors in the market react rationally to information. DeBondt and Thaler (1994) delineate the potential pitfalls of taking such an approach. DeBondt and Thaler argue that "in order to make scientific progress, some diversity in methods is probably a good thing. In particular, much is gained - and, possibly, some anomalies could be resolved - by careful observation of what people actually do" (p. 22). Jensen (1993, p. 870) contends that research has "concentrated on how capital market decisions should be made, with little systematic study of how they actually <u>are</u> made in practice."

Researchers conducting capital market studies also note the potential for mispricing in the market. Bernard (1993) suggests that up to one third of the variation in stock prices could reflect mispricing. Ball (1992) states "Extensive evidence of anomalies suggests that either the market systematically misprices securities or the limitations of the theory, data and estimation techniques

are binding, or both. The less interesting research question now is whether markets are efficient, and the more interesting question is what and how we can learn more about price behavior in competitive stock markets." These studies provide findings which suggests that certain anomalies may exist in market price formation.

This study follows the suggestion of DeBondt and Thaler in examining the behavior of actors in experimental markets to assess what traders actually do when provided with certain information. I examine whether bias in security prices can be induced in certain laboratory environments. Recent developments in decision making theory are tested against general assumptions of economic theory of market behavior.

Statement of Financial Accounting Concepts No. 1, in paragraph 34, states that "Financial reporting should provide information that is useful to present and potential investors and creditors and other users in making rational investment, credit, and similar decisions." This study assesses whether the of alternative presentation of equivalent information in a laboratory setting can induce predictably irrational or biased market pricing. I examine the importance of how information is released to the market and the impact alternative framing of information can have on market prices. Market participants are provided

information in terms of either the probability of success or the probability of failure of a firm facing bankruptcy. This paper explores the possibility that the different presentation forms can lead to different prices in specific laboratory market environments.

Research in judgment and decision making suggests that presentation form is crucial in the decision making process. This research indicates that the same information presented in different forms can lead to different decisions. The term "framing effects" is used to describe changes in decision associated with different presentation forms. Johnson et. al (1991) define the frame as "a structure of information in the problem statement that stimulates a representation in the agent. A framing effect then refers to the effect of a particular problem statement (frame) on the representation adopted by the agent" (p. 76).

Prospect Theory (Kahneman and Tversky, 1979) posits that these framing effects are predictable when a risky choice problem can be framed in terms of gains and losses. According to Fischoff (1983) "Kahneman and Tversky have offered powerful demonstrations of how the same decision problem may be framed in ways that are formally equivalent in terms of classical (utility theory) models of choice behavior but that produce reversals of preference that can be predicted on the basis of Prospect Theory" (p. 103).

Kahneman and Tversky posit that rather than evaluate the choice problem from the position of final wealth as stipulated in economic theory, the decision maker uses the current wealth position as a reference point. The choice problem is then evaluated in terms of gains or losses from the reference point.

The remainder of this dissertation is organized as follows: Chapter Two reviews the relevant literature. Chapter Three develops the theoretical framework for the dissertation and introduces the hypotheses. Chapter Four describes the methodology for the study. Chapter Five describes the results of the experiments and discusses the statistical analysis of the data. The final chapter contains concluding remarks and suggestions for future research.

CHAPTER 2 - LITERATURE REVIEW

Prospect Theory and framing effects have been the subject of much investigation. Individual and aggregate decision processes have been examined. This review first focuses on research at the individual level. The results of research at the aggregate level are then reviewed. Particular attention is paid to how this research suggests that information framing should affect pricing in markets.

2.1. Individual Processes

The research at the individual level demonstrates systematic effects of information framing. Framing effects have been shown to be persistent and predictable. A common thread found in this literature is that when subjects are presented with alternative framings of common data, their responses tend to be a function of the decision frame.

The invariance principle of Expected Utility Theory states that different representations of the same choice problem should yield the same preference (Tversky and Kahneman, 1986). At the individual level, many studies have examined violations of the invariance principle. A typical example is the study by McNeil, Pauker, Sox, and Tversky (1982). They gave subjects statistical information concerning the outcomes of two treatments for lung cancer, radiation therapy and surgery. (See Appendix A for a

reproduction of the problem.) Two groups of subjects were given variants of the same information. Some subjects were presented with information in terms of mortality rates and the others in terms of survival rates. Subjects then indicated their preferred treatment. The number of subjects favoring radiation therapy increased from 18% in the survival frame to 44% in the mortality frame. These results suggest that the manner in which the choice problem is framed can affect the decision outcome.

The McNeil et al. study also presented subjects with incomplete information regarding survival and mortality rates associated with the treatments. Some subjects were presented with information stating only the survival rate for a given treatment. Other subjects were presented with only the mortality rate for the same treatment. Subjects given the survival rate were more likely to select the treatment than subjects given the mortality rate.

Levin, Johnson, and Russo (1985) made a similar finding in their study. They examined framing effects in judgment tasks with varying amounts of information. Levin et al. presented half of the subjects with the probability of winning a gamble. The other subjects were presented the probability of losing the same gamble. Significant differences were found in the rate at which the subjects were willing to accept the gamble. The McNeil et al. and

Levin et al. studies are important because both investigations provide support for a similar incomplete information manipulation used in the current study.

It should be noted that the presentation of only the probability of the positive outcome versus the probability of a negative outcome has been characterized as a phenomenon distinct from framing. Schie and Van der Pligt (1995) use the term outcome salience to describe the situation where the manipulation does not shift the reference point but selectively emphasizes the probability of success versus emphasizing the probability of failure. They posit that Prospect Theory presents the whole problem in terms of gains and losses, whereas outcome salience only presents half of the probability distribution. The authors go on to state that "it seems incorrect to apply Prospect Theory to predict or understand the effects of outcome salience" (1995 p. 266). This statement is based on the observation that Prospect Theory predicts that people tend to be risk averse when confronted with a problem framed in terms of gains and risk taking when facing a problem framed in terms of losses. The authors assert that the general finding of studies of outcome salience found that emphasizing the positive outcome led to risk seeking, while emphasizing the negative outcome led to risk avoidance. Their study suggests that the manipulations used to test Prospect Theory and outcome

salience are separate and that the two theories lead to different predictions. The results of their study suggest possible confounding between Prospect Theory and outcome salience in many experimental manipulations.[1]

Lewis (1985) used six pairs of questions that the previous literature had found to induce framing effects. The questions presented both the positive and negative framing of a choice problem to subjects. Despite having both frames, the subjects' responses were still inconsistent in a manner predicted by Prospect Theory. Lewis later revealed the inconsistencies to his subjects. When given a chance to change their responses, the subjects did so only half of the time. These results point to the persistence of a framing effect once it has been established. This is relevant to this study in suggesting that framing effects may be sustainable in a market setting.

Roszkowski et al. (1990) found the predicted framing effect in their study of professional financial planners. Subjects were presented with one of two equivalent scenarios

---

[1] This dissertation, while acknowledging the possible distinction between Prospect Theory and outcome salience, does not purport to test the two theories. The manipulation used in this dissertation is intended to frame the possible outcomes in terms of gains and losses. The reference point is experimentally established through the requirement that the traders must purchase certificates, at a specified price, at the beginning of each market period.

regarding possible investment strategies. Here the subjects had to select between a sure loss or savings for a client and a probabilistic loss or savings. When the scenario was framed in terms of losing money, the financial planners were found to be risk seeking. When the scenario was presented in terms of saving money, the planners were risk averse.

Jou, et al. (1996) examine the question as to whether the results of framing effects are a "demonstration of fundamental inconsistency in human judgment, or is it simply a manifestation of a disagreement between the experimenters' and the subjects' interpretations of the problem" (1996 p. 2). The authors posit that "the equivalence relationship as defined by Tversky and Kahneman's (1981) original problem is arbitrary in the sense that it does not give a rationale for such a relationship between the gain and the loss which corresponds to people's familiar life experience" (1996 p. 2). The results of the study by Jou et al. suggest that the framing effect could be eliminated by introducing a causal schema providing the subjects with a rationale for the reciprocal relationship between the gains and losses.

2.2. Aggregate Processes

Research on framing effects done at the aggregate decision making level may be divided into two subsets - experimental market studies and empirical studies. These

studies suggest that biased decision making is not just a factor at the individual level, but is also observable at the aggregate level. Empirical market studies have found evidence of framing effects. The existence of such effects lends support to the theory that a framing effect bias may be induced in an experimental market.

Prospect Theory may be viewed as a viable alternative to or a special case of Expected Utility Theory (Demski and Swierenga, 1981). Some economists point out that the data supporting Prospect Theory and the demonstrated violations of the principle of invariance all pertain to individual decision making processes. These economists hold that market forces are exerted on the aggregate level and if such violations do occur, the market will serve to correct irrational behavior. Milton Friedman (1953) contends that theories can have predictive power even if their assumptions (such as invariance) are violated.

Camerer (1990) lists five theoretical explanations of how markets may act to correct irrationality: "[1] In naturally occurring markets, people will have enough financial incentive and experience to avoid the kind of mistakes observed in laboratory experiments; [2] Irrationality causes random mistakes which will average out in a market full of individuals." Note, however, the violations predicted by Prospect Theory have been shown to

be persistent and systematic as opposed to random in nature. Camerer continues: "[3] Irrational agents may be driven from the market by bankruptcy, either by natural forces or at the hands of more rational competitors; [4] Only a small number of rational people are needed to make market outcomes rational, if those people have access to enough capital or factors of production; and [5] Irrational people may learn implicitly by observing the actions of more rational people, or explicitly by buying advice or information."

If Camerer is correct, the market should operate to force irrational traders out of the market or at least force them to act as if they are rational. Russell and Thaler (1985, 1987) argue that this is not always the case. They examined "quasi rationality" in competitive markets. The authors defined quasi rationality as regular but nonrational behavior such as found in framing effects. They used a theoretical approach to demonstrate that "the existence of markets is not sufficient to eliminate the effect of quasi-rational behavior." (Russell and Thaler, 1985)

A number of experimental market studies have examined if there is evidence which supports a claim of bias at the market level. Many of these studies have involved the use of experimental asset markets. In these studies, the use of a heuristic such as representativeness or base-rate neglect

is compared to the normative Bayesian approach to probability revision. These studies generally employ bingo cages containing differently colored balls from which a sample is drawn. The distribution of the balls in a particular cage is known to the subjects, but they do not know from which cage the balls are drawn. They must infer this information from the observed sample. Subjects are given information as to the underlying probability that the sample came from a particular cage. The amount of the liquidating dividend (or payoff) is determined by which cage produced the sample.

Duh and Sunder (1986) compared the base-rate neglect pricing model to the Bayesian price and allocation model. The base-rate neglect theory predicts that subjects will ignore prior (base-rate) probabilities in their judgments. Duh and Sunder found that although the Bayesian model as a price predictor outperformed the base-rate neglect model, market behavior still deviated from the Bayesian prediction. Further, for other aspects of market behavior, the base-rate neglect model performed as well or better.

Camerer (1987) compared the Bayesian price prediction model with a model he called exact representativeness. Exact representativeness predicts that subjects will overestimate a cage's likelihood when a sample resembles the cage's proportions exactly. Camerer found that prices

tended toward the Bayesian predictions although the results showed some evidence of exact representativeness.

Jamal and Sunder (1996) used computer simulations to examine three asset markets with imperfect information. Traders in the three markets were Bayesian, empirical Bayesian, and heuristic. They found that all three converged to the same Bayesian equilibrium. These findings are given as support to the thesis that "the rationality of the market emerges as a consequence of the market structure, and not from the rationality of individuals" (1996, p. 1).

Ganguly, Kagel and Moser (1993) employed a context-specific setting based on the "cab problem" of Kahneman and Tversky (1972) to induce base-rate neglect in their subjects. Subjects were given the description of a setting in which a company engaged in an "ambitious project" that would result in either a "huge success or a total failure." The base-rate probability of success of the ventures was manipulated at various levels. Subjects were also informed of a prediction made by an expert about the success or failure of the venture. Experimental markets were then run in which the subjects traded in shares of the firm involved in the venture. The results indicated although there was some movement toward the Bayesian predicted probabilities, the adjustment was modest and did not result in price movements toward the Bayesian predicted price.

Anderson and Sunder (1995) compared Bayesian and base-rate neglect price and allocation predictions using both students and professional traders. They found that neither the Bayesian nor the base-rate model could be rejected as a predictor of prices in markets run with professional traders. However, student subjects were found to be extremely representative.

The above referenced market studies, while not examining framing effects per se, do provide evidence that biased decision making can exist at the market level. The next step is to extend this line of research to determine if framing effects can be demonstrated to exist at the market level. The objective of this research is to determine if such framing effects can be purposely induced through the framing of information provided to a market in a controlled experiment.

Several studies have examined framing effects in "real" financial markets. These include Shefrin and Statman (1985), Ferris, Haugen, and Makhija (1988), and Benartzi and Thaler (1993). These papers focus on the concept of loss aversion. Loss aversion, an element of Prospect Theory, predicts that the response to a loss is more extreme than the response to a gain of an equal amount. Expected Utility Theory predicts that the response to gains and losses of equal amounts should be equivalent. In this respect, loss

aversion may be viewed as a violation of the invariance principle.

Shefrin and Statman (1985) examined loss aversion and its implications concerning decisions to realize gains and losses in a market setting. Prospect Theory predicts that individuals are risk seeking when presented with a choice between a sure loss and a probabilistic loss. This implies that rather than taking a sure loss on a stock, stockholders will hold on to losers in hope that the loss will be reversed. Prospect Theory also predicts that individuals are risk averse when presented with a choice of a sure gain versus a probabilistic gain. This implies that stockholders should prefer to take a sure gain on a winning stock rather than hold the stock for possible future gains.

Shefrin and Statman develop a theory that investors tend to "sell winners too early and ride losers too long." This theoretical framework was compared to Constantinides' (1984) optimal strategy for realizing gains and losses. Their work provides evidence which suggests that the pattern of loss and gain realization is consistent with predictions derived from Prospect Theory.

Ferris et al. (1988) compared two competing models which they denote the "tax-loss-selling hypothesis" and "the disposition effect." The tax-loss-selling hypothesis predicts that:

"...at year end the volume of trading in stocks that have performed poorly in previous periods will increase as traders sell to realize losses before the end of the tax year. Conversely, the volume of trading in stocks that have increased in price will decrease at the end of the tax year as traders postpone sales to avoid being taxed on the gain in the current tax year."

The disposition effect is based on Prospect Theory and predicts that investors are "reluctant to realize losses but are eager to realize gains." Ferris et al. found strong evidence that the disposition effect is a better predictor not only at year end but throughout the year as well.

Benartzi and Thaler (1995) examine the equity premium puzzle. The equity premium puzzle questions why investors are willing to hold bonds in their portfolio despite the fact that stocks have greatly outperformed bonds over the last century. This phenomena requires "coefficients of risk aversion in excess of 30 to explain the historical equity premium, whereas previous estimates and their theoretical arguments suggest that the actual figure is close to 1.0." Benartzi and Thaler use loss aversion and the behavioral concept of mental accounting[2] to explain the equity premium puzzle. Empirical research (Tversky and Kahneman 1992) has suggested that the disutility for a loss is about twice as large as the utility for an equal gain. Using simulations,

---

[2] Mental accounting "refers to the implicit methods individuals use to code and evaluate financial outcomes." (Benartzi and Thaler, 1993)

Benartzi and Thaler found that the size of the equity premium is consistent with the predictions of Prospect Theory if investors evaluate their portfolios on an annual basis.

These empirical studies demonstrate that effects consistent with framing can be found in financial markets. They do not, however, address the question of whether the framing of information can affect prices in the market. The following studies do suggest that some effects do affect prices.

A number of researchers have used experimental markets to examine the willingness to pay (WTP) and the willingness to accept (WTA) phenomena (Coase Theorem). Standard economic theory implies that there should be no difference between what one would be willing to pay for a good and what one would be willing to accept in payment for the sale of the same good. Both theoretical and real exchange experiments provide evidence of a wide disparity between what people are willing to pay and what they are willing to accept for a good. Research suggests that the amount people are willing to accept greatly exceeds the amount they are willing to pay for certain goods.

Thaler (1980) attributes this disparity to what he termed the "endowment effect." The endowment effect, a manifestation of loss aversion, is the increased value an

individual places on a good when the good is owned by the individual. The relinquishing of ownership is seen as a loss and, as predicted by loss aversion, the disutility of the loss is more extreme than the utility of the gain (acquisition) of the same good.

Coursey, Hovis, and Schulze (1987) and Brookshire and Coursey (1987) present experimental market studies which examine the WTP/WTA disparity. They found that the iterative processes associated with laboratory markets reduces the difference between WTP and WTA. However, the market process did not completely eliminate the differences between WTP and WTA. Nonetheless, they posit that repeated exchanges in a market afford learning opportunities that correct this bias. Here again is the assertion that market forces act to eliminate or reduce irrational behavior.

Kahneman, Knetsch, and Thaler (1990) also use an experimental market setting to examine the WTP/WTA phenomenon. Their findings suggest that the market setting does not necessarily act to reduce the disparity between WTP and WTA. This is particularly true when the transaction involves real property. The importance of the Kahneman et al. study is that it provides further evidence that market forces do not always eliminate bias. The literature does not reveal any studies which examine the impact of information framing on market price formation. It does

provide evidence that market forces do not always correct biased decision making. There is also evidence of framing effects found in empirical market studies.

The empirical market studies that examine the phenomena of loss aversion also supply evidence of the violation of the principle of invariance. These findings provide support for the premise that framing effects can be induced in laboratory markets and that the effect of the framing should be reflected in price formation.

CHAPTER 3 - THEORY

Kahneman and Tversky (1979) first introduced Prospect Theory in an attempt to explain violations of various normative decision making theories. Expected Utility Theory assumes that the individual decision maker frames his choice in terms of the final consequence of his decision. The utility of an outcome is weighted by the probability of that outcome obtaining. The decision maker then chooses the outcome with the highest expected utility.

Prospect Theory assumes that gains and losses are evaluated from an initial reference point. The reference point is usually the individual's economic and mental state prior to consideration of the choice problem. "The reference point usually corresponds to the current asset position, in which case gains and losses coincide with the actual amounts that are received or paid. However, the location of the reference point, and the consequent coding of outcomes as gains or losses, can be affected by the formulation of the offered prospects, and by the expectations of the decision maker" (Kahneman and Tversky, 1979, p. 274). Kahneman and Tversky go on to posit that the "carriers of value are changes in wealth or welfare, rather than final states" (1979, p. 277). They further state that:

"This assumption is compatible with basic principles of perception and judgment. Our perceptual apparatus is attuned to the evaluation of changes or differences rather than to the evaluation of absolute magnitudes. When we respond to attributes such as brightness, loudness or temperature, the past and present context of experience defines an adaptation level, or reference point, and stimuli are perceived in relation to this reference point" (1979, p. 277).

The manner of presentation of the choice problem can therefore cause a shift in the reference point. Kahneman et al. (1990) provide data concerning the establishment of new reference points. This concept of establishing new reference points is elaborated on later in this chapter. Their findings suggest that once set the new reference point remains fairly stable in subsequent market iterations. This is very important to the theoretical development of the current study. The current study proposes that the framing of information establishes a new reference point which will persist and affect pricing in the market.

Kahneman and Tversky (1979) develop a value function which represents the values the decision maker places on gains and losses as viewed from the reference point (See Figure 3.1).

The value function is generally concave in the area of gains and convex in the area of losses. It describes the decision maker as risk averse in terms of possible gains and risk seeking in terms of losses. The value function is steeper for losses than for gains. Loss aversion is thus a

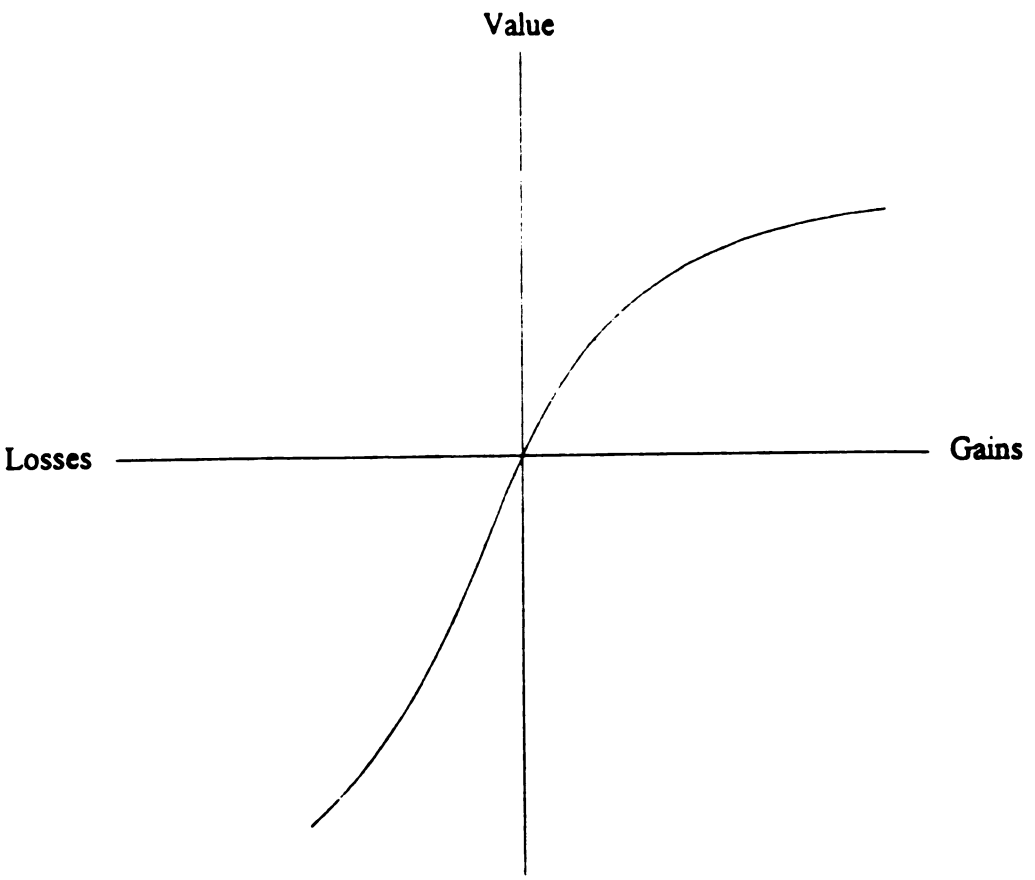

Figure 3.1: Example of a Value Function

significant property of the value function.

Preferences are relatively insensitive to small changes of wealth but highly sensitive to changes in the reference point. Tversky and Kahneman (1986) show that the reference point can be shifted by merely changing the wording of the choice problem.

Kahneman and Tversky (1979) describe the choice process as consisting of at least two phases, (1) framing and editing, and (2) evaluation/choice. The framing and editing phase "consists of a preliminary analysis of the offered prospects, which often yields a simpler representation of these prospects" (1979, p. 274). This phase serves to "frame" the effective acts, outcomes, and contingencies. This process is "controlled by the manner in which the choice problem is presented as well as by norms, habits, and expectancies of the decision maker" (Tversky and Kahneman, 1986, p. S257). The evaluation phase is conducted by evaluating the framed prospects and the selection of the prospect with the highest value. Two methods of choosing between prospects are distinguished by the theory: 1) Selecting the dominant prospect; or 2) Comparison of respective prospect values.

Tversky and Kahneman (1991) propose that the framing of the prospects establishes a reference state which is used to evaluate the outcomes. The initial reference state r can be

interpreted as partitioning the choice state X into four quadrants defined by treating r as the origin. The decision maker is indifferent between any two outcomes, x_1, $x_2 \in X$ which lie along an indifference curve as long as x_1 and x_2 belong to the same quadrant with respect to r. Separate monotonic transformation of the two axes can shift the reference state (origin) to new coordinates r_1. Following the transformation, an outcome in the positive quadrant will be preferred to an outcome in a negative quadrant (See Figures 3.2 and 3.3).

In this study it may be useful to imagine the subject as standing on the origin facing the first quadrant and the x and y axis laid out on the floor. The change in the initial reference point is induced by having the subject figuratively turn toward the third quadrant and focus attention to the prospect of a potential loss. This rotation in reference is induced by providing (framing) information in a negative manner. By giving the subject information in terms of the probability of an unsuccessful outcome, I attempt to create a representation that induces loss aversion. In terms of market prices, the induced loss aversion should lead to lower transaction prices than in the market with positively framed information.

The alternative framing can be interpreted as a transformation function which shifts the reference state

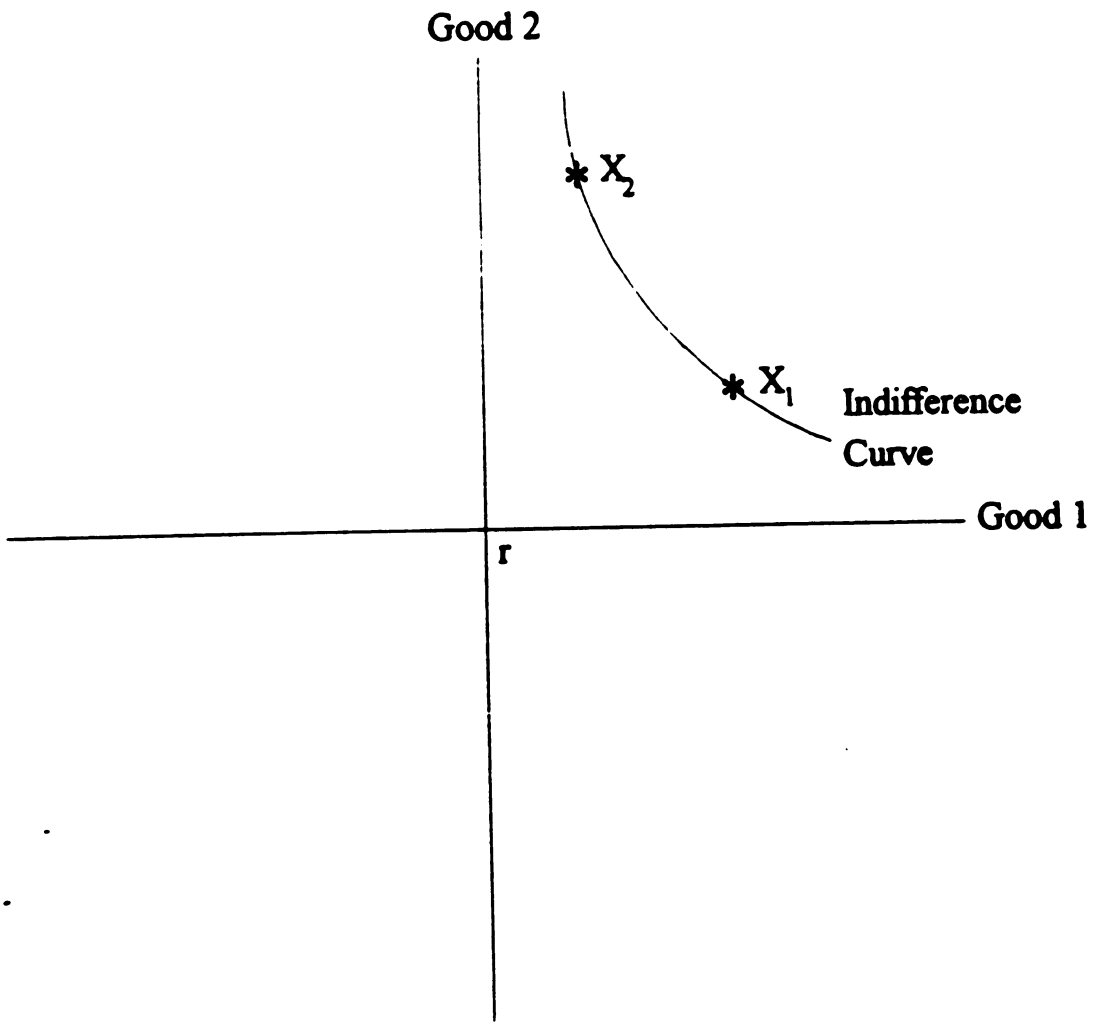

Figure 3.2: Reference Point

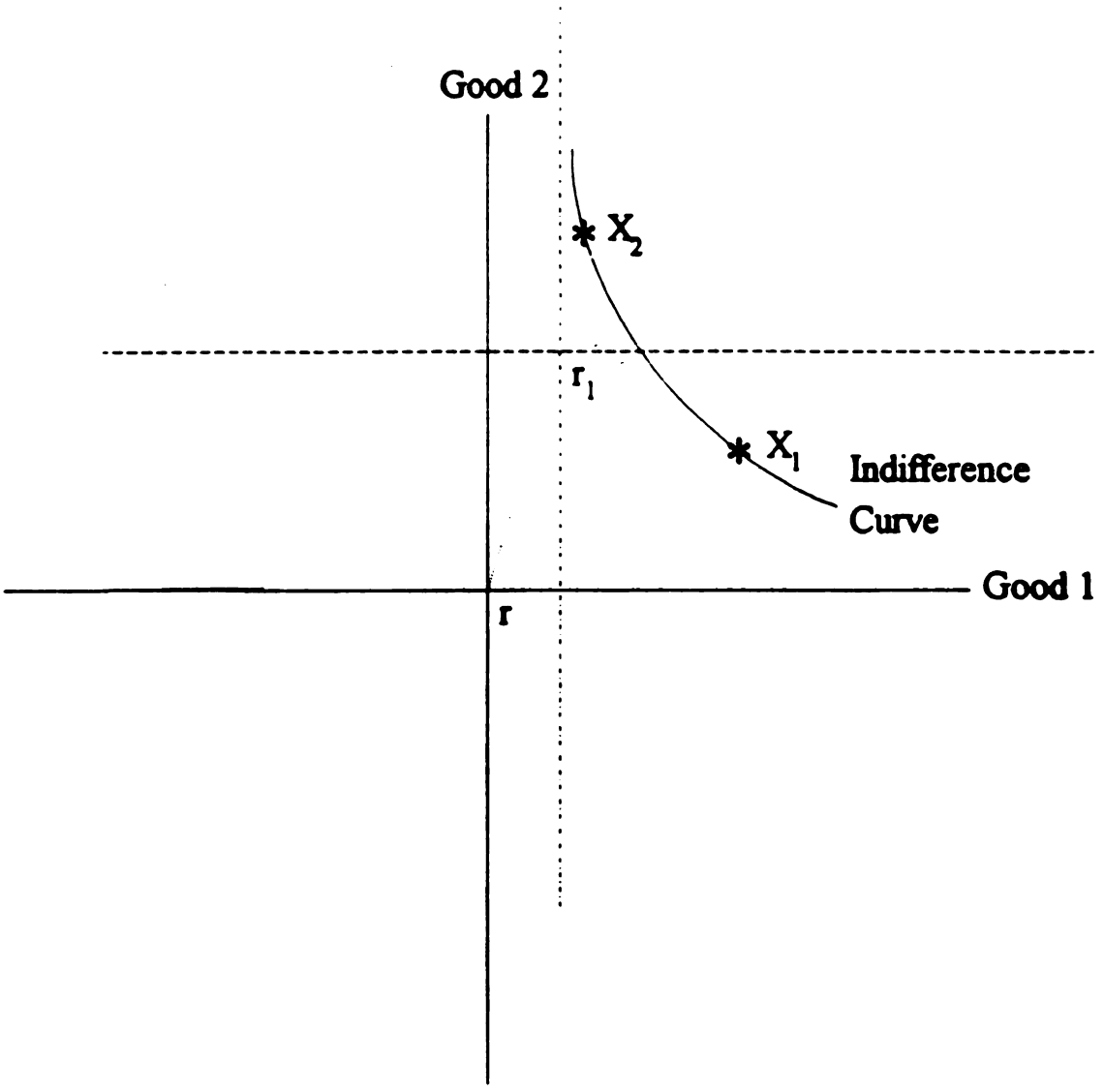

Figure 3.2: Shift in Reference Point

from r to r_i. Through the framing operation a change in reference can turn a gain into a loss or vice versa. In a risky choice problem, this transforms probabilities into decision weights. Here a risky choice is defined as a choice between gambles or prospects where there is uncertainty as to the outcome. Riskless choice refers to a condition where there is no uncertainty as to the outcome.

Tversky and Kahneman (1992) introduced Cumulative Prospect Theory which extends and generalizes Prospect Theory. This extension is important to this study in that it allows the calculation of ratio scale values associated with prospects. These values can then be used to compare prospects in a manner comparable to Expected Utility Theory. Cumulative Prospect Theory transforms the entire cumulative distribution function. It employs the concept of capacity, W, which is "a nonadditive set function that generalizes the standard notion of probability." The theory asserts that there exists a strictly increasing value function $v: X \rightarrow \Re$, satisfying $v(x_0) = v(0) = 0$, and capacities W^+ and W^-, such that for $f=(x_i,A_i)$, $-m \leq I \leq n$,

$$V(f) = V(f^+) + V(f^-) \qquad (1)$$

$$V(f^+) = \sum_{i=0}^{n} \pi_i^+ v(x_i) \qquad (2)$$

$$V(f^-) = \sum_{i=-m}^{0} \pi_i^- v(x_i) \qquad (3)$$

Where:

f = A sequence of pairs which yields x_i if state A_i occurs

V(f) = Value associated with the prospect

$V(f^+)$ = Value associated with the positive prospect

$V(f^-)$ = Value associated with the negative prospect

π^+ = Decision weight associated with positive prospects

π^- = Decision weight associated with negative prospects

v(x) = Value associated with the consequence.

The decision weights,

$$\pi^+(f^+) = (\pi_0^+, \ldots, \pi_n^+) \qquad (4)$$

and

$$\pi^-(f^-) = (\pi_{-m}^-, \ldots, \pi_0^-) \qquad (5)$$

are defined by

$$\pi_i^+ = W^+(A_i \cup \cdots \cup A_n) - W^+(A_{i+1} \cup \cdots \cup A_n), 0 \le i \le n-1 \qquad (6)$$

$$\pi_i^- = W^-(A_{-m} \cup \cdots \cup A_i) - W^-(A_{-m} \cup \cdots \cup A_{i-1}), 1-m \le i \le 0. \qquad (7)$$

Where: A = A state of nature where $f=(x_i, A_i)$ which yields x_i if A_i occurs. Letting $\pi_i = \pi_i^+$ if $I \ge 0$ and $\pi_i = \pi_i^-$ if $i<0$, this

reduces to

$$V(f)=\sum_{i=-m}^{n}\pi_i v(x_i)\,. \qquad (8)$$

"The decision weight π_i^+, associated with a positive outcome, is the difference between the capacities of the events 'the outcome is at least as good as x_i' and 'the outcome is strictly better than x_i.' The decision weight π_i^-, associated with a negative outcome, is the difference between the capacities of the events 'the outcome is at least as bad as x_i' and 'the outcome is strictly worse than x_i.' Thus, the decision weight associated with an outcome can be interpreted as the marginal contribution of the respective event, defined in terms of the capacities of W^+ and W^- ." (Tversky and Kahneman, 1994)

In the case where the prospect is indexed by a probability distribution $p(A_i)=p_i$, it can be viewed as a probabilistic or risky prospect (x_i,p_i). In this case, decision weights are defined by:

$$\pi_i^+=w^+(p_i+\cdots+p_n)-w^+(p_{i+1}+\cdots+p_n),\ 0\le i\le n-1,\ \pi_n^+=w^+(p_n) \qquad (9)$$

$$\pi_i^-=w^-(p_{-m}+\cdots+p_i)-w^-(p_{-m}+\cdots+p_{i-1}),\ 1-m\le i\le 0,\ \pi_{-m}^-=w^-(p_{-m})\,. \qquad (10)$$

Tversky and Kahneman (1992) represent v (found in Equation 8) as a two-part power function of the form:

$$v(x)=\begin{cases} x^{\alpha} & \text{if } x\ge 0 \\ -\lambda(-x)^{\beta} & \text{if } x<0 \end{cases} \qquad (11)$$

$w^+(p)$ and $w^-(p)$ are represented as follows:

$$w^+(p)=\frac{p^{\gamma}}{(p^{\gamma}+(1-p)^{\gamma})^{\frac{1}{\gamma}}},\quad w^-(p)=\frac{p^{\delta}}{(p^{\delta}+(1-p)^{\delta})^{\frac{1}{\delta}}} \qquad (12)$$

Where: γ = Exponent associated with positive prospects

δ = Exponent associated with negative prospects

A nonlinear regression procedure was used by Tversky and Kahneman (1992) to estimate the parameters of Equations (11) and (12) separately for each subject in their study.[3] The median exponent of the value function was 0.88 for both gains and losses. The median value of λ, the loss aversion coefficient, was 2.25, the median value of γ was 0.61 and the median value of δ was 0.69.

Using the derived values for the parameters λ, γ, and δ, decision weights can be calculated corresponding to the probabilities associated with a particular prospect. In this setting, these derived decision weights are then used to develop predictions for the expected share price under Cumulative Prospect Theory. It is important to note that the use of parameter values derived by Tversky and Kahneman (1992) requires the assumption that subjects used in this study have the same type and shape value functions and decision weighting functions as the subjects in the original work. (The assumption is necessary only for Hypothesis 2.) This implies that any difference between predicted share prices and experimentally derived equilibrium prices may be

---

[3] Twenty-five graduate students from Stanford and the University of California at Berkeley participated in the study.

due to the difference in parameter values. Appendix B details the expectations derived from Cumulative Prospect Theory. Appendix C details the expectations derived from Expected Utility Theory.

This study assumes that the framing of the choice problem results in different values being placed on the shares/certificates by subjects in the two markets. In the negative frame, the induced loss aversion decreases the value associated with the prospect. The lower value placed on the shares should be reflected in a willingness to pay less for them. Subjects in this frame should seek to minimize losses by the selling of certificates. Since certificates have a one period life, there is no advantage in holding the "losers" in anticipation of future price increases.

In the positive frame, no loss aversion is induced so traders should place a higher value on the shares than subjects in the negative frame. The higher value placed on the shares should result in higher prices in the positive frame than in the negative frame. In the positive frame, subject should anticipate gains from trading and seek to maximize profits. It is expected that traders in the positive frame will conform to predictions derived from Expected Utility Theory.

Predicted effects are tested using the following

hypotheses stated in alternative form:

H_1: Prices in the negatively framed markets will be lower than prices in the positively framed markets.

H_2: In the negative frame, Cumulative Prospect Theory is a better predictor of observed market prices than Expected Utility Theory.

Following Anderson and Sunder (1995), several maintained hypotheses are used in the derivation of the market predictions. They are: [1] Subjects are risk neutral (Applicable only to Expected Utility predictions); [2] Six or more subjects in a double oral auction yields an approximation of perfect competition (Gresik and Satterthwaite, 1983; Jamal and Sunder, 1991; Smith, 1994; Friedman and Sunder, 1994); and [3] The point of intersection between the market supply function and the market demand function gives the equilibrium price and quantity of the market (Plott, 1986; Smith, 1982; Friedman and Sunder, 1994).

CHAPTER 4 - METHODOLOGY

This study reports two experiments, each of which is replicated, for a total of four independent laboratory markets. Experiment 1 includes markets 1 and 1A. Experiment 2 includes markets 2 and 2A. In all experiments, subjects were randomly assigned to markets. Subjects in markets 1 and 2 received information presented strictly in a positive frame. Subjects in markets 1A and 2A received information presented strictly in a negative frame. Equivalent information was presented to subjects in markets 1 and 1A and markets 2 and 2A. The scenarios and outcomes in markets 1 and 2 and 1A and 2A respectively were identical.

4.1 METHOD

4.1.1 Subjects

Subjects in the experiments were graduate business and economics students from Michigan State University and Governors State University. Subjects in markets 1 and 1A were from Michigan State University. Ten MBA students took part in market 1. Market 1A consisted of nine MBA students. Subjects in markets 2 and 2A were from Governors State University. Market 2 consisted of ten graduate business students. Market 2A consisted of twelve graduate business students. Markets 1 and 1A were thirteen periods in length.

Market 2 and 2A were fourteen periods in length. No subject had prior experimental market experience.

4.1.2 Design

Experimental subjects (traders) were introduced to the market procedure by the experimenter reading aloud detailed trading instructions. Traders were also provided with written instructions. Traders were free to ask questions during the introduction of the procedures. Prior to the start of the actual market, traders were given the opportunity to practice trading in a zero (practice) trading period. Actual trading did not begin until traders were comfortable with the procedures. Appendix F contains a sample of the experimental packet provided to the traders.

Trading was conducted using a double oral auction. Trading was effected by traders verbally shouting bids to buy or offers to sell at specific prices. Bids or offers to buy or sell were recorded and displayed by the experimenter using an overhead projector. No short selling was allowed in the markets. Traders in each market were randomly assigned to one of two trader types (Trader Type I and Trader Type II). The two trader types had different liquidating dividends that were paid at the end of each period. This was done to generate gains from trading in the market. At the beginning of each period, each trader was

endowed with 10,200 francs. Before each trading period, each trader was required to buy two certificates at a cost of 100 francs each. Each certificate had a one period life and was paid a single uncertain dividend at the end of the period.

Table 4.1 Liquidating Dividends

Trader Type 1			
Scenario Outcome	**Price Paid**	**Dividend**	**Gain(Loss)**
Successful	100	400	300
Unsuccessful	100	50	(50)
Trader Type 2			
Scenario Outcome	**Price Paid**	**Dividend**	**Gain(Loss)**
Successful	100	300	200
Unsuccessful	100	25	(75)

The act of buying the initial certificates serves to establish an initial reference point for each trader. Prospect Theory predicts that possible gains or losses associated with trading and/or holding the certificates are then valued in reference to the 100 francs paid for each certificate. Both trader types in a given frame were faced with either a potential loss or gain (See Table 4.1).

Before the start of each period, traders were given a scenario that described a situation faced by a hypothetical firm. There was a different scenario for each period. To

promote comparability, equivalent scenarios and identical outcomes were used in both the positive and negative markets. In each scenario, the firm was faced with a situation that may affect its share price.

The traders were given a probability that the outcome would be successful or unsuccessful. Traders in each frame received only part of the probability distribution. For example, traders in the positive frame were only given the probability that the outcome would be successful. Traders in the negative frame were only given the probability that the outcome would be unsuccessful (See Appendix D). Traders in each market were given information as to the liquidating dividend payable under either outcome.

Periods 1 through 8 of Experiment 1 had a probability of success of 75%. In periods 9 through 12 the probability of success was 85%. The odds of a successful outcome was manipulated to test subject sensitivity to a change in probability. In the negatively framed market the probability of failure was 25% and 15% (1 minus the probability of success). For markets 2 and 2A, the probability of success was reversed. In periods 1 through 8 the probability of success was 85%. In periods 9 through 14 the probability of success was 75%. If the market results are consistent with individual results, then traders should react differently to the incomplete information. It is

predicted that traders in the negative frame should overweigh the probability of an unsuccessful outcome. This prediction is consistent with Cumulative Prospect Theory (Tversky and Kahneman, 1992) which predicts that low probabilities tend to be overweighted.

At the end of each period, the outcome of the scenario was announced. If the scenario had a successful outcome, the high dividend amount was paid. If the outcome was unsuccessful, the low dividend was paid. The determination of the outcome was decided in advance by a single draw, with replacement, from red and white balls in a bingo cage. The distribution of the colored balls in the bingo cage was determined by the probabilities stated in each scenario. This was accomplished by using a bingo cage with twenty balls. During periods when the probability of success was 75% ($p = .75$), the cage contained fifteen red balls and five white balls. If a red ball was selected from spinning the cage, it signified a successful outcome for the period. If a white ball was selected from the cage, it signified an unsuccessful outcome for the period. During periods when the probability of success was 85% ($p = .85$) the cage contained seventeen red balls and three white balls.

At the end of each period, dividends were paid and traders computed their profit. Profits consisted of those derived from dividends received for certificates held at the

end of the period plus net proceeds from trading (the buying and selling of certificates). Following Ganguly et al. (1991), trader profits are calculated as follows:

$$Profits = X[E_f - R_f + \sum O_i - \sum B_j + D(N)(E_c - x_s + x_b)] \quad (13)$$

Where X = dollar-per franc conversion rate

E_f = initial endowment in francs (10,000)

R_f = amount of francs repaid at end of period (10,000)

O_i = selling price of I-th certificate sold

B_j = purchase price of j-th certificate bought

D(N) = dividends per certificate given state of nature N

E_c = initial purchased certificates

x_s = number of certificates sold

x_b = number of certificates bought

At the end of the experiment, francs were converted to U.S. dollars and traders were paid in cash.

A between groups design is used to examine the effect of information framing. The explanatory variable consists of information framing which is manipulated at two levels (positive vs. negative). A within groups design is employed to examine sensitivity to a change in stated probability of success. Here, the explanatory variable consists of two levels of the probability of success (75% vs. 85%). Market

prices serve as the dependent variable.

4.2 MODEL PREDICTIONS

Expected Utility Theory predicts that market prices in the positive and negative frame should be the same.[4] Prospect Theory predicts that the framing of the information presented to the markets should result in different values being placed on the outcomes. The framing effect should induce traders in the negative frame to place a lower value on the outcomes than traders in the positive frame. This difference in values should lead to lower market prices in the negative frame than in the positive frame.

Traders in the negative frame should observe from the operation of the market that the high dividend will be paid 75% to 85% of the time. The question is whether this experience prompt a shift in their reference point or will the reference point induced by loss aversion persist. The literature on this point is mixed. The work by Coursey et al. (1987) and Brookshire et al. (1987) suggest that learning should take place and be reflected by a shift in the reference point. The work by Kahneman et al. (1990) suggests that reference points tend to remain stable. If

---

[4] This paper assumes risk neutrality in the positive frame. If traders are risk averse, this state would apply to traders in both the positive and negative frames. This state may lead to depressed market prices but it should not affect prices differently in the two frames.

this latter condition holds, negative frame prices should remain significantly lower than positive frame prices throughout the markets.

CHAPTER 5 - RESULTS

5.1 Results

Analysis of the results have been separated into two sections for each experiment. Periods 1 through 8 are analyzed separately from periods 9 through 14. This was done because the predictions of Hypothesis 2 vary as a function of the probability of success. The predicted prices derived from both Cumulative Prospect Theory and Expected Utility Theory are dependent upon the stated probability of success. In periods 1 through 8, the probability of success is 75%, whereas in periods 9 through 14 the probability of success is 85%. To facilitate comparisons between predicted prices and observed market prices the periods were separated.

5.1.1 Experiment 1

Period probability and outcomes for Experiment 1 are listed in Table 5.1. In Experiment 1, the outcomes for periods 3, 4, and 12 were unsuccessful. An unsuccessful outcome denotes that in the scenario presented to the traders the hypothetical firm went bankrupt. Accordingly, the low liquidating dividend was paid. All other periods had a successful outcome. A successful outcome denotes that the firm survived and the high liquidating dividend was paid. The probability of a successful outcome was 0.75 for

Table 5.1: Experiment 1 Outcomes

PERIOD PROBABILITY AND OUTCOMES

Period	Probability of Success	Outcome
1	0.75	Successful
2	0.75	Successful
3	0.75	Unsuccessful
4	0.75	Unsuccessful
5	0.75	Successful
6	0.75	Successful
7	0.75	Successful
8	0.75	Successful
9	0.85	Successful
10	0.85	Successful
11	0.85	Successful
12	0.85	Unsuccessful
13	0.85	Successful

periods 1 through 8, with periods 9 through 13 having a 0.85 probability of a successful outcome.

The mean price was calculated for each period. Figure 5.1 graphically shows this information for periods 1 through 13.The first four periods in each market are generally considered to be learning periods in which traders become familiar with how the market operates (Friedman and Sunder, 1994). These periods are discussed in some detail but the majority of the analysis is confined to periods 5 and subsequent periods.

In periods 5 through 13 the prices in the positively framed market were higher than those in the negatively framed market. These results are consistent with the prediction in Hypothesis 1.

The prices in the two markets were examined to determine if there was a significant difference between data generated in the positively versus the negatively framed markets. Nonparametric statistical analysis was used for this task due to the unknown nature of the distribution of market prices in experimental markets. Often, such data appears to be highly nonnormal (Davis and Holt, 1993;

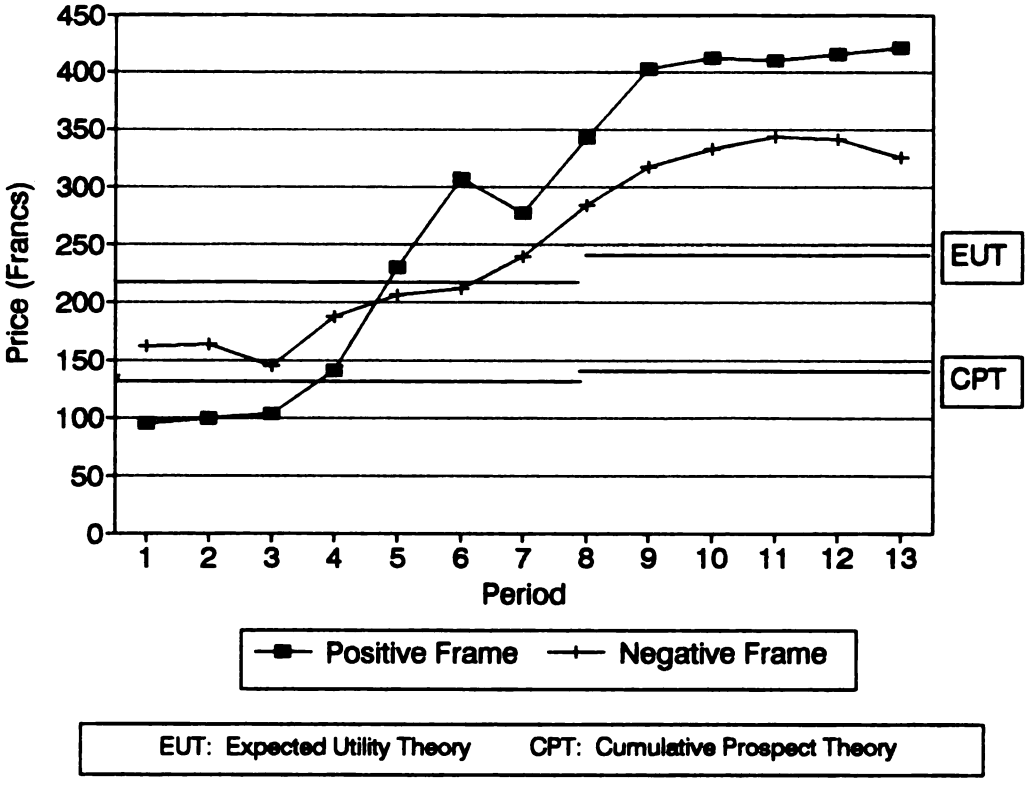

Figure 5.1: Experiment 1

Table 5.2: Experiment 1 Comparisons

Period	Outcome	Prob. of Success	Wilcoxon's U	Mann-Whitney 's W	p
1.	S	.75	14.0	142.0	.0027
2.	S	.75	36.0	354.0	.0001
3.	U	.75	24.0	294.0	.0001
4.	U	.75	13.5	181.5	.0009
5.	S	.75	53.5	119.5	.2917
6.	S	.75	14.0	80.0	.0004
7.	S	.75	40.5	118.5	.0153
8.	S	.75	11.0	89.0	.0000
9.	S	.85	0.0	91.0	.0000
10.	S	.85	0.0	45.0	.0001
11.	S	.85	0.0	78.0	.0000
12.	U	.85	0.0	66.0	.0000
13.	S	.85	0.0	78.0	.0000

Friedman and Sunder, 1994). Table 5.2 contains the results of a Mann-Whitney analysis of the null hypothesis assumption that the data generated by corresponding positive and negative periods come from the same distribution.

In period 5, it is not possible to reject the null hypothesis assumption that the data is derived from the same distribution ($p = 0.2917$). In periods 6 through 13, the data suggests that prices in the two markets are significantly different. This finding is consistent with the prediction of Hypothesis 1. A similar analysis using Student's t-test yields the same overall results. Table 5.3 contains the results of this analysis.

Hypothesis 2 predicts that in the negatively framed markets Cumulative Prospect Theory would be a better predictor of prices than Expected Utility Theory. In periods 1 through 8, where the probability of a successful outcome is .75, the price predicted using Expected Utility Theory is 312.50 francs. The predicted price using Cumulative Prospect Theory is 201.56. To analyze the predictive power of the two models, the absolute value of the difference of obtained prices from model predictions for

TABLE 5.3: Student's t-Test Comparisons

EXPERIMENT 1

Period	p
1	.002
2	.000
3	.000
4	.001
5	.129
6	.000
7	.030
8	.000
9	.000
10	.002
11	.000
12	.000
13	.001
14	.000

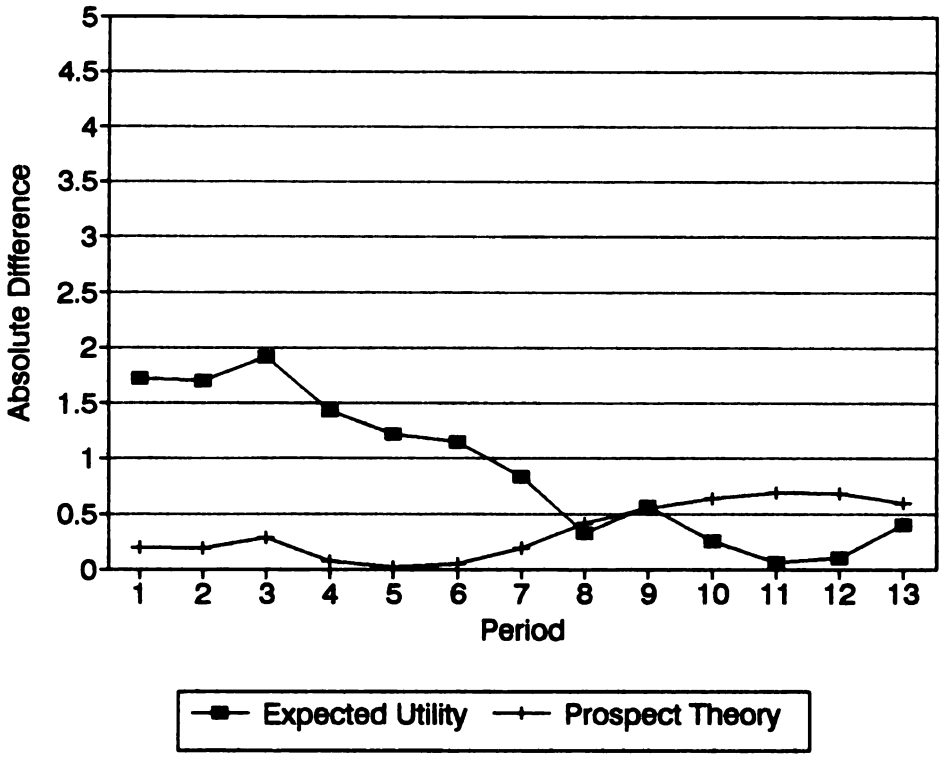

Figure 5.2: Absolute Difference - Market 1A

each market was calculated.[5] A graphic representation of the difference calculations are contained in Figure 5.2. Figure 5.2 shows the absolute value of the difference for Market 1 where the information was presented to traders in a negative manner. From the graph it is difficult to determine which model has greater predictive power. To facilitate the analysis, a Mann-Whitney (M-W) test was conducted comparing the difference generated by the two models. The results of the analysis suggests that for periods 5 through 8 Cumulative Prospect Theory better organizes the market data ($p = 0.043$). For periods 9 though 13 the data suggests that Expected Utility Theory is the better predictor ($p = 0.016$). Table 5.4 contains the results of the Mann-Whitney analysis for Markets 1 and 1A and Markets 2 and 2A.[6]

---

[5] This difference was calculated by subtracting the average period transaction price from the predicted price. The result was then divided by difference between the maximum liquidating dividend and the predicted price. The absolute value of the calculation was used to eliminate sign differences.

[6] A similar analysis was conducted using the Students t-test. The results of this analysis is similar to the results from the Mann-Whitney analysis. Results of the t-test analysis may be found in Appendix E.

Table 5.4: Comparison of Predictive Power

Mann-Whitney Test

EXPERIMENT 1 (MSU RESULTS)	
FRAME/PERIODS	**BEST PREDICTOR**
NEGATIVE 5-8	CPT ($p = 0.043$)
NEGATIVE 9-14	EUT ($p = 0.016$)
EXPERIMENT 2 (GSU RESULTS)	
NEGATIVE 5-8	CPT ($p = 0.021$)
NEGATIVE 9-14	NO DIFFERENCE

CPT - Cumulative Prospect Theory EUT - Expected Utility Theory

No prediction was made about market reaction to the change in the probability of success that occurred between periods 8 and 9. Sensitivity to this change was measured through an analysis of the reaction of prices to the change in the probability of success. The Scheffe method of simultaneous interval estimation was used to examine all transaction prices in each period. Results are contained in Table 5.5. In the positively framed market (Market 1), a significant difference was found between prices in periods 7 and 8. Periods 6, 7, and 8 were also found to be significantly different from periods 9, 10 and 11. No significant differences were found between periods 9, 10 and 11.

Table 5.5: SENSITIVITY TO CHANGE IN PROBABILITY

MARKET 1 (POSITIVE FRAME)

PERIOD	6	7	8	9	10	11
6						
7						
8		*				
9	*	*	*			
10	*	*	*			
11	*	*	*			

* Denotes significant difference at 0.05 level.

Table 5.6 contains a similar analysis that was conducted on prices taken from the negatively framed market (Market 1A). Prices in periods 6 and 7 were found to be significantly different from prices in period 8. Prices in periods 6, 7, and 8 were found to be significantly different from those in periods 9, 10 and 11. No significant differences were found between periods 9, 10 and 11. These observations suggest that prices were sensitive to the change in the probability of a successful outcome. Prices did increase as predicted, however the magnitude of the increase was greater than predicted.[7]

---

[7] A similar analysis was conducted for the GSU (Experiment 2) data. No significant differences were found between the relevant periods.

Table 5.6: Sensitivity to Change in Probability

Market 1A (Negative Frame)

PERIOD	6	7	8	9	10	11
6						
7						
8	*	*				
9	*	*	*			
10	*	*	*			
11	*	*	*			

* Denotes significant difference at 0.05 level.

5.1.2 Experiment 2

Experiment 2 consisted of Markets 2 and 2A. In Experiment 2, the sequence of probability of success was reversed. In periods 1 through 8, the probability of a successful outcome was 0.85. In periods 9 through 14 the probability of a successful outcome was 0.75. This reversal was undertaken to control for possible order effects that may be present in Experiment 1.

Period probability and outcomes for Experiment 2 are listed in Table 5.7. The outcomes for periods 7, 10 and 13 were unsuccessful. All other periods had a successful outcome.

As in Experiment 1, the mean price for each period was calculated. Figure 5.3 graphically shows the this

Table 5.7: Experiment 2 Outcomes

PERIOD PROBABILITY AND OUTCOMES

Period	Probability of Success	Outcome
1	0.85	Successful
2	0.85	Successful
3	0.85	Successful
4	0.85	Successful
5	0.85	Successful
6	0.85	Successful
7	0.85	Unsuccessful
8	0.85	Successful
9	0.75	Successful
10	0.75	Unsuccessful
11	0.75	Successful
12	0.75	Successful
13	0.75	Unsuccessful
14	0.75	Successful

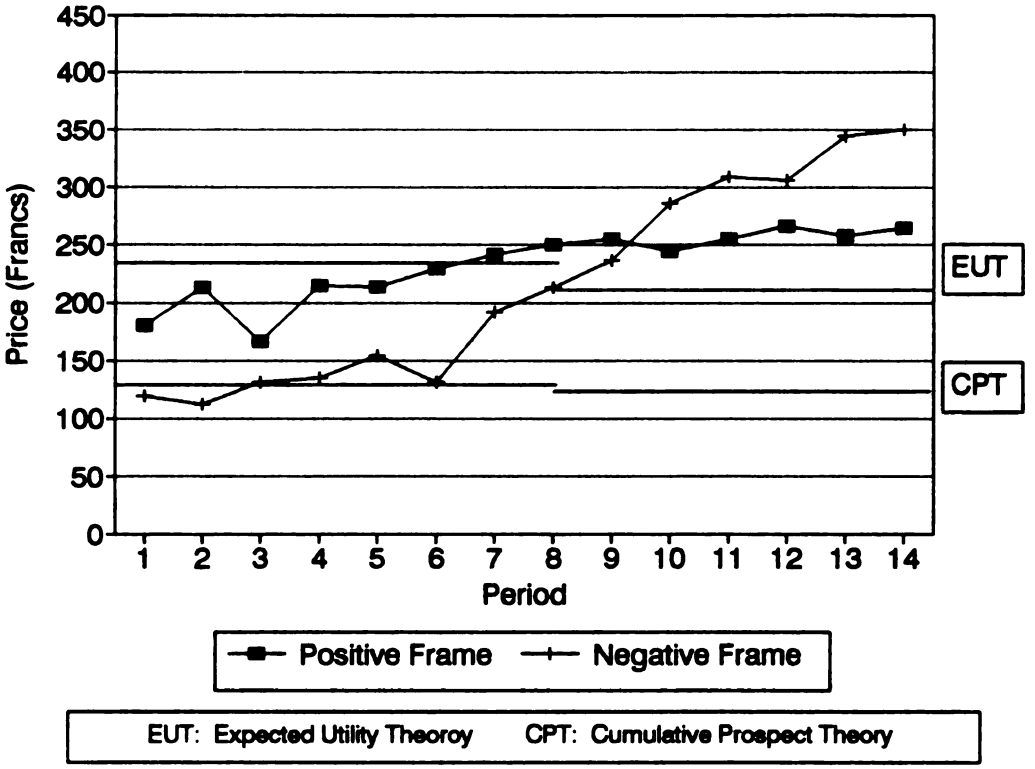

Figure 5.3: Experiment 2

information for periods 1 through 14. As can be seen from the graph, prices in the periods 5 through 9 are lower in the negatively framed market than prices in the positively framed market. This observation is consistent with the prediction in Hypothesis 1. In periods 10 through 14 prices in the positively framed market are lower that prices in the negatively framed market. This observation runs counter to the prediction in Hypothesis 1.

Table 5.8 contains the results of a Mann-Whitney analysis of the data derived from periods 1 through 14. Prices obtained in each period from the negatively and positively framed markets were compared to determine if they differed significantly. In periods 5 through 9, the data suggests that the prices in the negatively framed market were significantly lower than prices in the positively framed market. A similar analysis using Student's t-test found comparable results (See Appendix E).

Starting with period 9, the probability of success changed from .85 to .75. In periods 9 through 14, transaction prices in the negative frame were only significantly lower than prices in the positive frame in period 9. In periods 10 through 14, the prices in the negative frame were significantly higher than prices in the positive frame. These observations are not consistent with the prediction of Hypothesis 1.

Table 5.8: Experiment 2 Comparisons

Period	Outcome	Prob. of Success	Wilcoxon's U	Mann-Whitney 's W	p
1	S	.85	13.0	118.0	.0000
2	S	.85	.00	190.0	.0000
3	S	.85	117.0	327.0	.0006
4	S	.85	3.5	362.5	.0000
5	S	.85	12.0	387.0	.0000
6	S	.85	.00	420.0	.0000
7	U	.85	.00	222.0	.0000
8	S	.85	10.0	55.0	.0003
9	S	.75	16.0	103.0	.0189
10	U	.75	16.0	107.0	.0002
11	S	.75	.00	55.0	.0000
12	S	.75	10.0	65.0	.0005
13	U	.75	.00	91.0	.0000
14	S	.75	.00	153.0	.0000

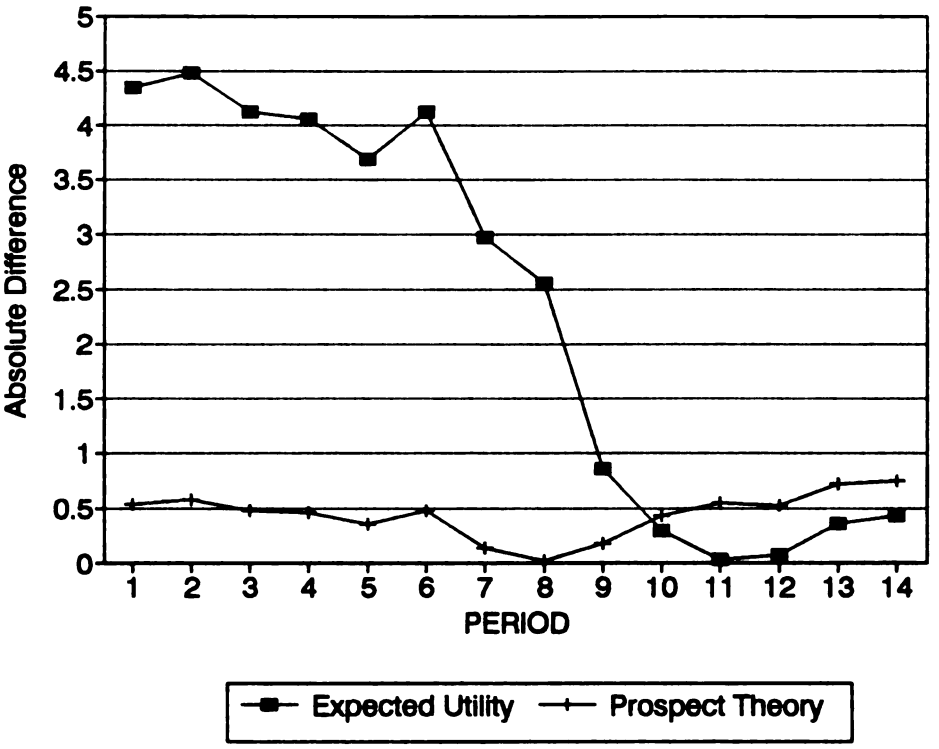

Figure 5.4: Absolute Difference - Market 2A

As in Experiment 1, the absolute value of the difference of market prices from predicted prices was calculated. Figure 5.4 contains the graphic representation of these calculations. In the negatively framed market for periods 5 through 8, the bias from Cumulative Prospect Theory predicted prices is less than the bias from Expected Utility Theory predicted prices.

In Market 2A where the information was presented in a negative manner, the data suggests that in periods 5 through 8 Cumulative Prospect Theory is the better predictor ($p = 0.021$). In periods 9 through 14 the analysis suggests that there is no significance difference in predictive power between the two theories.

5.2 Parameter Estimation

Predictions for market prices in the negative frame were calculated using parameters developed by Tversky and Kahneman (1992). Based upon data from the markets described in this study, new parameters were estimated. These new parameters and those calculated by Tversky and Kahneman are contained in Table 5.9.

The new parameters were developed using nonlinear regression based upon the equation (see Chapter 3, equation 12) developed by Tversky and Kahneman (1992). Estimates were calculated for each period individually. The median

value for all periods is the number displayed in the table[8]. No predictions were made as to the relative values of derived parameters compared to those developed by Tversky and Kahneman.

Table 5.9: Parameter Estimation

Positive Frame

	γ	δ	w^+	w^-
Tversky & Kahneman	0.61	0.69	0.568	0.294
New Estimate	0.66	0.67	0.608	0.294

Negative Frame

	γ	δ	w^+	w^-
Tversky & Kahneman	0.61	0.69	0.568	0.294
New Estimate	0.61	0.67	0.565	0.294

Table 5.10 also contains comparisons of the decision weights (w^+ and w^-) as calculated using the parameters developed by Tversky and Kahneman and the parameters derived from data generated in this study.

For the purposes of this analysis, the data generated in the corresponding markets at Michigan State University (MSU) and Governors State University (GSU) were combined. Comparison of the parameters derived by Tversky and Kahneman

[8] The median value was selected following Tversky and Kahneman's (1992) use of the median in the determination of their parameters.

with those derived from data from this study reveals that there is very little difference in the figures (See Table 5.10). Due to the derivation procedures no tests were conducted to determine if any differences were significant. In the positive frame the largest difference was for parameter γ. Here the difference was .05. The difference for parameter δ was .02. In the calculation of decision weight w^-, there is no difference.

In examination of the parameters for the negative frame, the only difference exists for parameter δ. Here the difference is .02. There is essentially no difference in the calculation of either set of decision weights. These results suggest it was not unreasonable to use the parameters derived by Tversky and Kahneman (1992) in predicting market prices in this study.

CHAPTER 6 - DISCUSSION

Following from the assumption of the principle of invariance, Expected Utility Theory predicts that prices in the positively and negatively framed market should not differ. Cumulative Prospect Theory predicts that how the choice problem is framed leads to a reference-point based analysis of the problem by the decision makers. Through the operation of loss aversion, prices in the negatively framed market should be significantly lower than prices in the positively framed market. The results of this study, although mixed, suggest that framing effects may exist in asset markets.

Hypothesis 1 predicts that prices in the negatively framed markets would be lower than prices in the positively framed markets. With the exceptions of periods 10 through 14 of Experiment 2, prices in the negatively framed markets were significantly lower than prices in the positively framed markets. This suggests that in all but five of twenty-three periods analyzed, or 78.26 percent of the periods, the prices were lower in the negatively framed markets.[9]

---

[9] These findings run counter to the predictions derived from outcome salience. Outcome salience predicts that emphasizing the positive outcome results in risk avoidance, whereas emphasizing the negative outcome results in risk

The data from periods 10 through 14 of Experiment 2 fail to replicate the results of Experiment 1. Several factors may be responsible this outcome. The change in the subject pool is one possible factor. Subjects in Experiment 1 were students at Michigan State University (MSU). Subjects in Experiment 2 were students at Governors State University (GSU). Characteristics of the student bodies at the two universities are somewhat dissimilar. The students at GSU tend to be older. The average age of undergraduate students at GSU is in the early thirties. GSU also has less stringent admission requirements. However, the impact of these differences upon subject behavior in the experimental markets is unclear. An ANOVA analysis was conducted to determine if there was a significant effect with school (MSU vs. GSU) as the independent variable and average period price as the dependent variable. No significant main effect was found ($p = 0.126$). This finding suggests that the failure of Experiment 2 in replicating Experiment 1 was not due to differences in the students traders at the two schools.

Theory suggests that the iterative process in these markets leads to learning as the traders become acquainted with the operation of the experiment. It is therefore

---

seeking. This suggests that lower prices should be found in the positively framed markets.

important to note whether, across market periods, the prices reflect diminishing of the framing effect and a movement towards the same prices as the traders in the positively framed markets? Lower prices in early trading periods would show evidence of this reversal of the manipulation followed by a movement toward prices found in the positively framed markets. Examination of the data demonstrates that in Experiment 1, starting with period 5, prices in the negatively framed market were lower than those in the positively framed market. In fact, in periods 6 through 13 prices in the negatively framed market were significantly lower than those in the positively framed market. This observation is consistent with Hypothesis 1 and suggests that the framing effect did not diminish across periods.

In Experiment 2, in periods 5 through 9 prices in the negatively framed market were lower than those in the positively framed market. However, in periods 10 through 14 prices in the negatively framed market exceeded those in the positively framed market. This suggests that the framing effect did diminish over time or that the manipulation was not effective. A possible alternative explanation of this result may be found in an examination of when in the experiment this effect takes place. Prices in the negatively framed market start to exceed those in the positively framed market in period 10. This is shortly

after the change in probability of a successful outcome that took place in period nine. The change in probability from .85 to .75 may have confused traders in the market. Evidence for this conjecture may be found in the fact that with the reduction in the probability of success prices should have declined relative to the prices before the change. An examination of market prices reveals that rather than declining, prices increased or remained constant after the change. This result is evident in both the negatively and positively framed markets.

Hypothesis 2 predicted that in the negatively framed markets Cumulative Prospect Theory would be a better predictor of prices than Expected Utility Theory. The results of the Mann-Whitney comparison of the absolute value of the difference from prices predicted by the two theories suggests that in two of the four conditions (See Table 5.5) Cumulative Prospect Theory appears to the better predictor. Expected Utility Theory appears to the better predictor only in one condition with no significant difference found in the other condition.

The decision weight parameters derived from market data in this study closely resemble the results derived by Tversky and Kahneman. The Tversky and Kahneman data was developed from individual decision behavior. The closeness of the parameters may suggest that market level outcomes may

develop in a similar fashion to individual outcomes in this setting. Much debate exists regarding the differences between individual and market behavior. The development of parameters from the results of this study is not a central thrust of this paper. However, it may suggest that further study along these lines may be fruitful.

Economic theory assumes that rational agents are the actors in the marketplace. Research in human decision making has shown that decision biases do exist and are predictable. The results of this study demonstrate some support for the theory that a framing bias can be sustained in a market setting. The manner in which information is presented to the market may affect the market's reaction. Although the existence of the bias is not consistent across markets and periods, its presence cannot be ignored. It should also be noted that in each instance initial transaction prices (periods 1 through 4 not discussed in this paper) are closer to that predicted by Cumulative Prospect Theory than that predicted by Expected Utility Theory. This suggests that initial transactions may be more susceptible to framing effects. If this is true, it may provide an opportunity for manipulation of prices for short periods.

The results, while not conclusive, indicate bias may be induced in a market setting through the manner in which

information released to the market is framed. The primary contribution of this research is the finding that the results found in psychology decision making studies may be replicated in an economic setting. This suggests that the decision making biases found in non-economic settings may exist in markets. However, the bias found in this study does not show evidence of being systematic in nature as was found in the psychology studies. This may be due to flaws in the design of this study or may suggest that the nature of biases found in market settings may somehow differ form those described by psychologist.

Further study of how bias may be introduced in market settings may help to shed light on the formation of prices in the market. This study examines a narrowly prescribed set of conditions. Examination of other settings which may promote bias should be undertaken to determine whether results found here may be replicated in asset markets.

APPENDICES

APPENDIX A

Problem used by McNeil et al. (1982):

Problem 1 (Survival frame)

Surgery: Of 100 people having surgery 90 live through the post- operative period, 68 are alive at the end of the first year and 34 are alive at the end of five years.

Radiation Therapy: Of 100 people having radiation therapy all live through the treatment, 77 are alive at the end of one year and 22 are alive at the end of five years.

Problem 1 (Mortality frame)

Surgery: Of 100 people having surgery 10 die during surgery or the post-operative period, 32 die by the end of the first year and 66 die by the end of five years.

Radiation Therapy: Of 100 people having radiation therapy, none die during treatment, 23 die by the end of one year and 78 die by the end of five years.

APPENDIX B

Cumulative Prospect Theory
Calculations for Trader Type I (Negative Frame)

$$v(gain) = 300^{(0.88)} = 151.31$$

$$v(loss) = -2.25(-50)^{(0.88)} = 70.35$$

$$w^{+}(0.75) = \frac{0.75^{(0.61)}}{(0.75^{(0.61)} + (1-0.75)^{(0.61)})^{(\frac{1}{0.61})}} = 0.568$$

$$w^{-}(0.25) = \frac{0.25^{(0.69)}}{(0.25^{(0.69)} + (1-0.25)^{(0.69)})^{(\frac{1}{0.69})}} = 0.294$$

$$V(f) = 0.568(151.31) + 0.294(70.35) = 106.63$$

The expectation of the share price is calculated as follows:

The above calculation of V(f) gives a value associated with the risky prospect. The following calculation transforms the value back into francs (F[V(f)]).

Set F[V(f)] = v(x), and solve for **x**

$106.63 = \mathbf{x}^{.88}$

x = 201.56 (in francs)

The expected share price is then equal to: 201.56

APPENDIX C

Expected Utility Theory

Calculations for Trader Type I

E(price) = p(high dividend) + q(low dividend)

E(price) = .75(400) + .25(50)

E(price) = 312.50

APPENDIX D

Positive Frame

PERIOD 1

You own two shares of stock in the Purple Construction Company for which you paid 100 francs each. The Purple Co. has suffered through two straight years of losses and is on the verge of bankruptcy. Its last hope is in securing a new contract to construct a proposed elementary school for a local town. If the Purple Co. is successful in winning the contract it will survive and the price of its stock will rise to 400 francs.

A spokesman for the Purple Co. states that there is a 75% chance the company will get the contract. (The validity of this statement is not in question.)

Negative Frame

PERIOD 1

You own two shares of stock in the Purple Construction Company for which you paid 100 francs each. The Purple Co. has suffered through two straight years of losses and is on the verge of bankruptcy. Its last hope is in securing a new contract to construct a proposed elementary school for a local town. If the Purple Co. is not successful in winning the contract it will not survive and the price of its stock will fall to 50 francs.

A spokesman for the Purple Co. states that there is a 25% chance the company will <u>not</u> get the contract. (The validity of this statement is not in question.)

APPENDIX E

Table 5.10: t-Test Comparison of Predictive Power

Cumulative Prospect Theory Versus Expected Utility Theory

EXPERIMENT 1 (MSU RESULTS)	
FRAME/PERIODS	BEST PREDICTOR
NEGATIVE 5-8	CPT ($p = 0.032$)
NEGATIVE 9-14	EUT ($p = 0.018$)
EXPERIMENT 2 (GSU RESULTS)	
NEGATIVE 5-8	CPT ($p = 0.002$)
NEGATIVE 9-14	NO DIFFERENCE

CPT - Cumulative Prospect Theory EUT - Expected Utility Theory

APPENDIX F

FORM_____

EXPERIMENTAL PACKET

SUBJECT_____

STUDY_____

DO NOT OPEN UNTIL INSTRUCTED TO DO SO

DO NOT TURN TO THE NEXT PAGE UNTIL INSTRUCTED TO DO SO

GENERAL INSTRUCTIONS

This is an experiment in the economics of market decision making. The instructions are simple and if you follow them carefully and make good decisions you may earn a considerable amount of money which will be paid to you in cash.

We are going to conduct a market in which you will be a participant in a sequence of market days or trading periods. On the next page you will find a sheet labeled Dividend Value which describes the value to you of any decisions you might make. You are not to reveal this information to anyone. It is your own private information.

The currency in these markets is francs. Francs will be converted to dollars at an exchange rate to be announced at the end of the experiment.

During each market period you will be free to buy or sell units as you choose. Your earnings can come from two sources: from trading and from the liquidating dividend value of units you hold at the end of the period. Trading earnings can result from buying and selling units. If you buy a unit and resell it to another participant at a higher price, then you make a profit which is yours to keep as earnings. Or, if you sell a unit and buy it back at a lower price, you make a profit. However, if you sell a unit at a price lower than the price you paid, then you incur a loss which you must absorb. Thus, buying and selling to other participants can result in either trading profits or losses.

Earnings from the liquidating dividend value of units held at the end of the period occur as follows. The liquidating dividend value is like a resale to the experimenter at a set price. Examine the sheet labeled Dividend Value. You will be paid this amount for each unit held at the end of the trading period. Note that there are two dividend values listed. The successful dividend amount will be paid if the outcome of the scenario is successful. The unsuccessful dividend amount will be paid if the outcome of the scenario is unsuccessful. The outcome of each scenario will be announced at the end of each period. Your earnings from the liquidating dividend payment is equal to the number of units held at the end of the period multiplied times the appropriate liquidating dividend.

Your total earnings will equal earnings from trading activities plus earnings from end of period liquidating dividends.

DIVIDEND VALUE

The dividend amounts listed on this sheet is your own private information. You are not to reveal this information to anyone.

Successful Dividend: 300

Unsuccessful Dividend: 25

PERIOD INSTRUCTIONS

At the beginning of each period, you will be given 10,200 francs for your use in trading during the period. Prior to the start of the period, you will be required to purchase two certificates at a price of 100 francs for each certificate. A total of 200 francs will be deducted from your cash on hand. You are to record this transaction on line 0 of your Information and Record Sheet. The certificates represent shares of stock in a hypothetical company. You will also be given information (a scenario) regarding a situation faced by the hypothetical company. You will then be given a five minute trading period during which you are able to trade your certificates with other traders in the market. At the end of the period, the outcome of the scenario faced by the company will be announced. The outcome of each period has been predetermined in advance by an independent draw, with replacement, from a bingo cage containing red and white balls. For each period, the number of red and white balls in the bingo cage matched the probability distribution described in the scenario. The draw for Period 0 is just for illustrative purposes.

Trading and Recording Rules

1) All transactions are for one certificate at a time. After each of your sales or purchases you must record the PRICE at which the deal (transaction) was made on your Information and Record Sheet in the appropriate column. Each deal (transaction) you consummate should be listed in the same order as consummated on the Information and Record Sheet, beginning with Line 1.

2) After each transaction, you must calculate and record your new certificate balance and your new francs-on-hand balance. Each sale should this balance, and each purchase should decrease this balance. The francs-on-hand balance must never go below zero.

3) At the end of each trading period, you are to calculate your earnings from the period. This is done by first calculating your earnings from certificates held at the end of the period (Line 19). You then add lines 18 and 19. From this subtotal you then subtract 10,000 francs (Line 20). The resulting total is then entered on line 21. These calculations give your end of period net profit.

4) At the end of the experiment you are to list the profit earned in each period on the Earnings Summary Sheet (at the end of the experimental packet). This will serve as the basis for your payment for participating in the experiment. At the end of the experiment the experimenter will tell you the exchange rate to be used to convert your francs to dollars. You will be paid the amount you earn.

Specific Experimental Organization

You may buy and sell certificates during each period. The transactions will take place in a market organized as follows. The market will be conducted over a number of periods (The experimenter will tell you when the experiment is over). Each period will last for five minutes. Anyone wishing to buy or sell a certificate must raise her or his hand and make a verbal bid to buy or offer to sell one certificate at a price he or she specifies. Any subsequent (following) bid to buy must be at a higher price to be admissible in the market. Conversely, any subsequent offer to sell must be at a lower price to be admissible in the market. If a bid or offer is accepted, a binding contract has been closed for a single certificate. The two parties to the transaction must record the transaction on their Information and Record Sheets. Any ties in bids, offers, or acceptances will be resolved by random choice among the parties involved.

Except for bids, offers, and acceptances, you are not to speak to anyone else. There may be many bids and offers that are not accepted. You are free to keep trying as often as you like to negotiate a sale or purchase. You are free to make as much profit as you can.

ZERO PERIOD EXAMPLE

Below is an example of the trading process. To illustrate how the market works, you will take part in this example. Each trader has been assigned a trader number (This number may be found on your period 0 Information and Record Sheet). You are to read aloud, in the order listed, the statement following your trader number. The experimenter will then record your bid or offer and it will be displayed on the screen by the overhead projector.

REMEMBER: A bid signifies that you want to buy a certificate at the stated price. An offer signifies that you want to sell a certificate at the stated price. If you accept a bid, it means you are selling one of your certificates. Conversely, if you accept an offer it means you are buying a certificate from another trader.

As you buy or sell certificates in this example, remember to record the transaction on your Information and Record Sheet for period 0.

TRADER 3: "3 bids 5"

TRADER 5: "5 offers 50"

TRADER 4: "4 bids 10"

TRADER 7: "7 offers 25"

TRADER 6: "6 accepts the offer of 25"

(Trader 6's acceptance of the offer means that a transaction has taken place. Once this happens, all prior bids and offers are void and the process starts anew.)

TRADER 1: "1 bids 8

TRADER 6: "6 offers 27"

TRADER 3: "3 bids 12"

TRADER 5: "5 offers 22"

TRADER 1: "1 accepts the offer of 22"

(Another transaction has taken place. All prior bids and offers are voided.)

TRADER 6: "6 bids 15"

TRADER 3: "3 offers 20"

TRADER 2: "2 bids 17"

TRADER 3: "3 accepts the bid of 17"

Sample
TRADER NO. _____

INFORMATION AND RECORD SHEET

Period: 0 Period Outcome:
(U or S)_____

Dividend: Successful 32 Unsuccessful 12

Transaction Number	Transaction Price Sale	Purchase	Certificates on Hand	Francs on Hand
START			0	10,040
0				
1				
2				
3				
4				
5				
6				
7				
8				
17	Total Certificate Earnings = Dividend Rate X Certificates on hand at end of the period			
18	Francs on Hand at the End of the Period			
19	Subtotal (Add lines 17 & 18)			
20	Less: Deduction of 10,000 Francs			-10,000
21	End of Period Net Profit			

To **BUY**: Make a bid or accept an offer To **SELL**: Make an offer or accept a bid

PERIOD 1

You own two shares of stock in the Purple Construction Company for which you paid 100 francs each. The Purple Co. has suffered through two straight years of losses and is on the verge of bankruptcy. Its last hope is in securing a new contract to construct a proposed elementary school for a local town. If the Purple Co. is not successful in winning the contract it will not survive and the price of its stock is expected to drop to 25 francs. You paid 100 francs per share for the two shares you hold.

A spokesman for the Purple Co. states that there is a 25% chance the company will <u>not</u> get the contract. (The validity of this statement is not in question.)

TRADER NO. _____

INFORMATION AND RECORD SHEET

Period:____ Period Outcome: (U or S)____

Dividend: Successful 300 Unsuccessful 25

Transaction Number	Transaction Price Sale	Purchase	Certificates on Hand	Francs on Hand
START			0	10,200
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17	Total Certificate Earnings = Dividend Rate X Certificates on hand at end of the period			
18	Francs on Hand at the End of the Period			
19	Subtotal (Add lines 17 & 18)			
20	Less: Deduction of 10,000 Francs			-10,000
21	End of Period Net Profit			

To **BUY**: Make a bid or accept an offer To **SELL**: Make an offer or accept a bid

LIST OF REFERENCES

LIST OF REFERENCES

Abarbanell, J. S., and Bernard, V. L. "Tests of Analysts' Overreaction/Underreaction to Earnings Information asan Explanation for Anomalous Stock Price Behavior" Journalof Finance (July 1992) 47: 1181-1207

Anderson, M. J., and Nutter, S. E., "Framing Effects and the Personal Exemption: Does Expertise Matter?" WorkingPaper, Michigan State University Department of Accounting, East Lansing, MI (1993)

Anderson, M. J., and Sunder S. "Professional Traders as Intuitive Bayesians." Organizational Behavior and Human Decision Processes, Vol. 64, No. 2, November, 1995, pp. 185-202

Arrow, K. "Risk Perception in Psychology and Economics." Economic Inquiry (January 1982): pp. 1-9

Ball, R., "The Development, Accomplishments and Limitations of the Theory of Stock Market Efficiency." Working Paper, University of Rochester, 1992

Bar-Hillel, M., "The Base-Rate Fallacy In Probability Judgments." Acta Psychologica, (1980) 44: 211-233

Becker, G. S., "Irrational Behavior and Economic Theory," Journal of Political Economy 70 (1962): 1 - 13.

Bernard, V. L., Thomas, F. K., and Marais, M. L., "Post-Earnings- Announcement Drift: Delayed Price Response or Risk Premium?" Journal of Accounting Research (1989) 27: 1-48

Bernard, V. L., "Accounting-Based Valuation Methods: Evidence on the Market-to-Book anomaly and Implications for Financial Statements Analysis." Working Paper, University of Michigan, 1993

Benartzi, S., and Thaler, R., "Myopic Loss Aversion and the Equity Premium Puzzle," The Quarterly Journal of Economics, v. 110, February 1995, pp. 73-92

Berg, J., Coursey, D., & Dickhaut, J., "Experimental Methods in Accounting: A Discussion of Frequently Asked Questions." Working Paper (1988)

Bohm, P., and Lind, H. "A note on the robustness of a classical framing result" Journal of Economic Psychology (1992) 13: 355-361

Brookshire, D., and Coursey, D., "Measuring the Value of a Public Good: An Empirical Comparison of Elicitation Procedures." American Economic Review, 77:4 (1987) 554-566

Camerer, C. F., and Weigelt, K. "Information 'mirages' in experimental asset markets." Working Paper. University of Pennsylvania Department of Decision Sciences, Philadelphia, PA. (1986)

Camerer, C. F. "Do Biases in Probability Judgment Matter in Markets: Experimental Evidence." American Economic Review (December 1987): pp. 981-997

Camerer, C. F., "Do Markets Correct Biases in Probability Judgment? Evidence from Market Experiments." Advances in Behavioral Economics, Eds. L. Green and J. H. Kagel. 126-172. Norwood, N.J.: Ablex Publishing Corporation. (1990)

Camerer, C. F., Loewenstein, G., and Weger, M., "The Curse of Knowledge in Economic Settings: An Experimental Analysis." Journal of Political Economy, forthcoming.

Constantinides, G. M., "Optimal Stock Trading with Personal Taxes: Implications for Prices and the Abnormal January Returns." Journal of Financial Economics 13 (March 1984), 65-89

Coursey, D., Hovis, J., Schulze, W., "The Disparity Between Willingness to Accept and Willingness to Pay Measures of Value."Quarterly Journal of Economics, August, 1987 679-690

Davis, D. D., and Holt, C. A. Experimental Economics. Princeton, New Jersey: Princeton University Press (1993)

Dawes, R. M., Rational Choice in an Uncertain World. Harcourt Brace Jovanovich. (1988)

DeBondt, W. F. M. and Thaler, Richard, H. T., Financial Decision-Making in Markets and Firms: A Behavioral Perspective." Finance, Series of Handbooks in Operations Research and Management Science. Elsevier-North Holland, 1994

DeJong, D. V., Forsythe, R. & Uecker, W. C. "The Methodology of Laboratory Markets and Its Implications for Agency Research in Accounting and Auditing." Journal of Accounting Research (Autumn 1985): pp. 753-793

Demski, J. S. and Swierenga, R. S.," Discussion of behavioral decision theory: Processes of judgment and choice." Journal of Accounting Research, 19:1 (Spring 1981)

Diamond, L., and Lerch, F. J., "Fading frames: Data presentation and framing effects" Decision Sciences (1992) 23: 1050-1071

Dickhaut, J. W. & Lere, J. C., "Comparison of Accounting Systems and Heuristic in Selecting Economic Optima. Journal of Accounting Research (Autumn 1983): pp. 495-513

Duh, R. R., and Sunder, S. "Incentives, learning and processing of information in a market environment: An examination of the Base-Rate Fallacy." Laboratory Market Research, Ed. S. Moriarity. 50-79. Norman, OK: University of Oklahoma, Center for Economic and Management Research.

Eger, C. and Dickhaut, J., "An Examination of the Conservative Information Processing Bias in an Accounting Framework." Journal of Accounting Research, (Autumn 1982, Part II): pp. 711-723

Einhorn, H. F., and R. M. Hogarth, "Behavioral Decision Theory: Processes of Judgment and Choice,"Annual Review of Psychology 32 (1981): 53 - 88

Ferris, S., Haugen, R., and Makhija, A., "Predicting Contemporary Volume with Historic Volume at Differential Price Levels: Evidence Supporting the Disposition Effect." Journal of Finance 43 (1988) 677-697

Financial Accounting Standards Board, Statements of Financial Accounting Concepts, 1992, Irwin, Homewood, Illinois

Fischhoff, B., "Predicting Frames" Journal of Experimental Psychology: Learning, Memory, and Cognition, 9:1 (1983) 103- 116

Fleishman, J., "The Effects of Decision Framing and Others' Behavior on Cooperation in a Social Dilemma." Journal of Conflict Resolution, 33:1 (March 1988) 162-180

Frederick, D. and Libby, R., "Expertise and Auditor's Judgments of Conjunctive Events," Journal of Accounting Research, 24(2), (1986): 270 - 290

Friedman, D., and Sunder, S., Experimental Methods: A Primer for Economists, Cambridge University Press, 1994

Friedman, M. Essays in positive economics. Chicago: University of Chicago Press (1953)

Ganguly, A., Kagel, J. and Moser, D. "The effects of biases in probability judgments in asset markets: an experimental Examination." Forthcoming in Accounting, Organizations and Society

Gresik, T. A., and Satterthwaite, M. A., "The Number of Traders Required to Make a Market Competitive: The Beginnings of a Theory,"Unpublished manuscript, Kellogg Graduate School of Management, Northwestern University, 1983

Hand, J. R. M. "A Test of the Extended Functional Fixation Hypothesis" Accounting Review (October 1990) 65: 740-763

Harris, T. S. and Ohlson, J. A. "Accounting Disclosures and the Market's Valuation of Oil and Gas Properties: Evaluation of Market Efficiency and Functional Fixation" Accounting Review (October 1990) 65: 764-780

Hendriksen, E. S. Contemporary Accounting Theory, Dickenson Publishing Co., Encino, CA, 1977

Hilton, R. W., "Integrating Normative and Descriptive Theories of Information Processing." Journal of Accounting Research (Autumn 1980): pp. 477-505

Jamal, K., and Sunder, S., "Bayesian Equilibrium in Double Auctions Populated by Biased Heuristic Traders," Journal of Economic Behavior and Organization, 1996

Jenson, Michael, C., "The Modren Industrial Revolution, Exit, and the Failure of Internal Control Systems" Journal of Finance, 48, 3, 1993, 831-880

Johnson, P., Jamal, K., and Berryman, R., "Effects of Framing on Auditor Decisions," Organizational Behavior and Human Decision Processes, 50, (1991) 75-105

Jou, J., Shanteau, J., and Harris, R.J., "An Information Processing view of framng effects: The Role of Causal Schemas in Decision Making." Memory & Cognition, 1996, 24(1), 1-15

Kahneman, D., "Experimental Economics from a Psychological Perspective," paper presented at the University of Minnesota Conference on Experimental Economics, 1988

Kahneman, D., Knetsch, J., and Thaler, R., "Experimental Tests of the Endowment Effect and the Coase Theorem." Journal of Political Economy, 98:6 (1990) 1325-1348

Kahneman, D., and Tversky, A., "On prediction and Judgment." Oregon Research Institute Bulletin, (1972) 12 (4)

Kahneman, D., and Tversky, A. "Prospect theory: An analysis of decision under risk," Econometrica, 47, 263-291 (1979)

Knetsch, J., and Sinden, J., "The Persistence of Evaluation Disparities." Quarterly Journal of Economics, August 1987 691-695

Knetsch, J., Thaler, R., and Kahneman, D. "Reluctance to Trade: An Experimental Refutation of the Coase Theorem," Working Paper, 1987

Levin, I. P., Johnson, R. D., and Russo, C. P., "Framing effects in judgment tasks with varying amounts of information" Organizational Behavior and Human Decision Processes (1985) 36: 362-377

Lewis, Scott B. (1985) Referenced in Dawes, Robyn M. Rational Choice in an Uncertain World. Harcourt Brace Jovanovich, p.36 (1988)

Lim, R.G., "A Range-Frequency Explanation of Shifting Reference Points in Risky Decision Making." Organizational Behavior and Human Decision Processes, Vol. 63, No. 1, July, 1995, pp. 6-20

Luft, J. "Bonus and Penalty Incentives". Doctoral Dissertation, Cornell University, (1991)

Lundholm, R., "What Affects the Efficiency of a Market? Some Answers from the Laboratory." The Accounting Review, 66, (July 1991) 486-515

Marr, D., Vision. San Francisco: W. H. Freeman (1982)

McNeil, B. J., Pauker, S. G., Sox, H. C., Jr., and Tversky, A., "On the Elicitation of Preferences for Alternative Therapies," New England Journal of Medicine 306 (1982):1259-1262

Nisbett, R. E., and Ross, L., Human Inference: Strategies and Shortcomings in Social Judgment, Englewood Cliffs: Prentice Hall, 1980

Plott, C. R., "Rational Choice in Experimental Markets," Journal of Business 59 (1986): S301 - S328

Puto, C., "The Framing of Buying Decisions." Journal of Business, 14 (December, 1987) 301-315

Redelmeier, D., and Tversky, A., "Discrepancy Between Medical Decisions for Individual Patients and for Groups," New England Journal of Medicine, 322:1162-1164 (April 19), 1990

Redelmeier, D., and Tversky, A., "On the Framing of Multiple Prospects." Psychological Science, 3:3 (May 1992) 191-193

Roszkowski, M., and Snelbecker, G., "Effects of 'Framing' on Measures of Risk Tolerance: Financial Planners Are Not Immune". Journal of Behavioral Economics, 19:3 (1990) 237-246

Russel, R., and Thaler, R., "The Relevance of Quasi Rationality in Competitive Markets," The American Economic Review 5(75) (1985): 1071-1082

Schie, E., and Van Der Pligt, J., "Influencing Risk Preference in Decision Making: The Effects of Framing and Salience." Organizational Behavior and Human Defcision Processes, Vol. 63, No. 3, September, 1995, pp. 264-275

Shefrin, H. and Statman, M., "The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence." Journal of Finance, 60:3 (July 1985)

Shefrin, H. and Statman, M. "Explaining investor preferences for cash dividends." Journal of Financial Economics, 13, 253-282

Shiller, R." Stock Prices and Social Dynamics." Brookings Papers on Economic Activity. 1984. No. 2: pp. 457-498

Simon, H. A., "A Behavioral Model of Rational Choice," Quarterly Journal of Economics 69 (1955): 241 - 260

Slovic, P., Fischhoff, B., and Lichtenstein, S. "Responsibility, framing, and information-processing effects in risk assessment." In Hogarth, R. (ed). New Directions for Methodology of Social and Behavioral Science: Question Framing and Response Consistency, No. 11. San Francisco: Jossey-Bass (1982)

Smith, V. L., "Experimental Economics: Induced Value Theory." Experimental Economics. (May 1976): pp. 274-279

Smith, V. L., "Microeconomic Systems as an Experimental Science,"The American Economic Review (December 1982): pp. 923-955

Smith, V. L., "Theory, Experiment, and Economics." Journal of Economic Perspectives (Winter 1989): pp. 151-169

Smith, V. L., Papers in Experimental Economics, Cambridge: Cambridge University Press (1991)

Smith, V. L., "Game theory and experimental economics: beginnings and early influences. (Toward a History of Game Theory)"History of Political Economy Annual (1992): v24 p241-242

Thaler, R., "Toward a Positive Theory of Consumer Choice." Journal of Economic Behavior and Organization 1 (March 1980): 39-60

Thaler, R., "The Psychology and Economics Conference Handbook: Comments on Simon, on Einhorn and Hogarth, and on Tversky and Kahneman." Journal of Business (October 1986): S279-S284

Tversky, A., and Fox, C.R., "Weighting Risk and Uncertainty."Psychological Review, 1995, Vol. 102, No. 2, 269-283

Tversky, A. and Kahneman, D. "The framing of decisions and the psychology of choice." Science, 211:453-58 (1981)

Tversky, A. and Kahneman, D., "Rational Choice and the Framing of Decisions." Journal of Business (1986): pp. S251-S278

Tversky, A. and Kahneman, D., "Loss Aversion in Riskless Choice: A Reference Dependent Model," Quarterly Journal of Economics, 106:4 1023-1039 (November 1991)

Tversky, A. and Kahneman, D., "Advances in Prospect Theory: Cumulative Representation of Uncertainty," Journal of Risk and Uncertainty, (December 1992)

Tversky, A., Slovic, P., Kahneman, D., "The Causes of Preference Reversal." The American Economic Review, 80:1 204-217 (March 1990)

Zeckhauser, R., Patel, J., and Hendricks, D., "Nonrational Actors and Financial Market Behavior." Theory and Decision, 31 (1991) 257-287