SUNK COST ACCOUNTING AND ENTRAPMENT IN CORPORATE ACQUISITIONS AND FINANCIAL MARKETS : AN EXPERIMENTAL ANALYSIS

Benjamin Kelly

A Thesis Submitted for the Degree of PhD
at the
University of St. Andrews

2008

Sunk Cost Accounting and Entrapment in Corporate Acquisitions and Financial Markets: An Experimental Analysis

Benjamin Kelly

University of St Andrews, School of Economics and Finance

For the Degree of Doctor of Philosophy

Date of Submission: 12th December 2006

I, Benjamin Kelly hereby certify that this thesis, which is approximately 72,000 words in length, has been written by me, that it is the record of work carried out by me and that it has not been submitted in any previous application for a higher degree.
date 10/12/07 signature of candidate ………

I was admitted as a research student in October 2003 and as a candidate for the degree of Doctor of Philosophy in October 2003 the higher study for which this is a record was carried out in the University of St Andrews between 2003 and 2006
date 10/12/07 signature of candidate ………

I hereby certify that the candidate has fulfilled the conditions of the Resolution and Regulations appropriate for the degree of Doctor of Philosophy in the University of St Andrews and that the candidate is qualified to submit this thesis in application for that degree.
date 10/12/07 signature of supervisor ………

Acknowledgements

Without doubt my PhD studies have been the most instructive and exciting years of my academic endeavour. As in life there are ups and downs and times of frustration but overcoming these hurdles has given me enormous satisfaction. Along the way I have met some truly wonderful people, too numerous to mention but there are certain individuals I would like to thank.

I would firstly like to thank Mr Shane Bonetti for his supervision and his constant encouragement and support throughout this endeavour. I feel I have a learnt a huge amount from Shane and not just from an academic perspective. Over the four years he has become a good friend and have appreciated his advice on many topics. He has devoted many hours to the progression of this dissertation and it has been a real pleasure to have him supervise my studies. I would also like to thank him for his highly entertaining and informative lectures over the years. I would also like to thank the members of the Economics department in St Andrews for their analytical advice and encouragement throughout the years. Especially Professor Gavin Reid who has demonstrated great interest in my work and has always made himself available on whatever issue I wish to confront him with. I would like to give special thanks to firstly John MacLeod for his enthusiasm and comments towards this research which I will be forever grateful for and secondly, Christopher McGhee for his IT assistance and tutorage which expediated my write-up process significantly.

Naturally, I would like to thank the secretaries of the Economics department: Eliana, Caroline and Angela for all their hospitality and assistance over the years. I would also like to thank the individuals with whom I have shared an office. They are all super people and have made my stay in the department highly enjoyable.

I would also like to thank all my friends whom I have shared a flat with in St Andrews over the four years. They have made my postgraduate years my most enjoyable in this town and for that reason would like to fully acknowledge how grateful I am for their friendship. They are (in chronological order): Amir Afshar, Suzanne Laing, David Reid, Josh Jeffrey, Catriona Kneelands Sarah Lynch, David Williams, John Williams, James Chippindale, David Walker, Christopher Burdon, Sarah Dwyer, Holly Fowden, Sarah Rogers, Rebecca Ormisher, Alana Fraser, David Fearnley, Oliver Horrowitz, and Alistair Knight.

I would like to thank my Godfather Mr Nigel Strudwick for his financial support and encouragement throughout my studies. It is very much appreciated and hope he enjoys the completed dissertation.

I would also like to take this opportunity to thank Stanford Thain for his continued interest in my studies and armouring me with the motivation and belief to combine my academic interests with private sector work during many long days this summer.

My parents deserve a special mention for allowing the possibility to pursue my studies beyond undergraduate level. I don’t think either of them expected my university years to be so extensive but they have never offered me anything but total support in whatever course of action I have taken with my education and I am extremely grateful.

Table of Contents

Tables

Figures

Symbols

Chapter 2

u	Utility
x	Final assets
y	Foregone assets
P_t	Current price
P_{t+1}	Risky future price

Chapter 3

π	Sum of all the shares in a pie (ultimatum bargaining game)
x	Portion of the total
d_1	Amount player 1 receives
d_2	Amount player 2 receives
z	*A* random variable
P	Probability
u	Utility
E	Expected
C	Certainty
F	*F* distribution

Chapter 4

v_i	Valuation for bidder_i
F	*F* distribution
V	Unobserved true value
H	*H* distribution
x	Private signal
ε	A "known" positive number
b	Bid
ǎ(x)	Nash Equilibrium bid function
E	Expected
t	Amount of money present in the wallet
p	Price

Chapter 5

α	Bookmakers costs
b	Amount bet
X_h	The amount bet for a win on horse *h*
W	Total win pool on the race
D_h	Win dividend paid on horse *h*
P_h	The subjective probability that any horse will win

π_h	The objective probability that any horse will win
R_h	The expected return
f	Fixed fraction of losses
q_i	The objective probability of losing for horse *I*
D^*	Sum of starting prices in each race
VAR *P*	vector of Shin's variance of winning probabilities in each race
z	Incidence of insider trading
DE	Disposition Effect
PGR	Proportion of Gains Realised
PLR	Proportion of Losses Realised

Abstract

Sunk cost accounting refers to the empirical finding that individuals tend to let their decisions be influenced by costs made at an earlier time in such a way that they are more risk seeking than they would be had they not incurred these costs. Such behaviour violates the axioms of economic theory which states individuals should only consider incremental costs and benefits when executing investments. This dissertation is concerned whether the pervasive sunk cost phenomenon extends to corporate acquisitions and financial markets. 122 students from the University of St Andrews participated in three experiments exploring the use of sunk costs in interactive negotiation contexts and financial markets. Experiment I elucidates that subjects value the sunk cost issue higher than other issues in a multi-issue negotiation. Experiment II illustrates that bidders are influenced by the sunk costs of competing bidders in a first price, sealed-bid, common-value auction. In financial markets their exists an analogous concept to sunk cost accounting known as the disposition effect. This explains the tendency of investors to sell "winning" stocks and hold "losing" stocks. Experiment III demonstrates that trading strategies in an experimental equity market are influenced by a pre-trading brokerage cost. Not only are subjects influenced in the direction that reduces the disposition effect but also trading is diminished. Without the brokerage cost there was a significant disposition effect.

JEL-Classifications

C70, C90, D44, D80, D81, G11

Chapter 1 :

Introduction

1.1 Introduction

As humans we are consistently confronted with decision-making challenges on a regular basis. Until relatively recently it was assumed individual decision makers conformed to the model of expected utility theory. The theorem posits individuals are completely rational in the selection of their decisions, which are measured against the marginal benefits and costs involved in each course of action. However, real world observations demonstrate individuals consistently violate expected utility theory by unilaterally deviating away form it. The underlying motivations for this behaviour are explained by competing psychological and cognitive biases, which offset the calculations of marginal analysis. A synthesis of these psychological processes can produce what is known in the literature as the *sunk cost effect*. This describes the tendency of individuals to base future investment decisions on the sunk costs of past investments. A cost is “sunk” if the cost is irreversible. For instance, placing a £10 stake on red in roulette; regardless of outcome, the £10 is irreversible and therefore, “sunk”.

Examination of the sunk cost effect has economic relevance because individuals and organisations who observe this phenomenon are violating one of the foundations of microeconomic theory. This raises the question of how accurately expected utility theory maps human behaviour in the natural world. In fact, persistent preference of a specific failing course of action influenced by sunk costs is labelled *entrapment* or *escalation of commitment*. Such behaviour has been presented in academic literature as pre-cursors to financial and political disasters (examples of which will be discussed in section 1.2). Thus sunk cost accounting not only has economic importance but also social and cultural implications. Accounting malpractice has led to the collapse of some of the world’s largest corporations in the last five years. These have impacted the global financial markets by driving down market indices and thus created a sustained period of market uncertainty. A corollary of this is that the amount of downside welfare can be large and significant. Until recently, despite the prevalent nature of sunk costs, academic economists had devoted relatively little attention to this phenomenon. This dissertation aims to rectify this situation by presenting a research driven economic appraisal of sunk cost accounting in corporate investments and financial markets. This approach is based on a combination of economic reasoning and experimental analysis.

The application of experimental analysis to the sunk cost effect and to decision making in general represents an important auxiliary instrument in economic research.

This relatively new practice provides economists with the opportunity to observe actual human behaviour instead of implementing theoretical models that postulate how humans should behave. This area of endeavour has shed light on a wide range of important issues, including investor behaviour in financial markets, psychological determinants of escalating commitment to an investment, psychological and social costs of withdrawing from investments and cultural effects of investment strategies.

The common thread linking research with all of these topics is the development and testing of hypotheses in a laboratory setting within which suitable data can be collected. A major benefit of experimentation is the ability to obtain results from a large number of economic propositions that would be difficult to test in other areas because of a lack of suitable data. Experiments, therefore, have offered opportunities for research into areas such as game theory, public goods, markets and individual learning processes.

The substance of this dissertation focuses on the foregoing phenomenon by extending previous sunk cost literature to assess its impact in the following domains: firstly, the sunk cost effect in corporate investments and secondly sunk costs in financial markets.

1.2 Evidence of the Sunk Cost Effect

To illustrate the prevalent nature of sunk costs in investment decision making, the following examples vividly portray how individuals and organisations (both private and public sector) can become attached to a failing project.

1.2.1 The Taurus Project

Taurus was touted as a computerised system for the clearance and settlement processes on the London Stock Exchange whose implementation would revolutionise the way securities were traded and eliminate the antiquated paper based procedures. [1] The project was initiated in 1986 but at that time there was little agreement concerning the requirements of the system. However, as it stood, the project was expected to take three years at a cost of £6 million. Unfortunately, with the deregulation of the London Stock Exchange looming in October 1986 and with competing IT projects also to be completed, the Taurus project was neglected.

It was not until 1988 that the Taurus project was resurrected but there was continued confusion surrounding the requirements of the system and the costs for completing the project. The estimates had increased by a factor of 10 to £60 million. After considering 17 different designs, an agreement was reached, with implementation rescheduled for 1991. By this time a number of individuals were quietly voicing their opposition to the project, but no one was prepared to speak out publicly, for Taurus, it was said, had become sacrosanct and vital to London's continued pre-eminence as a world financial centre.

As the Taurus development gathered momentum, the computational software problems mounted. By the end of 1990, it emerged that the software would require more modification than originally anticipated causing a further time delay. In March 1993, the exchange publicly announced that the Taurus project had been cancelled.

1 Clearance is the process of identifying the parties and what they owe. Settlement is the process of ensuring that shares and payments are properly transferred to buyers and sellers.

The stock exchange had spent over £80 million, and securities firms within the city of London had collectively spent an estimated £400 million developing their own system in preparation for Taurus. All of this spending was wasted as "Taurus came crashing down." (Keil and Montealegre, 2000, pg.60)

1.2.2 The Scottish Parliament

In a referendum on 11th September 1997, approximately 75% of the Scottish electorate voted in favour of a devolved Scottish Parliament. This result made it necessary to identify a permanent home for the forthcoming Parliament. The timetable for construction dictated the adoption of a "fast track" procurement method entailing relatively high risk. The decision was made without an adequate evaluation or understanding of the extent of risk involved and without being referred to Ministers. The figure of between £40 and £50 million originally put before the Scottish public was never going to be sufficient to secure the construction of a new Parliament building of original and innovative design, especially when the precept for the building was heavily emphasised on quality rather than cost. This estimate was made prior to the identification of a location or a design but when several locations in Edinburgh were considered Holyrood was eventually selected as the site for the new Parliament.

In July 1998, a design proposed by a Spanish architectural firm was selected for the new Parliament building. At that stage it was estimated that the cost of construction could be contained at £55m plus VAT, fees and extras. Twelve months later the project was transferred to the Scottish Parliament Corporate Body, headed by the

Scottish Parliament's Presiding Officer. After a Parliamentary debate on the building project, costs were estimated by the First Minister at £109m including VAT, fees and fit-out. By February 2000 the Corporate Body commissioned an investigation by an independent architect. Two months later and a Parliamentary debate on the project concluded that work should continue at the Holyrood site. At this point the estimated cost of the completed project had appreciated to £195m. Initial construction commenced shortly afterwards but in July 2000, after the death of the leading architect in the project, the Auditor General presented a report to Parliament containing a number of recommendations to improve the management of the Holyrood project. However, construction continued, but it wasn't until the appointment of a new First Minister and a report published by the Parliament's Audit Committee citing poor management that further investigations into the project halted development. Three years elapsed before an official independent inquiry investigated the problems of the project. By July 2003 the costs of the project had escalated to £431 million.

1.2.3 Enron

The rapid decline of Enron illustrates an example of entrapment at its most severe. Enron was an American based energy trading company and throughout the 1990's was consistently regarded as the most innovative company in the world whose value was greater than Argentina's economy. Its trading operations relied heavily on complicated transactions, many relating to deals several years in the future. It is alleged many of these speculations on the future energy prices were failing. Enron's solution was to create a series of firms/organisations, which acted as instruments for keeping debts off the balance sheet. It is said these partnerships would buy business from Enron to boost the balance sheet. These losses were navigated around the Enron organisation to secure their anonymity but eventually surfaced in 2001, and with that came the downfall of Enron.

Enron collapsed, leaving behind $15bn of debts. Its shares became worthless, and 20,000 workers around the world lost their jobs. Many banks were exposed to the firm, from lending money and trading with it. JP Morgan admitted to $900m of exposure, and Citigroup to nearly $800m. Former high-ranking Merrill Lynch bankers were charged with fraud in connection with Enron transactions. Andersen, which failed to audit the Enron books correctly, collapsed with the loss of 7,500 jobs in the US, and 1,500 in the UK.

Senior managers were keen to disguise the fact that the organisation was losing money and as a consequence began investing in elaborate processes to accomplish this. As time progressed these processes became more costly. Even though Enron was falling further and further into debt, the managers escalated their commitment, unable to withdraw from this course of action.

1.2.4 Barings Bank

In 1992 Barings Bank appointed Nick Leeson as manager of a new operation in futures markets on the Singapore Monetary Exchange (SIMEX). His job was to bet on the future direction of the Nikkei Index and he proved to be highly successful, making millions for the bank within months of his appointment.

The function of a derivatives trader is taking bets on people making bets, which is analogous to the function of a bookmaker at a racetrack. Leeson had authority to perform two types of trading.

1. Transacting futures and options orders for clients or for other firms within the Barings Organisation, and
2. Arbitraging price differences between Nikkei futures traded on the SIMEX and Japan's Osaka Exchange.

SIMEX regulation stated that traders were only required to deposit a small fraction of the amount that was being traded. Thus, it was not uncommon for the deposit on the table to be exceeded many times by losses. However, Leeson was perceived to be flawless by Barings' Chief Executives and this view was seemingly validated when he made £10 million by the end of 1993.

Leeson took unauthorized speculative positions primarily in futures linked to the Nikkei 225 and Japanese government bonds (JGB) as well as options on the Nikkei. These transactions were hidden in error account *88888*, where Leeson hid his losses. This account had been set up to cover up a mistake made by an inexperienced team member, which led to a loss of £20,000. Leeson used this account to cover his own mounting losses.

In a fatal move, the bank allowed Leeson to remain Chief Trader while simultaneously being responsible for settling his trades. Jobs that are usually split. This made it much simpler for him to hide his losses.

By December 1994 the red ink hidden in account *88888* totalled $512million. Getting increasingly desperate Leeson bet that the Nikkei index would not drop below 19,000 points. At the time this seemed an educated speculation as the Japanese economy was rebounding after a 30-month recession. Then on the 17th January 1995, a devastating earthquake measuring 7.2 on the Richter scale hit the Japanese city of Kobe.

The previously stable Nikkei index plummeted by 7% in a week. As the losses grew, Leeson requested extra funds to continue trading, hoping to extricate himself from the mess by more deals. Leeson was counting that there would be a post quake rebound and the Nikkei would stabilise at 19,000. There were no hedges, no bets the other way, to protect Bearings' huge exposures. There was no rebound. Over three months he bought more than 20,000 futures contracts worth about $180,000 each in a vain attempt to move the market. Some three quarters of the $1.3 billion he lost Barings resulted from these trades. When Barings executives discovered what had happened, they informed the Bank of England that Barings was effectively bankrupt.

In his wake he had wiped out the 233 year-old Baring Investment Bank, who proudly counted the Queen as a client. The $1.3billion of liabilities he had run up was more than the entire capital and reserves of the bank. Investors saw their savings wiped out and some 1,200 of Leeson's fellow employees lost their jobs. Dutch bank ING agreed to assume nearly all of Barings' debt and acquired the bank for the sum of £1.

This is a severe case of how even the most stable of institutions can be sent into complete financial distress in a matter of days. Barings had financed the Napoleonic Wars, the Louisiana purchase and the Erie canal. The most striking feature was that the failure was caused by the actions of a single trader in a remote office in Singapore.

1.3 What drives the Sunk Cost Effect?

The question why such behaviour arises has been central to the sunk cost literature in the last three decades. Research has determined that there is no single explanatory mechanism but offers four key determinants that lead decision makers to engage in seemingly irrational acts: These four factors are labelled: *project determinants*, *psychological determinants*, *social determinants* and *organisational determinants*. A description of these is illustrated in Table 1.1

1.3.1 Project Determinants

Classification of Determinant	Description
Project Determinants	Objective attributes of a project-the project's benefit and costs.
Psychological Determinants	Subjective attributes in the form of information processing errors.
Social Determinants	Saving face and external binding to an investment decision.
Organisational Determinants	Attributes of sunk cost accounting which are unique to the organisation.

Table 1.1 ***Determinants of the Sunk Cost Effect***

"Project variables are the most obvious determinants of persistence in a course of action." (Staw and Ross, 1989, pg. 1) The literature reveals an individual's commitment to a project is affected by three factors: firstly, proximity to the goal (Rubin and Brockner, 1975), secondly by future expenditures or costs necessary to achieve a project's payoff, (1981) and finally the number of times previous commitments have failed to yield a return. (McCain, 1986)

A few project variables are less obvious causes of persistence. Endeavours such as R&D and construction projects often foster commitment because there is a long delay between expenditures and economic benefits. In these cases, shortfalls in revenue or outcomes may not be monitored closely or cause alarm, since losses are (at least initially) expected to occur. In other cases, projects may continue in part because they have little salvage value if terminated in midstream. (Noorthcraft and Woolfe, 1984)

1.3.2 Psychological Determinants

Psychological determinants of escalating commitment have attracted much research and provide subjective motivations for pursuing such a course of action. The simplest of these are information processing errors on the part of the decision makers.

Two mechanisms in particular are said to be the principal theoretical explanations of this effect: *Self-justification* and *prospect theory*. Established from cognitive dissonance theory, self-justification theory posits individuals will remain with the present course of action because they feel they need to rationalise their initial decision in the face of losses. "People do not like to admit that their past decisions were incorrect, what better way to reaffirm the correctness of those earlier decisions than by becoming even more committed to them." (Brockner 1992, pg. 41) Prospect theory developed by Kahneman and Tversky (1979) is concerned with the behaviour of decision makers who face a choice between two risky alternatives. Decisions subject to risk are deemed to signify a choice between alternative actions, which are associated with particular probabilities (prospects) or gambles. The thread of their argument is that individuals are hindered by cognitive limitations, which promotes the simplification of complex problems. This approach is inconsistent with the proposition that individuals act rationally. Economists conjecture that individuals are highly rational utility maximisers who compute any action's likely effect on their total wealth, and choose accordingly.

1.3.3 Social Determinants

Experimental and real world evidence demonstrates the pertinent impact of social variables upon an individual's propensity to escalate commitment to a given investment. Fox and Staw (1979) tested the notion of external justification in a role-playing experiment. They found that subjects holding administrative roles with low job security and lack of support by management allocated the greatest resources to a losing course of action. Similar results were also reported by Brockner, *et al*. (1981). They found persistence to be highest under a large audience, high social-anxiety condition and interpreted these results as a face-saving effect.

1.3.4 Organisational Determinants

The simplest organisational determinant is institutional inertia. Just as there is less than full consistency between individual attitudes and behaviour there is also a very loose coupling between organisational goals and action. Organisations have imperfect sensory systems, making them relatively impervious to changes in their environments. Furthermore, because of breakdowns in internal communication and difficulties in mobilising their constituents, organisations can be slow to respond.

Organisations attempting to withdraw from a losing course of action must also contend with political forces. Not only will those who are directly related to the project will resist its dismantling, but so too will units interdependent or politically aligned with the venture. This can become a special problem when projects are important or central enough to have political support on governing bodies and budget committees charged with their fate.

1.4 Sunk Costs in Financial Markets

In financial markets there exists an analogous phenomenon to the sunk cost effect: the *disposition effect*. It is a descriptive theory based upon the selling behaviour of investors in stock markets. In such an environment, individuals demonstrate systematic propensity to sell recently purchased shares that have appreciated relative to the purchase price and a reluctance to sell shares that have depreciated in price since they were purchased. Such behaviour violates the efficient market hypothesis, which assumes investors are “rational traders”. The availability of account-level transaction data has made the disposition effect a widely documented empirical regularity: subsequent to the seminal paper by Odean (1998), several studies find investors reluctant to unload assets at a loss relative to the price they purchased the asset.

The empirical evidence demonstrates that the effect transcends all levels of investor sophistication. Specifically even professional traders to some degree embrace the disposition effect. Locke and Mann (2005) analyse the trading behavior of professional futures traders and find that while all traders hold losers longer than winners, the least successful traders hold losers the longest, while the most successful traders hold losers for the shortest time. Coval and Shumway (2005) report evidence of behavioral biases among professional market makers at the Chicago Board of Trade with the most compelling evidence concentrating in morning-loser traders. Shapira and Venezia (2001) find evidence of the disposition effect among professional investors in Israel while results in Wermers (2003) show that managers of losing funds appear reluctant to sell their losing stocks, which is consistent with their being disposition-prone.

1.5 Justification of Research Topic

1.5.1 Identification of Problem

Despite the proliferation of experiments investigating individual decision making behaviour, both in psychology and economics, there is a lack of quantitative results examining the effect of sunk costs which are intrinsically attached to an investment in dynamic environments. The areas under examination are two fold: the effect of discrete sunk costs in interactive bargaining contexts, and the effect of unanticipated brokerage fees in an equity market.

This dissertation examines these effects (see research questions below) by examining the implementation of three distinct experiments (see proposed solution below) on undergraduate and postgraduate students.

1.5.2 Research Questions

This dissertation addresses the following three research questions:

1 When faced with a sunk cost that consists of a larger investment decision, is the sunk cost ignored?

2 Do opponents sunk costs affect one's own future investments? (The transmission of sunk costs across investors)

3 Do unanticipated external costs affect the disposition effect in financial markets?

These effectively reduce to questions about whether sunk costs can be strategically advantageous to investment behaviour in certain environments. (First and second question) and examining investment behaviour with implicit and explicit costs.

1.5.3 Proposed Solution

In order to answer the research questions stated in Section 1.5.2, the development of three experiments which support the ideas surrounding the research question are proposed. These experiments include the following two central motivations:

1 The experiments would be interactive, maintaining a high degree verisimilitude and with real monetary payoffs. A main tenet of this goal would be to present dynamic experiments that engaged the students and to make the experiments as replicable to the real world as is possible.

2 The experiments would be implemented in two versions the sunk cost version and a conditional environment in which subjects invest without the presence of sunk costs. This provides a direct comparison in which to evaluate the variability of the data.

1.6 Overview of Results

The overview is restricted to the key findings only. A detailed analysis of the results is provided in Chapters Four and Five.

1.6.1 Experiment I: Sunk Costs in a Mergers and Acquisition Context

The aim of this study is to examine whether sunk costs affected decision making behaviour when they were peripheral to the investment. Specifically, does the sunk cost of a prior investment affect the investment strategy for a corporate acquisition? In a merger and acquisition negotiation context, the results illustrate subjects are influenced by peripheral sunk costs. In a two round bidding process subjects make fewer concessions to their opponents in an issue that has a sunk cost attached.

1.6.2 Experiment II: Sunk Costs in a First-price, Sealed-bid Auction

This experiment provides novel findings to a relatively untouched area of the sunk cost literature: sunk costs across individuals. Specifically, do the sunk costs of opposing bidders influence one's own bid? Subjects were externally influenced by the sunk costs of competing bidders and subjects increased their bids in the direction of the sunk costs. The findings reinforce a previous study that demonstrates sunk costs transmit across from buyers to sellers in an experimental housing market. (Diekmann *et al*. 1996).

1.6.3 Experiment III: The Disposition Effect in Financial Markets

This examination of the disposition effect in financial markets bridges the domains of experimental economics and behavioural finance. Subjects initiate a brokerage fee from their portfolio selection, and are then allowed to trade in a virtual stock market. The brokerage fee affects behaviour. With a prior brokerage fee the disposition effect is diminished as subjects exhibit behaviour counter to the phenomenon. i.e. subjects sell more "losers" than "winners"

1.7 Overview of Dissertation

This section contains a brief outline of the contents of each of the following chapters of this dissertation. Chapter 2 provides a survey of the literature. The chapter proceeds with a detailed literature review into the arena of sunk costs and entrapment focusing on the main psychological mechanisms driving these phenomena coupled with key experiments and findings.

Chapter 3 provides a historical review of experimental economics and examines the key findings that have contributed to the rapid ascent of this discipline in economics research. In addition it examines questions raised against experimentation in the past and posits evidence to suggest these questions are unfounded. Previous studies have displayed sunk cost accounting at an aggregate level and the general trend is that individuals indulge in the phenomenon but it does not apply to everyone. The experiments aim to examine sunk cost effects at the individual level and it is hypothesised that attitude to risk may be a determining variable in the analysis. Therefore explanatory theories of attitudes to risk and methods of assessment are explored with the aim being to propose a purposeful methodology of eliciting risk in the experiments.

Sunk costs in corporate investments and the functionality of the sunk cost within this setting are the main themes in Chapter 4. Following the review of the literature, little research into how individuals respond to sunk costs in variant contexts has been conducted, or more specifically how individuals respond to a sunk cost that is "mixed" with four other investment decisions and how individuals respond to the sunk costs of others. The chapter reports two experiments, the first of which examines the influence of sunk costs in multi-issue negotiations within a corporate acquisition context. Virtually all experimental analyses of the relationship between sunk costs and persistence in a losing course of action involve single-issue individual decision-making. The experiment has three purposes: to examine the sunk cost - persistence relationship within a negotiation or bargaining environment; to determine whether sunk costs attached to one bargaining issue "spillover" into bargaining behaviour on other issues and to establish whether sunk costs of one party influence others' bargaining behaviour. Econometric data indicates individuals commit greater resources to the sunk cost decision within the group of five decisions. The second experiment extends the corporate finance scenario to a sealed-bid, first-price, common-value auction. Traditional experimentation into sunk cost accounting has focused upon sunk costs as a within person process. This experiment directs the research towards sunk costs as an inter-person context, namely, if one's opponent has a sunk cost is it strategically advantageous to at least acknowledge the opponent's sunk cost. Results suggest subjects are influenced by the sunk costs of opposing bidders.

Chapter 5 examines the disposition effect in financial markets. Using a virtual stock market, the experiment seeks to determine how individuals will treat an up-front brokerage fee in an experimental stock market. Two groups one with a brokerage fee and one without are compared and their trading behaviour analysed. Subjects with the brokerage fee trade less frequently throughout the experiment and exhibit less of a propensity to sell "winning" shares than "losing" shares. Subjects without the brokerage fee observe the disposition effect i.e. selling a greater majority of "winning shares" than "losing shares."

Chapter 6 concludes the dissertation providing conclusions to the findings and how these contribute to the existing body of literature. Furthermore potential strategies to diminish the phenomenon of sunk cost accounting are explored with references to "real world" examples. The chapter culminates with a guide to future work.

Chapter 2:

Theoretical Analysis and Literature Survey

2.1 Introduction

In the domain of sunk cost accounting, experimentation has proved an extremely desirable instrument for the elucidation of investment behaviour. As a consequence a significant portion of the sunk cost literature is expressed using this technique and the subsequent sections of this chapter will assemble a review of this experimental literature.

Since the 1970s an expanding literature emanating from economics and social psychology has been investigating the phenomenon of sunk cost accounting under the direction of escalation of commitment (Garland, 1990, Keil, 1995; Newman and Sabherwal, 1996; Ross and Staw, 1986, 1993; Staw and Ross, 1987) and entrapment

(Brockner, Rubin, and Lang, 1981; Fox and Staw, 1979).[2] An entrapment situation may be characterised by "repeated (rather than one-shot) decision making under uncertainty in the face of negative feedback about prior decisions and choice about whether to continue." (Zuchel, 2001, pg.11) Escalation of commitment can be conceptualised as situations in which decision makers choosing between discontinuing an unproductive line of behaviour and investing additional resources to make that course of action work adhere to or "persist with" (Brockner, 1992) the failing course of action. Keil (1995) considers project escalation "to occur when there is continued commitment and negative information" (Keil, 1995, pg. 422). Although escalation involves resource commitment in the face of negative interim outcomes, the eventual outcomes may or may not be negative (Brockner, 1992). Moreover, escalation involves the allocation of additional resources, but not necessarily at an increasing rate.

The effect has also been examined in non human animals and is labelled the *Concorde Fallacy* (Arkes and Ayton, 1999). The authors found no traces of the Concorde Fallacy and suggested that non human animals may not fall prey to this behavioural bias because they fail to follow norms or rules present in human decision making.

The remainder of the chapter is structured as follows: Section 2.2 navigates through the theoretical background providing a critical analysis of the relevant mechanisms which are frequently referenced in the literature. Section 2.3 seeks to advance the

---

2 There is greater depth to the literature than detailed in this paragraph. These citations provide an

understanding of entrapment and sunk cost accounting in investment decision making along four directions: to examine the effects of three broad types of determinants; to examine changes in their effects over time; to examine if there is evidence of sunk cost accounting and to determine whether there is a single feature of sunk cost accounting that encourages an individual to increase commitment to an investment decision.

2.2 Mechanisms of Sunk Cost Accounting

Over the last three decades, non-exclusive theories explaining sunk cost accounting and entrapment have exhibited rapid growth. Whilst some theories explain the phenomena in terms of economic rationality (Tang, 1988), the most plausible explanations have concentrated on psychological rationality (Brockner and Rubin, 1985; Brockner, 1992; Staw and Fox, 1977; Staw and Ross, 1987; Tegar, 1980). The majority of these explanations are based upon the following three mechanisms: *Self-Justification Theory, Prospect Theory* and *Regret Theory*.

2.2.1 Self-Justification Theory

The seminal theory of entrapment entitled "self-justification theory" has been a widely adopted mechanism in explaining situations of escalating commitment (Rubin

---

abridged list of the significant expositions in this particular field of endeavour.

and Brockner, 1975; Staw, 1976; and Tegar, 1980). Embedded originally in Festinger's (1957) theory of cognitive dissonance,[3] this viewpoint posits individuals may become entrapped by their past investments or previous course of action, mainly because of their unwillingness to admit previous expenditures do not produce the desired outcomes. The crucial element with this behaviour is the individual's pre-disposition to exhibit rational behaviour not just to himself but also equally as important to appear rational to others. The underlying motive is simply no one likes to admit one was wrong. "Amongst the criteria by which rationality might be defined, as are consistency and coherence, but the evidence from research studies on entrapment and sunk costs confirm these criteria are frequently and systematically violated." (Wilson, 2001, pg. 4)

Economists view rationality as acting optimally in any given situation i.e. considering all the available information and selecting the course of action that produces the optimal result. Therefore, theory dictates individuals should always be striving to achieve this optimum state. As Chapter 1 demonstrated in the real world decision making does not always expose the most rational choice and the outcomes reflect this. Thus, decision making in the real world and a normative model of decision making can yield different outcomes.

3 According to cognitive dissonance theory, there is a tendency for individuals to seek consistency among their cognitions (i.e., beliefs, opinions). When there is an inconsistency between attitudes or behaviours (dissonance), something must change to eliminate the dissonance. In the case of a discrepancy between attitudes or behaviour, it is most likely that the attitude will change to accommodate the behaviour.

A more useful definition would be to substitute rationality with the word *competence*. Individuals desire to exhibit an image of competence. This could be achieved in several ways. For example, some individuals focus on justifying decisions made earlier, whereas others align their positions with the course of action that appears to be most successful. The way in which people maintain their images is dependent on the individual characteristics of the decision makers. Whilst it has yet to be demonstrated empirically, Rao and Monk (1999) believe these characteristics are related to personality factors.

Self-justification theory indicates that the joint presence of: negative feedback concerning the outcomes of initial resource allocation, and a strong desire to justify the correctness of the initial allocation of resources should lead to the greatest likelihood of escalation (Brockner, 1992). In addition, Staw and Ross (1978), emphasise five variables which may intensify a self-justification effect:

The major theoretical contribution of a self-justification mechanism is that it posits a form of what Staw and Ross (1978) describe as "retrospective rationality" as opposed to prospective rationality. Essentially, the individual, instead of considering only incremental costs and benefits (rational economic behaviour) that would lead to alternative courses of action, focuses upon alternatives that will correct or reduce the loss resulting from a previous error.

The theory is essentially applied to explain cognitive rationalisation or behavioural inaction (Staw and Ross, 1978), although, it could also apply to situations in which decision-makers have encountered a set-back but still have an opportunity to recoup their losses. Whilst the theory is a suitable mechanism in the domain of losses, it is inappropriate in the domain of gains. Specifically, individuals are not required to justify their successful actions to themselves.

Self-justification notions have provided explanatory power in some circumstances. However, it would be misleading to suggest that self-justification theory is robust enough to explain the majority of entrapment situations. In fact this dissertation counters self-justification as nothing more than an auxiliary theory in explaining individuals' motives to escalate commitment. In the spirit of the above statement Bowen (1987) argues, "prior escalation studies, having not met the criteria for demonstrating the phenomenon, should be questioned regarding the theoretical value of the reported results." (Bowen, 1987, pg. 54) He postulates entrapment/escalating commitment can stem from any one of the following motives: (a) economic considerations; (b) curiosity; (c) the need to see whether greater effort will bring the project to fruition, (d) the desire to learn about the phenomenon.

Variables	Description
Visible Responsibility for Negative Consequences	In one of the earliest escalation experiments, Staw (1976) demonstrated individuals may commit resources to a losing course of action so as to justify or rationalise their previous behaviour. He suggested that being personally responsible for losses is an important factor in becoming locked in a course of action.
Public Advocacy of a Losing Course of Action	Individuals want to appear competent and not admit their errors to others even if they are in a losing course of action. This is known as a "face-saving" effect.
Side Bets	Individuals with side-bets are more likely to remain investing in the project as the act has specific importance to the individual, thus rendering the investment a difficult one to terminate.
Political Vulnerability	Organisations/Individuals attempting to withdraw from a losing course of action must also contend with political forces. Not only those who are directly involved with a project will resist its dismantling, but so too will units interdependent or politically aligned with the venture. "This can become a special problem when projects are important or central enough to have political support on governing bodies." (Staw and Ross, 1989, pg. 4,)
Individual Differences	Individual social identity may become externally bound by their actions with respect to a project. In fact, it is expected decision-makers to be most closely identified with a project when their advocacy of it has been public and explicit.

Table 2.1: ***Staw and Ross (1978) Enhancement Variables of Self Justification***

So, if self-justification is not the unique driver of escalation of commitment then what is? For resolution on this issue several other theories will be examined. These include *prospect theory* and *regret theory*.

2.2.2 Prospect Theory

As stated in Section 1.32, prospect theory explains individuals' risk taking propensities under conditions of uncertainty (Kahneman and Tversky 1979). In addition, it has been widely implemented to explain the phenomenon of entrapment. Whyte (1986) promotes this theory as a more compelling explanation of escalating commitment than self-justification. The theory posits that individuals code outcomes as positive or negative relative to a neutral reference point. The outcome of a choice will be coded as a gain when it is above the reference point and as a loss when it is below the reference point. Studies by, *inter alia*, Tversky and Kahneman (1981), McNeil *et al*. (1982), and Meyerowitz and Chaiken (1987) support this view. For example, what is the degree of insight and awareness we have regarding our own thinking when engaged in decision-making? Subjects are much more likely to identify factors other than framing to justify their choices, which makes one wonder how much freedom of choice people have if they are susceptible to manipulation via framing.

Sutherland (1992) noted "it cannot be rational to make different decisions on the same problem depending on how it is posed" (Sutherland, 1992, pg. 223-4). He conjectured that, whilst some satisfaction will be obtained by making a certain gain, the additional satisfaction which might accrue by making a larger but uncertain gain may not be sufficient to compensate for the sense of disappointment in making no gain at all if the gamble does not come off. This raises the likelihood of the individual regretting his/her choice. "In the case of losses, if he/she opts for taking a certain loss, that in itself will cause dismay: hence the actor may think it worth risking a larger loss with the compensating chance of avoiding any loss at all and therefore avoiding any dismay" (Sutherland, 1992, pg. 224).

One of the earliest papers on prospect theory, by Bazerman (1982), tested whether individuals treat the prospect of gains differently than the prospect of losses. Subjects were asked to make a decision about a large car manufacturing company that was in decline. The vice president had produced two plans. Half the subjects used plans denoted *Set 1*.

> *Plan A*: This plan will save one of the three plants and 2000 jobs.
>
> *Plan B*: This plan has a 1/3 probability of saving all three plants and 6000 jobs, but has a 2/3 probability of saving no plants and jobs.

For the other half of the subjects the two plans were *Set 2*:

> *Plan C*: This plan will result in the loss of two of the three plants and 4000 jobs.

> *Plan D*: This plan has a 2/3 probability of resulting in the loss of all three plants and all 6000 jobs, but has a 1/3 probability of losing no plants and no jobs.

The two plans in each set yield identical payoffs to the subjects but *Set 1* is framed in the domain of gains while *Set 2* in the domain of losses. In *Set 1*, more than 80% of the subjects opted for *Plan A*. In *Set 2*, more than 80% of the subjects opted for *Plan D*. The behaviour observed was described as the “reflection effect”: “The reflection of prospects around (the origin) reverses the preference order. Note that the reflection effect implies that risk aversion in the positive domain is accompanied by risk seeking in the negative domain.”(Bazerman, 1982, pg. 268) The theory claims that people perceive outcomes as gains and losses, rather than the final states of wealth and welfare. Therefore, the carriers of utility are changes of wealth from the previous reference point, rather than final asset positions that include current wealth. The key observation is whether the movement from the reference point is in the positive (gains) or negative (losses) direction. Moreover, because of diminishing marginal value the utility function is generally concave for gains and convex for losses, as shown in Figure 2.1.

Essentially this means “that the difference in value between a gain of 100 and a gain of 200 appears to be greater than the difference between a gain of 1100 and a gain of 1200.” (Bazerman, 1982, pg. 278) Figure 2.1 clearly illustrates that the value function is steeper for losses than for gains. Therefore, individuals are commonly risk-averse in the domain of gains and risk seeking in the domain of losses. Specifically, a decision maker given the option of additional loss or complete recovery of the investment will prefer additional investment to withdrawal.

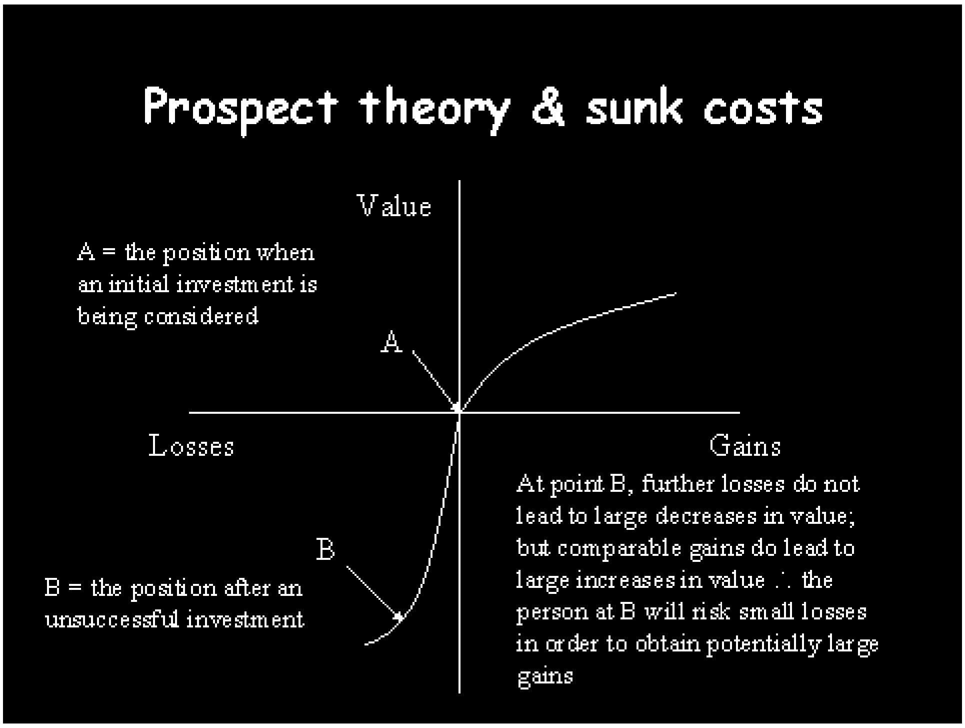


Figure 2.1: ***A hypothetical value function. (Adapted from Kahneman and Tversky, 1982, pg. 342)***

Whilst prospect theory cannot explain entrapment alone, it provides a more lucid explanation of why individuals escalate commitment than self-justification theory. The likelihood of individuals conforming to this theory is captured by the adage that one may as well be hung for a sheep as a lamb.

2.2.3 Regret Theory

"Regret is an emotional feeling associated with the ex post knowledge that a different past decision would have fared better than the one chosen." (Shefrin and Statman , 1985, pg. 781) Regret theory is a motivational theory of decision-making. The underlying assumption is that individuals are concerned with how the outcome of the decision is going to make them feel about the decision itself. In contrast, the traditional expectancy value theories such as prospect theory and expected utility theory emphasises that decisions are a function of probabilities and values or utilities of outcomes alone. Bell (1982) and Loomes and Sugden (1982) couple regret with the expected utility framework. To capture regret, a two attribute utility function $u(x, y)$ is used, where x denotes final assets and, this is the novel feature, y denotes foregone assets. Regret, then stems from the particular shape of the utility function. As an example, consider the functional form suggested by Bell (1982).

$$u\,(x,y) = g(x) + f\,(g(x) - g(y)) \tag{2.1}$$

Where g and f are increasing functions. Bell (1982) and Loomes and Sugden (1982) stated their theories for choice between two gambles. In that case foregone assets simply means the level of assets in a given state of the world that would have been obtained had the individual chosen the foregone gamble. It is not clear how to generalise this to the case of choices between more than two alternatives which is the case confronting an investor contemplating adjustments of his/her portfolio. But suppose an investor who holds an asset is simply considering the two alternatives to hold or to sell (and hold the cash). So does regret theory imply the disposition effect under any circumstances?

The answer is unlikely. For a disposition effect, current decisions need to be some way linked to whether there are prior gains or losses. Regret theory offers no such link and consequently no disposition effect. To see this more formally, suppose the investor holds n units of a risky asset with current price P_t and risky future price P_{t+1} and suppose the investor uses mental accounting, i.e. he or she thinks about his or her investments at the level of the individual asset rather than at the portfolio level. Maximisation of expected utility then implies that the investor will continue to hold the asset whenever $E\,[u\,(n\,P_{t+1,}\,n\,P_t)] > E\,[u\,(n\,P_{t,}\,n\,P_{t+1})]$ and sell when $E\,[u\,(n\,P_{t+1,}\,n\,P_t)] < E\,[u\,(n\,P_{t,}\,n\,P_{t+1})]$. Assuming no autocorrelation of asset returns, these inequalities and hence behaviour are unaffected by past prices so there is no scope for the disposition effect. Thus expected regret does not explain the disposition effect.

To counter the argument, Shefrin and Statman (1985) conjecture regret as an underlying explanation of the disposition effect: Investors might feel regret when they realise a loss, and conversely feel pride when they realise a paper gain. So it is not losses *per se,* but rather the realisation of losses that brings about regret. Conversely, it is not gains but the realisation of gains that brings about pride. In this case, investors might display the disposition effect. They might sell winners to rejoice over their past decision and they might refrain from selling losers to avoid feeling the regret over their initial purchase. The disposition effect here stems not so much from regret and pride but rather from the failure to understand that paper gains and losses are as real as realised gains and losses. Why realising a loss should cause regret is unclear. After all any gain or loss is there irrespective of whether or not it is realised. The only difference selling makes is the resulting portfolio composition (ignoring transaction costs and taxes). According to the definition by Shefrin and Statman (1985) quoted above regret is caused by the knowledge that a different past decision would have fared better, not by the act of realising a loss.

This is not to argue that there are no investors who fail to understand that paper gains and losses are just as realised as gains and losses, but simply that such a failure may not be relevant for all investors who display the disposition effect. For example it seems unlikely that the professional futures traders whose livelihood depends on trading success should fail to take unrealised gains or losses for real. Nevertheless such investors do display the disposition effect (Coval and Shumway, 2005; Locke and Mann, 2005; and Heisler, 1994).

The mechanisms detailed above have typically explained one or more situations of entrapment/escalating commitment. Other mechanisms such as expectancy theory[4] fail to capture the motivation behind this phenomenon. Whilst none of them can exclusively lay claim to explaining entrapment, elements of these mechanisms do feature in the process of entrapment. However, from the previous analysis prospect theory is the best singular description of how individuals react to losing courses of action. Self-justification under certain circumstances is an appropriate analysis of entrapment but is nothing more than an auxiliary theory.

2.3 Literature Survey – Methodology

Several factors influencing escalation of commitment have been drawn from the above theories. Moreover, a typology of these factors will be implemented for the review based upon a typology that has been used by several authors. (e.g., Ross and Staw, 1986, 1993) It includes three broad types of influencing factors: (a) *psychological factors*, which characterize the individual participants in the process; (b) *social factors*, which pertain to the various groups involved; and (c). *project factors*, which are attributes of the project. These categories will be reviewed systematically

---

4 Designed to supplement self-justification theory, expectancy theory postulates decision makers will assess the probability as well as the value of goal attainment for the alternatives available to them and choose that course of action which has the greatest subjective expected utility. According to this theory, investment decision-makers, focus on the future outcomes and the probability of achieving them with future behaviour even if exposed to setbacks in the past.
This mechanism is most relevant to entrapment when there is a possibility of recouping one's losses through future course of action. However, expectancy theory, while providing an examination of sources of future utility in explaining the actions of decision makers, does not offer the content necessary for predicting the occurrence of entrapment/escalating commitment.

focusing on the key journals in the field to assist in answering two of the key issues of this paper: Is there evidence of sunk cost accounting? And whether there is a single feature that induces individuals to account for sunk costs?

The data search was carried out systematically which involved a computer search of the literature using four key words (i.e. entrapment, escalation, sunk costs and commitment).[5]

2.3.1 Psychological Factors Affecting Sunk–Cost Accounting

The literature in this group focuses on the suitability of the self-justification theory, and prospect theory. The review focuses on two variables: *personal responsibility* and *framing of the project status*. A decision maker who has a high personal responsibility is expected to display greater commitment to the continuation of the project than one who is not. *Personal responsibility* may come from supporting the project, identifying with it, and unwillingness to admit that the previous decision to continue was wrong.

As already discussed in Section 2.2.2, according to prospect theory, individuals are risk seeking when choosing between two losing options but risk averse when

5 The Computer search involved the following electronic journals: Journal Storage (JSTOR), Expanded Academic (ASAP), Psychology Literature (Psychlitt), Google Scholar and Economics Literature (Econlitt).

choosing between two winning options. Consequently, the decision to invest additional resources depends on how the problem is framed.

2.3.1.1 Effects of Internal Justification "Accepting Incurred Losses"

The following experiments acknowledge self-justification theory through studying the behaviour of decision makers when their initial investments have failed. Specifically how do they act when they incur a loss? Whilst much of the literature in this section supports self-justification theory there are a number of paradigms that depreciate the value of the theory as a valid mechanism in explaining sunk cost accounting.

In an early study by Staw (1976) negative feedback and the need to justify were manipulated orthogonally. The case utilised "Adams & Smith Company" which over the years has emerged as the classical paradigm for the field. Subjects played the role of a company's financial vice president who had to decide how much money to allocate for continued research and development in one of the company's operating divisions. In all instances, a certain amount of money had been allocated to a particular operating division five years earlier. Prior to making the second resource allocation decision, subjects received feedback about the outcome of the initial allocation of funds. Half of the subjects were led to believe that the prior commitment of funds had proved to be financially successful to the corporation (*positive feedback condition*) whereas the other half was told just the opposite (*negative feedback condition*). In addition, half of the participants had made the initial resource allocation decision (*personal responsibility condition*). Presumably, those in the *personal responsibility condition* felt more of a need to justify the initial resource allocation than did those in the *no responsibility condition* who had been informed that "their predecessors in the organisation" had made the initial decision. As predicted by self-justification theory, the mean amount allocated to the previous course of action was higher in the *negative feedback/personal responsibility condition* than in all other groups. However, a caveat was that the subjects did not have sufficient information to make an economically sound decision. One could rationally justify investment in either project. This lack of information was ignored in the study.

Staw and Fox (1977) in a later study tested the duration of commitment over time. They again utilised the "Adams and Smith" case with the difference that this time negative consequences were allowed to persist over three time periods. The results verified the authors prediction that commitment would persist through time, but also showed that subjects in both *high* and *low responsibility* conditions and in the presence of negative feedback, changed the direction of their commitment at each period (e.g. *Period 1*: *high commitment*, than *Period 2*: *lower commitment* and *Period 3*; again *high commitment* and vice versa). The authors took this behaviour as a sign of active processing of information by the subjects in the search for a way out of the dead-end.

This inconsistency in the commitment of the subjects led to the experiment conducted by Staw and Ross (1978), where the processing of information following negative versus positive feedback was studied. In this research, subjects were asked to act as an assistant director of the World Bank, with the duty of making decisions on the allocation of funds for projects in developing nations. In the first investment decision, regarding the location of a hydroelectric dam in Nigeria, the subjects chose between three possible sites. However, this time feedback was in all cases negative with half the subjects receiving information that failure was due to an exogenous cause (unusual amount of rain) while for the other half the cause of the failure was endogenous (a different one for each of the three locations). The third decision was about the resources that would be further allocated in a Kenya project (from $0 to $70 million dollars). This decision initiated the dependent variable: the subjects' commitment to a previously chosen course of action. Results showed that "the least amount of resources was committed by subjects who had experienced a prior failure and who faced an exogenous setback."(Staw and Ross, 1978, pg. 54) Therefore, "…overall, a tendency to escalate can be broken by clear cut negative results attributed to an endogenous cause. However, individuals can continue to invest when provided an external justification of failure."(Staw and Ross, 1978, pg. 60) As the authors rightly point out, in a real world context feedback is so mixed that it is hard to distinguish purely endogenous factors contributing to failure. Moreover, since participants reacted to causal information about the nature of the setback, self-justification was not fully supported (according to the theory, the nature of the cause is irrelevant). However, the *High/Low Personal Responsibility* conditions had yielded results fully supportive of sunk cost effects.

Conlon and Parks (1987) replicated the conditions of Staw (1976) to test the hypothesis that self-justification pressures give rise to retrospective focusing and sunk cost accounting. "Retrospective focusing occurs partly because justification and exoneration require a plausible explanation of how or why a setback occurred." (Conlon and Parks, 1987, pg. 344) The authors again used "Adams & Smith co.", but in addition this time subjects were offered two sets of information concerning the feedback, of which they could choose to view only one. The results of the study were striking. The data displayed a very significant difference between the Personal Responsibility-Negative Feedback condition and the three others. 75% of the subjects in these conditions selected to see the Retrospective information, whereas across all the other conditions this happened with fewer than 20% of the subjects.

2.3.1.2 Psychological Effects of Framing

Prospect theory has been shown to be a pre-cursor to a significant proportion of the research on framing of information. Consequently, the literature concentrates on utilising this mechanism.

Brockner *et al*. (1984) utilized a funding decision case, in which the "financial vice president at the ABC University" had to choose between two available funding options. All the subjects received negative feedback concerning the first decision. However, this feedback was positively framed for half the subjects and negatively for the rest. In view of sunk costs of the magnitude of $20 million, subjects had to decide whether they would deescalate or adopt the alternative option of investing an additional \$20 million in the previously chosen project with a 50-50 chance of recouping the losses or losing all \$40 million. This set of options was framed negatively for subjects in the initial negative frame of the feedback condition and positively for the subjects in the positive frame of feedback condition. In accordance with the prediction of prospect theory, 73% of the subjects in the Negative frame condition chose to persist with the project in sharp contrast with the mere 33% of subjects in the positive frame condition.

When conducting experiments in framing effects, one must consider whether there is an element of artificiality involved when subjects are presented with contrived dilemmas requiring them to choose what they consider to be the best option. The role of language in the social construction of reality (including our experience of specific decision-making dilemmas) is important in the context of framing. Forms of wording can be chosen to encourage subjects to perceive decision dilemmas in particular ways.

Phillips *et al*. (1991) explored a slightly different aspect of prospect theory. Their focus was on the transparency of the frame. The level of transparency represents how obvious the costs and benefits appear to the individual. The authors argue that the greater the transparency of the frame the more likely is the decision maker to behave in accordance with economic theory. "In particular, if a sunk cost has a transparent frame, it is likely to be ignored. Direct, out of pocket expenses are generally more transparent as losses than indirect, opportunity costs. As a result, opportunity costs, which may be sunk, are often valued as smaller losses relative to equivalent direct costs." (Phillips *et al*. 1991, pg. 113) To test this rationale, the authors designed an experiment to determine whether decision makers ignore sunk costs in selected contexts, and whether or not implicit opportunity costs are perceived as equivalent direct costs. Three experiments were conducted. The first two were lottery experiments and results showed that when the problem was more transparent to the subjects they were more likely to ignore a sunk cost. An auction experiment was the setting for the third experiment and confronted the issue of the nature of the cost. Subjects participated in an auction and had the option of participating in parallel auction for a certain cost. This cost was a direct entry fee for half of the subjects and an indirect fee for the rest. The findings were as the authors had predicted the nature of the cost did influence the subjects' decisions. "Individuals were much more likely to participate in the optional market when the cost was an implicit, opportunity cost rather than an explicit direct payment. That is, the opportunity costs were undervalued relative to the direct costs by the participants." (Phillips *et al*. 1991, pg. 127) Overall the transparency both of the problem and of the sunk costs were found to have a significant effect on sunk cost accounting and subsequently on individuals' deviation from rational economic behaviour.

2.3.2 Effects of External Justification: A Social Factor

Social determinants are considered to inhibit the individual from deviating from the initial course of action, even at the expense of their own beliefs. Fox and Staw (1979) demonstrated that external justification processes could also produce escalation. They tested whether political and social variables enhanced the self-justification process and, therefore, sunk cost accounting and escalation of commitment. The variables employed were *Job Insecurity (High/Low)* and *Resistance to the subjects' policies (High/Low)*. The study again utilized the "Adams & Smith" decision case, requiring of the subjects to make an R&D funding allocation and defend it. All of the subjects received negative feedback plus both support and resistance to their views from the Board and then were asked to make a second funding decision. Results showed commitment of resources in the failing cause (sunk cost effect) was highest in the *High Job Insecurity – High Resistance* condition and lowest in the *Low Job Insecurity – Low Resistance* condition: "As predicted, under high job insecurity, subjects committed more money than under low job insecurity and high resistance resulted in greater commitment than low resistance."(Fox and Staw, 1979, pg. 461) This takes on special significance in public life, where political opposition and investigative reporting is likely. Naturally, if public officials anticipate their opposition will attack them and they risk loss of office if their actions are regarded as a failure, they will make every effort to suggest that success is just around the corner.

Brockner *et al*. (1981) tested whether the degree of entrapment was mediated by face saving variables. Subjects decided how much (0 to $5.00) of their initial stake they would bet in a counter game that could win them in a jackpot ($3.00). The researchers initially split the subjects in *High* and *Low Social Anxiety* according to their scores on an anxiety scale. The subjects then received advice on how to play the game, half being encouraged to bet a good portion of their stake (*Risky* condition), while the other half was told the "smart thing" would be to invest a small portion of their stake (*Cautious* condition). Furthermore, half of the subjects were playing in the presence of one experimenter (*Small audience* condition), while the other half were playingin the presence of two (*Large audience condition*). All the hypotheses were accepted. First the effect of the *Risk-Caution* manipulation was indeed more pronounced in the *High Social Anxiety-Large Audience* condition, indicating that, individuals concerned with their social image followed the advice of the experimenter. Second, the same effect was least influential in the *Low-Social Anxiety-Small Audience condition*. Thus verifying that high social pressures can heighten sunk cost accounting.

2.3.2.1 Cultural Variance

The concept of cultural differences has been operationalised in many ways (*inter alia*: Hofstede, 1980, 1991; Brislin, 1983; Triandis, 1984; Schein , 1985). However, the taxonomy presented by Hofstede (1980 and 1991) is considered amongst social science academics as the most accurate and representative in this field of endeavour. A major advantage of Hofstede's (1980) approach is that is disaggregates culture into several component dimensions, thus enabling the formulation of hypotheses based upon these more focused cultural characteristics.

Based on a survey of over 116,000 workers in 40 countries for a large international firm, Hofstede (1980) identified the following five cultural dimensions: *Individualism*; *Masculinity*; *Power Distance*; *Confucian Dynamism*; and *Uncertainty Avoidance*. Of these five dimensions, "Individualism is most directly related to the escalation phenomenon."(Hofstede, pg. 351, 1980) According to Hofstede (1980, pg. 51, 1980), "*Individualism* pertains to societies in which … everyone is expected to look after himself or herself and his or her immediate family. Countering this is *Collectivism*, which describes societies containing strong cohesive units of individuals. These units are established from birth. As a result of a collective culture's need for group affiliation, its members are very concerned with maintaining face. Ho (1976) explains: "A person's "face" is assessed in terms of what others think of him… Face may be lost when conduct or performance falls below the minimum level considered acceptable." Further, "face is always attached to status…. At stake is nothing less than the effective maintenance of one's standing in society. (Ho 1976, pg. 876, 871)

In contrast, in individualistic cultures people are supposed to look after themselves. Hofstede (1980) and Triandis (1989) observe that as a result, an individual's self-respect can be preserved regardless of what other people think about his or her performance.

Chow *et al*. (1997) explored the effects of national culture upon individual's choice between continuance and abandonment of unprofitable projects. The experiment consisted of 192 American and Chinese undergraduate accountants. The decision making task placed each subject in the role of a company's senior project manager. His/her primary job responsibility was to oversee the company's investments in product research and development projects. Subjects were provided with both retrospective and prospective information in a concrete decision-making context. They were also given probabilistic information about future performance expectations for each alternative. The results displayed a significant cross-national difference. The mean decision of the Chinese sample was to continue the project, while that of the US was discontinuance. The much greater escalation tendency among the Chinese subjects was consistent with their greater concern with maintaining "face". In a culture that emphasizes "face" preservation, approaches that cause the loss "face", such as publicly announcing project outcomes, may increase rather than reduce escalation tendencies.

Brandts *et al*. (2002) document behaviour across four countries (*Japan*, *Netherlands*, *Spain* and *U.S.A*) in public goods experiments with linear voluntary contribution mechanism. Their contribution function design allowed them to obtain a view of subjects' behaviour from two complementary points of view. Their results illustrated two important findings that counter findings documented in previous cultural studies:

Firstly, differences across countries were found to be "minor" "When people play the same game they behave similarly" (Brandts *et al*. 2002, pg. 1). Their results give support to the notion that when people from different countries play the game they behave similarly. In fact unlike previous studies where Japanese subjects were found to display spiteful behaviour this experiment showed no evidence of such a trait amongst their Japanese subjects. Secondly, for all four countries the data are inconsistent with the explanation that subjects contribute only out of confusion and cooperation is a stronger motivating force than spite.

2.3.3 Project Determinants

Project determinants are the objective attributes of a project, the project's benefits and costs (Brockner, 1992). Factors such as proximity to the goal and project completion effects have been found to enhance entrapment and sunk cost accounting.

Rubin and Brockner (1975), conducted an experiment designed to investigate the effects of reward value, awareness of costs and goal proximity. Subjects were able to win large amounts of money, which diminished over time. For half of the players, the rate of decrement was high (*High Decrement* condition) whereas for the other half it was low (*Low Decrement* Condition). This condition was introduced so as to test the experimenters' hypothesis that the lower the rate of decrement, the greater the temptation to continue and the sunk cost effects. In order to win the jackpot, the participants had to solve a series of crossword puzzles. However, players could request a dictionary for puzzles they deemed difficult. However, they were warned that only one dictionary was available and so they might have to wait in line in order to use it. In fact, the dictionary was never available. Half the subjects, after asking for the dictionary, were given a card telling them that they were first in line for its use (*High Proximity* condition), whereas the other half were informed that they were third in line (*Low Proximity* condition). The researcher's prediction was that subjects in the *High Proximity* condition would exhibit greater entrapment. It was hypothesised if people became more focused on costs, entrapment would be reduced. To test this, half of the subjects were provided with a chart indicating costs and benefits at various time periods during the game (*High Salience* Condition), while half were not (*Low salience* Condition). Entrapment was measured by the amount of time the subjects spent staying in the game, as they were given the option to quit but their payoff in this case would be significantly smaller than if they had not participated at all, since participation in the game meant a reduction in their initial stake at each time period. The results confirmed all three hypotheses. Namely, the rate of decrement of the reward and cost salience is inversely related to the magnitude of sunk costs, while proximity to the goal is positively related to sunk cost effects.

In fact, examining goal proximity in entrapment situations has been the focus of many experiments. Arkes and Blumer (1985, Experiments *3*, *4* and *5*) found that subjects faced with a decision to invest that same amount of funds to start up with the same R & D projects. The authors also tested to see whether this decision was owed to the fact that subjects falling prey to sunk costs spend despite high probability of failure or because they do not perceive the situation as a lost cause. The first hypothesis displayed only face saving concerns, but the second verified the existence of sunk cost effects, since the latter are supposed to distort the decision makers' judgement. Therefore, the findings verified the second hypothesis as the greater the proximity to the goal, which in this case also meant higher sunk costs, the more "irrationally" confident were the decision makers about the success of the project.

Garland (1990) tested the functional relationship between sunk costs and the decision to continue investment in an R & D project (based on the original design of Arkes and Blumer, 1985). Subjects were asked to take the role of president in the *Aero-Flite Corporation* and decided whether to commit additional resources to a partly completed project. Five stages of prior spending and project completion were considered – 1, 3, 5, 7 and 9 million dollars had been spent and the project was 10%, 30%, 50%, 70% and 90% completed, respectively. The overall budget for the project was $10 million dollars. Subjects were asked to comment on how likely is it that: a) they would decide to use the last *x* million dollars to complete the project? b) they would authorise the next million to continue with the project? c) if the project was completed, the company would realize a profit? The findings illustrated that project completion or goal proximity is an important factor in decision-making. Subjects' willingness to authorise additional resources for a threatened R & D project was both positively and linearly related to the proportion of budget that had already been expended. As a consequence, project completion effects may not be important in the presence of small sunk costs and in the initial stages of the projects but become very influential later on. Surprisingly enough, however, although the subjects generally considered the continuation of the project more likely than the abandonment of it, they were far less confident about the probability of the project turning out to be profitable. This contradicts Arkes and Blumer's (1985) assumption that individuals continue because of "irrational" expectations concerning the success of the project. Note however, that both findings could be interpreted by self-justification or prospect theory but do not conform to "rational" economic behaviour. Indeed Garland (1990) noted the individuals' propensity to invest further in the project was independent of previous incremental costs (on average).

Although sunk costs and project completion may be highly correlated in many situations, they are conceptually distinct variables, worthy of separation in experimental studies in order to uncover any separate or combined effects they may have on escalation behaviour. In two studies with undergraduate business students, Conlon and Garland (1993) found that when sunk costs and project completion information were manipulated independently, there was no evidence of sunk cost effects, even in a series of control conditions where no information was presented regarding the degree of project completion. There was, however, considerable evidence of project completion effects, where the closer the project was to completion, the greater the likelihood that decision makers would continue to invest in the project. These project-completion effects occurred under varying budget conditions, with the amount of money remaining in a project budget unknown, held constant, or inversely related to the amount that had been spent. Finally project completion effects occurred whether or not subjects were personally responsible for the initial investment in the project.

Conlon and Garland (1998), extend the notion explored in their 1993 paper, that what had been labelled a sunk cost effect might actually be a goal substitution effect. The studies allowed them to examine the effects of sunk costs and project completion in a scenario that investigates students' willingness to continue investment in projects that were already underway. In studies with experienced bank managers, Chinese graduate students and advanced MBA students they found overwhelming support for the importance of project completion an investment intention with no indication of typical sunk cost effects. The results reinforce a goal substitution escalation for many escalation phenomena where, as progress moves forward on a project, completion of the project itself takes an increasing precedence over other goals (e.g., economic profit) that may have been more salient at the time project was initiated.

Diekmann, *et al*. (1996) explored whether the amount sellers previously paid for their property affects both buyers and sellers engaged in a real estate negotiation. *Study 1* demonstrated that buyers base their initial and highest offers on the seller's previous purchase price. This finding extends the sunk cost literature to a negotiation context and suggests that sunk costs extend beyond the focal actor to one's opponent and to the negotiated outcome. *Study 2* demonstrated that sellers base their lowest acceptable offers on their previous purchase price. This is consistent with the negotiation framework developed by Raiffa (1982) who argues for an asymmetrical prescriptive/descriptive approach. This approach suggests that the best prescription for a negotiator should be based on a description of the likely decisions of the opponent negotiator. In contrast to game theory approaches, Raiffa (1982) explicitly acknowledges that the actual behaviour of the opponent may fall far short of rationality. *Study 3* reveals that the seller's previous purchase price affects not only the buyers' and sellers' offers and expectations, but also the final negotiated outcome. The integration of these studies suggests that sunk costs do transmit across players, and that while the consideration of one's own sunk costs may be irrational from an economic perspective, the consideration of one's opponent's sunk costs may be strategically rational if such consideration provides a descriptive analysis of one's opponent's actions.

Overall it is quite apparent that factors associated with the project influence escalation of commitment but not in the way "rational" economists would argue. Most researchers believe individuals' motives for task completion alter during the course of a project. At the outset, economic decisions are dominant. As additional resources are poured into the investment, economic concerns are mixed with psychological motives. There is an increasing tendency to withdraw from the project due to increasing costs accompanied by an increasing tendency to escalate further. Later on, the psychological component becomes stronger as now the decision maker's decisions reflect the need to appear consistent, save face and justify previous expenditures. Whilst these statements appear consistent with human behaviour in investment projects, it poses the question: at what stage of a project do economic considerations become psychological motives for task completion? If there is a visible boundary, is it uniform or does it depend on the individual's personality? It is certainly worthy of future research.

2.4 The Reverse Sunk Cost Effect

The central theme of this chapter has been to document the "apparently instinctive tendency of human decision makers, affected by what has been committed to date, towards deeper or continued involvement ("escalation") rather than rational withdrawal." (Johnstone, 2003, pg. 210). However, there are studies that testify towards the opposite behaviour, i.e. a reverse sunk cost effect.

Heath (1995) determines that the sunk cost effect is dependent upon two factors. Specifically, individuals who are reluctant to disengage themselves from an investment do so because either they fail to set a mental account of their spending or because of a failure to maintain an account of aggregate expenditure. Heath's (1995) findings promote features of de-escalation from subjects who adopt either of the above characteristics. Their ability to withdraw from an investment is a function of recognising when aggregate sunk costs equal or exceed their self-imposed budget. This cognitive process is independent of when continued investment may appear "rational". Such behaviour can be often observed in stockbrokers or traders. They will adopt a "sell-price" at which the computer will automatically sell the asset at a pre-specified price. This precludes traders from falling prey to emotional phenomena such as sunk cost accounting and escalation of commitment.

These findings are based upon "a theory of mental budgeting" of which there are two principal components. First, individuals set a budget and second, they track their ongoing expenses against the budget.

Within the process of implementing a budget, Heath (1995) assumes individuals will assess the expected benefits of a new investment opportunity and then mentally allocate the necessary resources required to achieve those benefits. After the budget has been set, individuals will track their investments against the budget. Heath states the success rate of tracking investments is a function of two processes: "(1) investments must first be noticed and (2) then assigned to their proper accounts. An investment will have no impact on the budget if either process fails." (Heath, 1995, pg. 43) When subjects were confronted with an investment decision that was difficult to budget, individuals escalated commitment. [6]

With such evidence Heath (1995) raises external validity questions about experiments that omit information about expected benefits. The budgeting model offers a new dimension to the sunk cost literature but questioning the validity of previous experiments that fail to offer subjects the opportunity to learn about the benefits of an investment is unnecessary. One of the many appealing aspects about decision-making is that there is ambiguity. This feature pertains to the core research into sunk costs and entrapment. Investment decisions are rarely observed as "black and white" and as a consequence setting mental budgets can be difficult. In such situations posited by Heath (1995) where mental budgets can be implemented then de-escalation is likely to occur.

2.5 Direction of Dissertation

The theme of this chapter has been to demonstrate the importance of experimentation in contemporary economic research and more specifically provide an overview of the sunk cost accounting phenomenon focusing on the psychological and economic motivations for pursuing this course of action. By examining the evidence it is possible to elicit the following stylised facts pertaining to sunk cost accounting and entrapment.

1. Sunk cost accounting (as a within person process) is a robust phenomenon in the real world.
2. Sunk cost accounting decreases with the transparency of the sunk cost.
3. Repeated violations of sunk cost accounting increases the probability of entrapment and escalation of commitment.

---

6 The investment decision was difficult to budget for because the expected benefits were omitted from the experimental scenario.

4. Goal proximity and magnitude of prior costs increase the degree of entrapment and escalation of commitment.

As prior work has clearly highlighted the existence of sunk cost accounting and certain conditions under which the occurrence is prevalent further work should concentrate on how individuals regard the sunk costs of others i.e. a departure away from sunk costs as a within person process towards an interpersonal approach of the phenomenon. Further, how do individuals treat sunk costs when they are incorporated into a series of several costs? Previous literature has failed to explore how sunk costs are treated when integrated into a group of other costs. In real world activities, individuals will respond to sunk costs and other costs simultaneously so it is important to understand what effect this phenomenon will have in such a setting. Finally, sunk costs are pervasive across decision making environments one of which is in financial markets. This provides an interesting domain to test how sunk costs affect investment strategies and whether unanticipated brokerage fees ameliorate the sunk cost effect.

2.6 Conclusion

The sunk cost effect is a robust phenomenon and can be captured under controlled laboratory conditions. This chapter has identified three mechanisms that drive the phenomenon but has failed to detect one over-riding psychological strategy. In terms of importance, prospect theory is a powerful explanation of sunk cost accounting but it fails to explain all instances. Whilst self-justification and regret deserve merit they serve as auxiliary roles in determining how individuals respond to the phenomenon. However, in the findings of a large proportion of experiments subjects exhibit an amalgam of all three mechanisms, which suggests the sunk cost effect is driven simultaneously by these three processes.

The literature has demonstrated that sunk cost accounting is common in the real world, which violates the axioms of expected utility theory. In particular, this effect is enhanced with proximity to goal and magnitude of resources expended. However, mental budgeting can result in individuals disengaging from an investment even in the face of large sunk costs.

The literature review has identified areas of importance to the domains of business, finance and politics that have yet to be explored and the spirit of this dissertation is in accordance with the above statement. Specifically subsequent chapters will provide the design, implementation and economic analysis of three experiments that will explore sunk costs in three directions: Firstly, sunk costs in a corporate acquisition process hidden amongst a "bundle" of other costs: secondly, sunk costs as an inter-person process in corporate acquisitions: and thirdly, sunk costs in volatile, dynamic markets, i.e. sunk costs in financial markets.

Chapter 3:

Methodological Issues

3.1 Introduction

Chapter 2 identified the key themes in the sunk cost accounting and entrapment literature. Most of these findings were examined using the technique of experimentation. This relatively new area of economic analysis has emerged to challenge the traditional axioms of the discipline. Specifically it is the application of experimental methods to evaluate aspects of economic behaviour with reference to the theoretical predictions. In fact, as a discipline, economics shares many features with those in the natural sciences in the sense that economists are able to observe naturally occurring events, devise theories to explain their observations and evaluate their theories in light of additional evidence.

Experimentation has developed into a valuable instrument because it allows the isolation of specific variables. This permits economists to "untangle" interrelated variables of interest that would be otherwise problematic using data from existing natural markets. This is because "natural data often fail to allow "critical tests" of theoretical propositions…For example, predictions are often based on very subtle behavioural assumptions for which there is little practical possibility of obtaining evidence from naturally occurring markets." (Davis and Holt, 1993, pg. 3)

One of the principal benefactors of experimental analysis has been in the area of decision-making under uncertainty and more specifically sunk cost accounting. As this dissertation concerns itself with experimental designs to test the sunk cost accounting phenomenon this chapter has two main objectives. The first is to demonstrate the ubiquitous nature of experimental work in economics, highlighting its importance in contemporary analysis. Section 3.2-3.4 navigates through the major studies that have characterised experimental economics with reference to its historical development and to methodological issues and to discuss some of the objections and failings to experimentation, as well as some of the principal lessons that have been learned.

The second objective is to determine how attitudes to risk (a critical component of experiments in this dissertation) are determined in economics and the practicalities of measuring them in the laboratory with references to previous experiments that have sought to identify a subject's risk posture.

3.2 Development of Experimental Economics

The historical evolution of experimental economics dates back to the mid-twentieth century and since that time a series of themes have emerged that remain important in contemporary experimental analysis. The most important findings have occurred through experiments in the following areas: (1) markets, (2) public goods, (3) individual learning processes, and (4) game theory.

3.2.1 Experiments on Markets

A burgeoning number of studies have focused on experimental markets and several of the most recognised belong to this category. Much of the research relates to the convergence of competitive markets and the establishment of a competitive equilibrium. Academics were concerned with the dynamics of such equilibrium, i.e. do markets converge towards a competitive equilibrium and if they do what is the velocity of adjustment? At a fairly early stage in the experimental investigation of such issues it was repeatedly observed that one particular trading mechanism, known as the double auction trading institution, was especially efficient at attaining the competitive equilibrium and this attainment was rapid. As a consequence much of the experimental literature is concerned with studying this mechanism and applying it in various contexts. The pioneers of these experiments were Chamberlain (1948) and later Smith (1962). They reproduced the competitive market postulated by economic theory in a laboratory using a class of university students. In a double auction, buyers are free to accept the price "ask" of sellers, or to propose alternative terms in the form of "bids." Symmetrically, sellers may accept the bids proposed by buyers, or counter with asks. All bid and ask information is public, and is typically submitted under a bid/ask spread-reduction rule, or a condition that only proposals that improve upon the best standing terms are admissible.

Outcomes in Smith's double auction markets conform to competitive equilibrium predictions.[7] In fact, competitive predictions turn out to be remarkably robust in double-auction markets. Competitive allocations are generated in experimental double auction markets under extreme structural conditions, and under unusual supply and demand configurations. For this reason the double auction has become a performance standard against which others are evaluated.

3.2.2 Public Goods Experiments

Public goods experiments confront the principal issue of the free-riding problem. Generically, a public good possesses the following two distinctive characteristics.

1. Its fundamental characteristic is non-rivalry in consumption. "Each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good." (Samuelson, 1954, pg. 387)
2. Exclusion from its consumption is difficult.

Thus, when it comes to the financing of a public good by private arrangements, individuals face a monetary incentive to "free-ride" on the contribution of others.

7 Smith differed from Chamberlain in two procedural respects. First, Smith used real financial incentives. Second, Smith's markets were repeated.

According to economic theory this leads to a Pareto inefficient provision of the public good. In other words, this strategy is sub-optimal.

Such behaviour has inspired a series of experiments designed to investigate whether individuals actually pursue a free-riding strategy. Whilst each experiment differs slightly in the methodology they mostly conform to the following generic design.

3.2.2.1 The Generic Public Goods Experiment

A group of *n* subjects are each endowed with a fixed number of tokens. Subjects in such an experiment might well be told that the following rules apply. Each token can be either traded for cash or contributed to a common pool. The total contributions to a common pool will be multiplied by a factor α (α<1) and the resulting sum divided equally between the subjects. Each subject must decide how many tokens to contribute to the pool and how many to trade for cash. Under a game theoretic approach the dominant strategy for each player is to allocate his or her entire endowment to the private investment and nothing to the collective investment regardless of the other players' investment decisions. If the game is played a series of times by the same players, the game-theoretical solution is produced by backward induction. In the subgame perfect equilibrium of the game each player allocates in each round all of his or her tokens to the private investment and nothing to collective investment. However, the profit of all players together is maximised if all the tokens are allocated to the collective investment. Thus, the group optimum is realised if, in each round, each player allocates all of his tokens to the collective investment.

These rules are intended to create an experimental analogue of a public goods problem and this voluntary contributions mechanism design has stimulated substantial research. Experiments along these lines have investigated a number of questions including the extent to which the contributions to the public good depend upon a variety of treatment variables such as: the manipulation factor; the number of subjects; whether or not the subjects are allowed to communicate; whether or not binding agreements are allowed and the composition of the subject pool (e.g. are they men or women, are they familiar with economic theory?)

Voluntary Contributions to public goods is an area of great interest to experimental economists. Comprehensive surveys of the literature are presented by Ledyard (1995) and Davis and Holt (1993). They conclude that in early rounds of the public goods game, subjects tend to make considerable contributions to the collective investment. The contribution level decreases, however, over time until it is almost zero by the final round. Many experimental studies replicate these results but also show that the average contribution level depends on several factors. These factors might be parameters of the model or other factors that are irrelevant with respect to the game theoretic prediction. These so-called treatment effects in voluntary contributions experiments are illustrated by models that incorporate generalised preferences,[8] noisy decision making, evolution and adaptation, or cooperation and signalling.

8 A generalised preference function is a compound of egotistic and altruistic preferences.

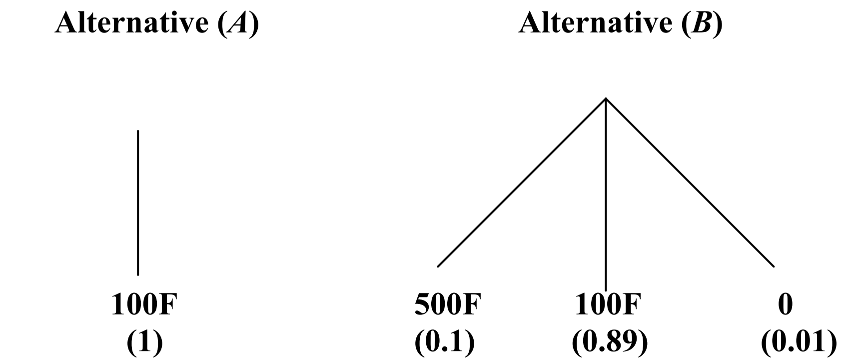
3.2.3 The Experiments on Individual Learning Processes

The seminal experiment in this field conducted by Thurstone (1931) sought to empirically determine the shape of an indifference curve. Subjects selected several (hypothetical) baskets containing alternative quantities of hats and shoes. This traditional model was critically commented citing the environment as too artificial, the choices hypothetical, and therefore, the experiment of little use. This is one of the major criticisms directed at experimental economics and will be discussed further in Section 3.3.3, as this opinion is quite widespread among economists.

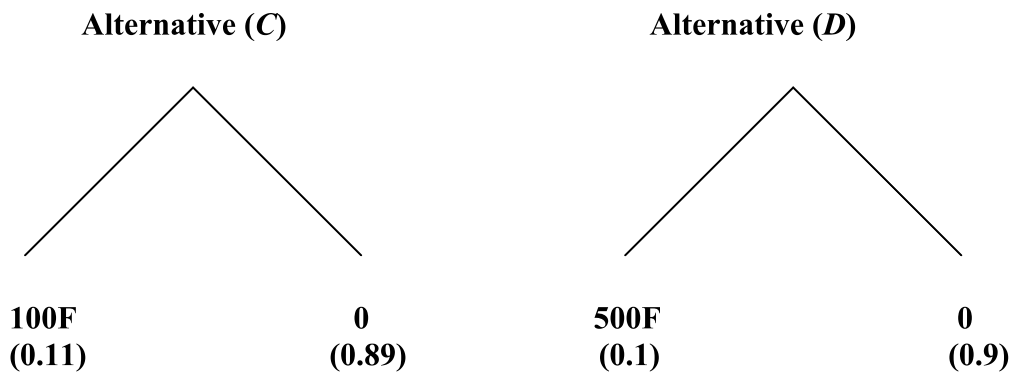
However, later studies by Allais (1953) and Kahneman and Tversky (1979), (1992) are more important to this line of enquiry. They were developed after Von Neumann and Morgenstern (1944) introduced the concept of *expected utility theory*.

Through replication by other economists, these experiments have shown robust violations of the axioms of invariance, transitivity and dominance, which are central in expected utility theory. The subjects use heuristic decision making rules and make systematic errors in their choices.

The Allais (1953) procedure adopts a basic framework. He used hypothetical questionnaires with no remuneration. The subjects had to make two choices. The first choice was between the alternatives *A* and *B*, the second one between the alternatives *B* and *C*. Each alternative was characterised by a different outcome, certain or uncertain. A typical variation of the outcomes of the various alternatives were:



Alternative *A* yields with certainty a payoff of 100 Francs. Alternative *B* yields a payoff of 500 Francs with probability of 0.1, a payoff of 100 Francs with probability of 0.89 and a payoff of 0 with probability of 0.01.



Alternative *C* yields a payoff of 100 Francs with probability of 0.11 or a payoff of 0 with probability of 0.89. Alternative *D* yields a payoff of 500 Francs with probability of 0.1 or a payoff of 0 with probability 0.9.

According to expected utility theory, if a subject prefers *A* to *B*, he should also prefer *C* to *D*. However, the experiment demonstrated that many subjects preferred *A* to *B* and *D* to *C*, thus contradicting the axiom of transitivity.

As presented in chapter 2.2.2 Kahneman and Tvesrky (1979) synthesised the above evidence to develop a new theory: *Prospect Theory*. Such a theory was consistent with the empirical evidence gathered. Among the empirically gathered data included in the model, an important aspect concerns, for example, the propensity to risk. In several contexts individuals are averse to losing more than the equivalent earnings attract them. According to Kahneman and Tversky (1979), for the subjects of the experiment the value of a little loss is almost twice as high as the value of an equivalent gain.

Moreover, in Prospect Theory the expected utility function is replaced by a value function. The results are weighed with decision-making weights that are a function of probabilities but are not probabilities. Outcomes of the choices are assessed by a reference point of the status quo.

A further experiment by Starmer and Sugden (1991) where participants were presented with two 2 equivalent lottery pairs report that subjects did not view the lottery choices as equivalent. Violations of this type are common. This design is unique in the care that the authors used in controlling for rival behavioural motivations. For example, unlike many studies of individual decision theory by psychologists, decisions are financially motivated. Anomalous decisions of this type may be mitigated somewhat by factors such as experience and increases in payoffs (Kagel *et al*. 1990).

3.2.4 Experiments on Game Theory

There are strong linkages between experimental economics and game theory. Several authors maintain that the development of experimental methods in economics may be attributed to those researchers who have worked on game theory, since the models proposed by such a theory can be empirically tested immediately.

A particularly important experiment was the one carried out by Flood (1952). Two subjects had to interact in the context which later became known as the *prisoner's dilemma.* The participants in the game interacted for many rounds under identical conditions and with the same partner. Results reveal that the subjects selected cooperative behaviour instead of the opportunistic behaviour foreseen in the model. The experiments also confirmed the game theoretic prediction that the incentives for individuals to act in their own interest may in some circumstances make it difficult to achieve the gains available from co-operative action. The difference between the experimental and the theoretical outcomes was due to the fact that the subjects interacted for many rounds. Such comment emphasised an important aspect on which subsequent attention has focused.

3.2.5 Ultimatum Bargaining

Initial work on ultimatum bargaining focused on whether real bargainers (in contrast the ultimatum game two players must divide a pie (π), which in most instances is a sum of money. The first player, proposes a division in which he or she receives $d_1 = \pi - x$, where $x \in [0, \pi]$, and the second player, receives $d_2 = x$. If Player 2 accepts the offer, then π is split according to the proposal; if Player 2 rejects the offer neither player receives anything. Denoting the proposed allocation $\boldsymbol{d} = (d_1, d_2)$, the subgame perfect Nash equilibrium proposal for the ultimatum game is $\boldsymbol{d} = (\pi - \varepsilon, \varepsilon)$. This solution follows from the following three assumptions: The first of these (*A1*) is that each player prefers a payoff of α to β whenever $\alpha > \beta$. Assumption 2 (*A2*) states both players are aware of (*A1*). Finally, Assumption 3 (*A3*) states Player 1 can calculate the optimal offer.

Since by *A1*, Player *2* prefers any positive payoff to a payoff of 0 and player *1* knows this by *A2*, Player *1* can use backward induction (*A3*) to arrive at the subgame perfect Nash equilibrium ($\pi - \varepsilon, \varepsilon$).

Güth, Schmittberger, and Schwarze (1982) pioneered work on ultimatum bargaining and discovered unique behaviour from their subjects which violated subgame perfect predictions (detailed above). In the early condition subjects played two rounds of ultimatum bargaining separated by one week against different opponents with π from DM4 to DM10. Of the 21 proposals in the 1st round, only two were consistent with the game theoretic prediction, and of these only one was accepted. More than a quarter (6 of 21) of player 1's offered a 50:50 division. None of these offers were rejected. The second round outcomes were significantly different from the first, though the rejection rate was slightly higher. Intra-individual ultimatum bargaining behaviour was also examined. Using π = DM7, 37 subjects gave both their demands d_1 and minimum acceptable offer. A large number of the subjects, 17, offered more than their minimum acceptable offer (d_1> Minimum acceptable offer), five offered less (d_1 < Minimum acceptable offer), and 15 gave offers consistent with their own minimum (d_1 = Minimum acceptable offer). Again, the results were inconsistent with game theoretic predictions. Only two subjects demanded nearly all of π for themselves and only two were willing to accept very small offers (Minimum acceptable offer ≤ DM10). This evidence implies subjects frequently anchor to what they perceive as a "fair" result. This is further reinforced, as subjects do not hesitate to punish opponents for requesting "too much". This conclusion from the early ultimatum game results stimulated a whole industry of research on bargaining behaviour.

Sceptical of the failure of game-theoretic predictions in ultimatum bargaining, Binmore *et al*. (1985) implemented a two-period ultimatum game in which first period rejection led to a game in which the size of π was reduced to a $\delta\pi$ in Period 2 where δ = 0.25. The authors found that in the second game, in which Player *2* of the first game played the role of Pplayer *1*, the first period offers were close to equilibrium, which in this game is 0.75π, whereas the modal first period offers in the first game were around 0.5π. The authors claimed that the one-period ultimatum game is a special and dangerous case from which to draw strong conclusions, and the two-period game has the proper virtues needed to truly test the predictive accuracy of game theory.

Further studies to examine the effect of δ on ultimatum bargaining behaviour have been conducted by Güth and Teitz (1987, 1988) and Ochs and Roth (1989) who discovered one of the most informative regularities in ultimatum bargaining literature: Player *2* rejections are always followed by demands that give player *2* less than he/she rejected.

Generically, the early ultimatum bargaining experiments pinned down the following conclusions: individuals dislike unfairness; especially, when it is perpetrated against them: subjects offered less when they felt they could do so and get away with it: and subjects made disadvantageous counterproposals to avoid being treated unfairly – i.e., to avoid getting a substantially lower payoff than their opponent. Continually Player 1s attempt to exploit their strategic position when they can, and Player *2*s try to avoid being exploited, even if doing is economically disadvantageous.

To summarise, experiments have provided economists with pertinent information regarding markets, public goods, individual learning and game theory that would otherwise be undetected from traditional theoretical models. In the context of markets, experimentation has supported the models postulated by economic theory i.e. experimental double auction markets conform to competitive equilibrium predictions. Furthermore, competitive allocations are generated in double auction markets under extreme structural conditions, and under unusual supply and demand configurations. However, experimentation does not always indicate findings that are analogous to economic theory. Experiments on individual decision making under risk illustrated that expected utility theory failed to explain the behaviour of individuals when confronted with binary decision making options. Consequently, Kahneman and

Tversky (1979) developed a more accurate and powerful theory of this behaviour: *prospect theory*. In ultimatum bargaining experiments the subgame perfect conditions from game theory does not explain the bargaining behaviour of subjects. This does not suggest when experimentation does not concur with theory that the experimentation is incorrect. However, despite these findings experimentation lends itself to criticism such as this and much more besides.

3.3 Problems with Experiments

Since its inception, experimentation has proven to be a useful instrument in examining economic theory. However, there are of course legitimate reasons for avoiding this method of enquiry in specific contexts. For example, experimentation is unlikely to provide information about the values of specific factors outside the laboratory, parameters such as the average costs of a firm or an individual's bequest motive. *Ceteris Paribus* accurately designed and implemented experiments can generate pertinent data to a diverse array of situations. Although experiments have been broadly applied to a variety of experimentation there are a number of reservations regarding the use of experiments, which have inhibited its progression. These objections can fall into two classes. The first category stems from the perception that the logical status of theory makes experimentation unnecessary. The second class regards misgivings about the way experiments are conducted. [9]

9 It should be noted that these views are not necessarily the opinion of the author but rather a generic synopsis of concerns raised by economists.

3.3.1 Theory is Logically Correct

There is a school of thought that believes experimentation is unnecessary because a theory is “correct” as long as it is internally consistent. However, theories should offer more than just mathematical elegance. Internal consistency is only a first step. Economic theories should have some explanatory power as well.

Economic theories are based on two kinds of assumptions, *behavioural* and *structural.* The principal objective of experimentation is to appraise behavioural assumptions. If humans don’t correspond with the theoretical behavioural presumptions, then the theory is incorrect, and it must be altered despite its internal consistency.

For example with reference to the ultimatum bargaining problem described in Section 3.2.5, the results found in the majority of experiments suggest players fail to conform to a sub-game perfect equilibrium as determined by Rubenstein (1985). Does this inherent lack of correlation between experimental and theoretical results correspond to the failure of experiments to capture bargaining behaviour or is it indicative of a theoretical model failing to prescribe the human element of bargaining? Should the latter be true, then it confers a compelling case for modification of this theory.

Critically, humans cannot be perceived as stupid or foolish if they fail to make the decisions predicted by theory, and it is generally undesirable to inform the participants how to behave in such instances. If behavioural suggestions of this type are enforced, it degenerates an experimental test of theory into a simulation of theory. This is not to denigrate the importance of simulations as an analytic tool. The objective is to distinguish experimental investigation, an empirical technique, from simulation, which is a theoretical device for extending the range of application for theories that do not have analytic solutions. Simulations impose both behavioural and structural assumptions on parameterised versions of a model, and then rely on a computer algorithm to generate outcomes. Experiments are a means of evaluating human behavioural assumptions.

3.3.2 Theory is Normative

In many instances economic theory imposes restrictions on models by specifying variables that should not enter the analysis. Hey (1991) suggests, "consider, the typical methodology adopted by economists. First, an area of study is defined and delineated: second, a set of assumptions concerning the "rules of the game" and the objective functions of the players are proposed; third, a set of conclusions is deduced from these assumptions, usually using mathematical logic." (Hey, 1991, pg. 7) Problems arise when the theory is applied to empirical testing. Data from an "abstracted world" is deemed acceptable to predict events in the real world. Under inspection there would appear a gap between the world of theory and the world of the data used to test that theory. This gap is often bridged by the introduction of stochastic variables which represent the additional impact on the dependent variables of those factors that were assumed to be constant in the world of the theory, but were not in fact constant in the world of the data. These stochastic variables are typically not part of the original economic theory but an *ad hoc* appendage.

For example this dissertation is concerned with the pervasive influence of sunk costs in future investments, which economic theory typically labels “irrational”, and which should never enter the decision making strategy of the individual. The fact is theory in certain environments can promote a false view on how individuals actually behave in the real world.

3.3.3 Laboratories are Unable to Replicate the “Real World”

The third reservation regards the way experiments are conducted. The world is a complicated arena, filled with complex, multi dimensional interactions. In stark contrast, laboratory environments examine human decisions in simple and finite surroundings. How can decisions made under such simple, streamlined conditions hope to inform economists of anything useful? As a consequence there is a propensity by some individuals to concede that decisions made under simple, streamlined conditions are unlikely to inform economists of anything valuable. Some of the foremost misgivings concern the following.

3.3.3.1 Financial Incentives

From a methodological perspective, using financial incentives in experiments has been a contentious issue. Economists conjecture that experiments devoid of financial rewards offer the subjects little or no incentive to think hard or to get the “right” answer. The counter argument posited by psychologists is that the subjects’ behaviour will not be affected by financial incentives, as “intrinsic motivation is usually high enough to produce steady effort even in the absence of financial rewards." (Camerer and Hogarth, 1999, pg. 8).

There is agreement among experimentalists that greater financial incentives typically reduce the behavioural variance (Camerer and Hogarth, 1999). Grether and Plott (1979) replicated Lichtenstein and Slovic's (1971) experiment on the preference reversal phenomenon with and without incentives. They discovered preference reversals were somewhat stronger when financial incentives were used, which provoked Falk and Fehr (2003) to state, "at higher stake levels, subjects become more focused." (Falk and Fehr, 2003, pg. 11) However, Camerer and Hogarth (1999) surveyed 74 experiments in which the level of financial incentive varies. They concluded that central behaviour was not affected by financial incentives, and in some instances financial incentives can "impair" individual behaviour. [10]

However, Holt and Laury (2002) found subjects are significantly more risk averse when the average earnings in a lottery – choice experiment increased from approximately $70 to $230. In contrast in the context of fairness preferences, increases in the stake level have little or no impact in the incidence of fair responses. (Cameron, 1999; Slonim and Roth, 1998;and Fehr and Tougareva, 1995).

It can be concluded that in the domain of games, auctions and risky choices, financial incentives fail to significantly alter decision making. These results reinforce the viewpoints of experimental psychologists who believe subjects are intrinsically

10 "In the kinds of tasks economists are most interested in, like trading in markets, bargaining in games and choosing among gambles, the overwhelming finding is that increased incentives do not change average behavior substantively." (Camerer and Hogarth, 1999, pg. 8)

motivated to perform and monetary reward is insignificant. In fact, incentives can hinder subject performance in complex problems or in situations where intuition and habit provides the optimal answer and thinking harder makes things worse.

3.3.3.2 Learning

This statement is derived from the position that experiments do not offer the subjects the opportunity to learn. Thaler (1986) conjectures there is no reason to believe the real world facilitates learning and this can only be considered as accurate when the individual receives pertinent feedback. For example, golfers may consistently "miss" putts on a specific side of the hole but they rarely learn and adjust their aim accordingly. Einhorn and Hogarth (1978) showed many repetitive decision making tasks do not provide this type of learning opportunity. Subjects in many contexts have displayed overconfidence which is a well-documented decision making failing. Einhorn and Hogarth (1978) have shown that in decision making tasks in which the decision maker usually succeeds, such as selecting students for admission into a highly selective college with a very attractive applicant pool, experience will tend to increase confidence regardless of the ability of the decision maker to discriminate good from bad applicants. Therefore, experience does not necessarily lead to learning.

Upon reflection, it should be clear that this reservation is a criticism of economic theory as much as it is a criticism of experimentation. Theories are necessarily extremely simplified characterisations of the complicated natural world. If the complications of the natural world are expected to systematically affect outcomes, then a more complex theory should be evaluated. Moreover, this evaluation process should ideally begin, not in the domain of the complex natural world where numerous confounding events may impinge on variables of interest, but strictly on the domain of the theory, where all structural assumptions can be implemented. The laboratory is an ideal and unique environment for evaluating a theory on its own domain. Of course, observation of the theory "working" in the laboratory does not imply that it explains behaviour in the natural world. But the failure of a theory under the "best shot" circumstances of the laboratory suggests that the theory is not a good explainer of behaviour. It is perhaps in this role of theory rejection that experimentation is most useful.

Importantly, it is not the view of experimentalists that other empirical methods, particularly econometrics, are without merit. Econometrics very usefully allows to be evaluated in light of data from the natural world, via the use of a series of auxiliary assumptions. Experimentation allows more direct evaluation of theory in a simplified environment, but without the need of auxiliary assumptions.

3.3.3.3 Deception

The use of *deception* in economic experiments has long been regarded as a methodological "taboo" amongst researchers. A definition of deception has proved difficult to pin-down. However, there is agreement amongst most academics that premeditated falsification of the purpose of an experiment or any element of it constitutes deception. Hey (1998) conceptualises deception as the following: "There is a world of difference between not telling subjects things and telling them the wrong things. The latter is deception, the former is not" (Hey, 1998, pg. 397). So why is such an experimental technique treated with so much distain? Economists conjecture two main points of concern over the use of deception. Firstly, deception will directly alter the behaviour of the subjects as subjects who suspect they are being deceived will shift their behaviour towards "second-guessing" what the experimenter is actually attempting to elicit from them. Subjects who have been deceived in the past by experiments may expect further deception in future experiments. (Beins, 1993; Christensen, 1977; and Krupat and Garonzik, 1994). However, Bonetti (1998) argues "the mere anticipation of deception does not by itself cause or establish the existence of behaviour on the basis of that apprehension." (Bonetti, 1998, pg. 381) A series of experiments in the spirit of this conjecture how anticipated deception alters behaviour in the following experimental settings: obedience and conformity, attribution and social dilemmas. Within these domains the conclusion is that there are no significant deviations away from measured behaviour

The second problem concerning deception is entrenched in population effects. More specifically, the acknowledgement of deception during experimental debriefing distorts the population of subjects for later experiments. Whilst economists have openly aired their concerns, the experimental evidence offers little justification for this. West and Gunn (1978) are proponents of this view, finding a non-significant increase in the proportion of students over time that are classified as "suspicious" of experiments. Such evidence appears understandable and as a consequence the following hypotheses are formulated. Firstly, it is not always necessary to host a debriefing session. So long as experimenters conform to the promise of monetary incentives, subjects will not be affected by the absence of feedback. If no feedback is presented, subjects will continue to participate in experiments under no illusion of deception. Secondly, the concern for distorting future pools of subjects is unlikely as the majority of university populations turnover every three years or if using postgraduate students, every year. This rapid turnover would limit contamination of deception across subject pools.

In psychology, deception plays a much more prominent role in experimental studies and its methodological position within this domain has rarely been challenged. For instance, Kahneman and Tversky's (1974) study of "anchoring" involves an aspect of deception. Subjects are invited to spin a wheel containing the numbers 1-100 and then requested whether this number is greater or smaller than the percentage of African countries in the United Nations. The wheel was manipulated by Kahneman and Tversky so that the values 10 or 65 were generated. The results are widely accepted in the domains of social and cognitive sciences as indicative of subjects exhibiting anchoring effects and have served as a pre-cursor to a series of experiments investigating the effect of anchors (for example: Neale and Bazerman, 1985, 1991; and Diekmann *et al*. 1996). If the use of deception in certain contexts is beneficial to the experiment, then economists should be prepared to adopt this principle as a tool for further investigating human behaviour.

According to Bonetti (1998) deception can "enhance experimental control and ensure validity" (Bonetti, 1998, pg. 389). The justification of this is as follows. Experiments should not offer control to the subjects. In the same spirit, experiments should not instruct subjects how to behave or inform subjects of the experimental hypothesis as such a strategy may induce subjects to purposefully confirm or purposefully contradict it. The selective use of deception can assist the experimenter, so long as the deception is plausible to the subject (Walster *et al*., 1967; and Bonetti 1998)

3.3.4 Subject Sophistication

The final reservation regards the subjects typically used in laboratory research. Even if it is desirable to evaluate a theoretical prediction in a very simple environment, the critic may contend that the environment is inappropriate because the laboratory decision makers are less sophisticated than the decision makers in the relevant natural environment.

This is not an objection *per se,* but rather an objection as to the way economists conduct experiments. Recruiting students as subjects is a convenient method as they are easy to recruit, have a quick understanding of the rules of the experiment, and have rather low opportunity costs. However, there is no reason to exclude other subject pools and certainly if "relevant" professionals behave differently from student subjects, then the appropriate subject pool should be composed of relevant professionals. Furthermore, it is possible to elucidate behavioural differences across subject pools in a precise way. Cooper *et al*. (1999) examined the ratchet effect arising from price rate incentives with Chinese students and Chinese middle managers as experimental participants. They observed behaviour slowly converged both with managers and students towards the pooling equilibrium. Thus the behavioural differences across subject pools vanished over time. In the early periods of their experiments they observed some subject pool differences, however. If the experimental instructions were formulated in an abstract context-free language that was removed from the daily context in which the managers' decisions took place, student behaviour converged more quickly toward the equilibrium than the managers' behaviour. In contrast, if the instructions made explicit reference to the interactions between planners and managers, the managers' behaviour converged more quickly towards the equilibrium. Fehr and List (2003) recruited CEO's to study the extent to which CEO's use explicit incentives and how they respond to these incentives. They were particularly interested in the question as to what extent certain kinds of incentives are counterproductive and, if so, whether students and CEO's use such counterproductive incentives. Results indicated differences in the behaviour of CEO's and students. CEO's were found to be trustworthier than students. However, both subject pools predominantly used the available explicit incentive, even though this had strong negative side effects and decreased their earnings

These examples suggest subject pool differences may be a real issue. However, the studies show that the different subject pools do not behave in fundamentally different ways. After some time students' and managers' behaviour was very similar in the Cooper *et al*., (1999) study and similarly Fehr and List (2004) studied subjects and managers exhibiting trusting behaviour, which should be absent if all players are assumed to be selfish. In addition both subject pools exhibited a lot of non-selfish, reciprocally fair, behaviour. Thus, although there were some quantitative subject pool effects, the qualitative effects of behaviour were rather similar across the different pools. This pattern of behaviour is not exclusive. Traders, for example, tend to generate speculative price bubbles, as do college students. (Smith *et al*. 1988) Similarly building contractors are as susceptible to a *winner's curse* as college students (Dyer *et al*. 1989) and one group of ecologically conscious environmentalists were observed to free ride in a manner very similar to college students (Mestelman and Feeny, 1988)

While the subject pool is a matter that must be addressed on an experiment-by-experiment basis, it is interesting to note that in a variety of instances where the laboratory behaviour of both students and relevant professionals has been examined, performance has generally not varied substantially across subject pools.

In summary there are a number of reasons for not doing experiments. Although some of these claims are not without merit they do not outweigh the critical advantages of replication and control allowed by careful experimental investigation. For these reasons, the use of experimentation as a means of evaluating economic theory propositions has not only grown but should also continue to grow.

3.4 What has been Learned?

What has experimentation told the economic world? Below are key findings from experimental literature over the last 40 years. These findings are taken from experiments featured in this chapter.

a) *In at least some markets, competitive predictions are remarkably robust.* Markets organised under double-auction rules generate competitive predictions so pervasively that any design that generates deviation is publishable. This finding is illustrated with the double auction market session (refer to Section 3.24)

b) *Institutions matter.* Performance in markets organized under posted-offer trading rules, for example, can be markedly different from performance in double-auction markets similar in all respects except for the institution. The specification of the institutional rules parallels work in the "new" game theoretic industrial organization. For this reason, there has been a lot of interest in experimental work among both game and industrial organization theorists.

c) *Some of the predictions of game theory work.* In general, participants appear drawn to Nash equilibria when they exist, particularly in static games.

d) *In instances anomalies are observed:* the assumptions of those theories just seem to fail to work. This problem is particularly noticeable in individual decision-making experiments, as illustrated by results of the Starmer and Sugden (1991) experiment. Such anomalies call for further investigation to determine their pervasiveness, as well as for a consideration of alternative theories.

Over the last 40 years, experimentalists have cultivated the capacity to exploit the control allowed by the laboratory to evaluate economic theory precisely in its own domain. Analogous data is unavailable from the natural world and the importance of such data will undoubtedly appreciate in value as the new, institution specific theories become more refined.

Naturally, there are anomalies and inconsistencies in laboratory work but this is only problematic to the extent that we expect actual behaviour to conform to all of the elegance and precision of the theoretical models shown in textbooks and journals.

Much of the scepticism surrounding the discipline is unfounded and based around false assertions. Moreover experimentation has taught economists a great deal and enhanced their understanding of several microeconomic issues including game theory and competitive markets and will certainly continue to play a prominent role in contemporary economic analysis.

3.5 The Role of Risk in Experimental Decision Making

Chapter 2 identified sunk costs as a robust phenomenon and the following stylised feature of previous sunk cost research is:

> *At the aggregate level, the sunk cost effect is a widely observed and robust phenomenon.*

However, what has failed to be identified thus far is why some individuals fail to observe the sunk cost effect. This dissertation hypothesises the sunk cost effect is linked to a subject's attitude to risk. To support the experiments this dissertation encompasses, an attitude to risk model was designed and implemented to examine individual's propensity to risk and how this affects decision-making behaviour.

Decision making can be considered an action and actions are inherently "risky" endeavours. They are "risky" in the sense that the outcome form any given action may vary according to the state of nature. Whether the action is choosing between black and red on the roulette table or investing money in a current account or an investment fund it is a salient and ubiquitous feature of everyday life. Furthermore, attitudes to risk are central to economic decision-making.

A widely accepted understanding of genetics courtesy of Charles Darwin is that all individuals are unique. This finding can be extended to the individual treatment of risk. As a direct consequence, research into risk, focusing on determinants affecting an individual's attitude to risk and how one measures risk have burgeoned in recent years.

The following sections provide a synoptic account of attitudes to risk and how it is measured. This is considered through descriptive theories of risk aversion and experimental studies. Its direct relevance to experimental studies on investment decision-making will be studied.

3.6 Propensity to Risk

Classic decision theory describes risk as a function of the variation in the distribution of possible outcomes, the associated outcome probabilities and their subjective values, with the decision choice entailing risk and expected reward trade-offs (March and Shapira, 1987). In the context of sunk cost accounting in investment decision making, the effect of prior outcomes on subsequent choice has been the subject of several empirical studies. The nature of these studies reveals that results are often conflicting. For example, prior losses have at times been found to increase risk-taking and at times to decrease risk-taking. Thaler and Johnson (1990) reinforce the opinion of most academics that generic risky decisions are not based exclusively on rational calculations (Bromiley and Curley, 1992). Consequently, a stream of research has emerged which examines the effects of psychological processes on decision-making. The confluence of this research supports the notion that risk taking is a pre-meditated endeavour rather than simply situational. (Jackson *et al*. 1972; and Plax and Rosenfeld, 1976), and on strong evidence for a general propensity for risk taking (Jackson *et al*., 1972)

3.7 A Taxonomy of Risk

In defining the risk attitude of individuals, economists allocate one of three "labels" to characterise risk using the following economic nomenclature: *Risk averse*, *risk neutral* and *risk seeking*. A risk averse individual prefers to receive the expected value of an uncertain alternative for certain rather than the uncertain alternative. A risk neutral individual finds receiving the expected value for certain to be equally preferred to the alternative and a risk seeking individual prefers to receive the alternative rather than the expected value for certain.

Deriving an agent's attitude to risk can be calculated using an individual's utility function $U(z)$. This technique has been the principal method employed by economists and the underlying mathematics will be detailed in this section.

Friedman and Savage (1948) conceptualised the term "univariate" risk aversion, which alludes to the propensity of individuals when faced with choices of comparable returns to choose the less risky option. This is emphasised in Figure 3.1 Consider a random variable *z* which can bare on two values, $\{z_1, z_2\}$, and let *P* be the probability that z_1 happens and (1-*P*) the probability that z_2 happens. Consequently, expected outcome, is:

$$E(z) = Pz_1 + (1-P)z_2 \tag{3.1}$$

This is represented in Figure 3.1 on the horizontal axis as the convex combination of z_1 and z_2. Intuitively, expected utility is therefore:

$$E(u) = Pu(z_1) + (1-P)u(z_2) \tag{3.2}$$

This is represented in figure 3.1 by point E on the chord connecting A = $\{z_1, u(z_1)\}$ and B = $\{z_2, u(z_2)\}$. Naturally, the position of E on the chord depends on the probabilities *p*, (1-*P*).

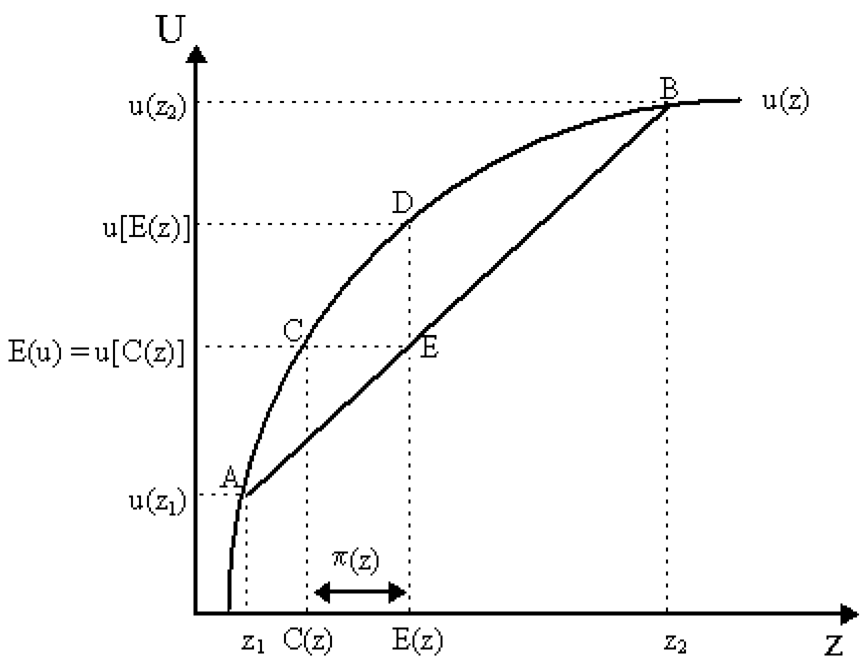


Figure 3.1: ***Univariate Risk Aversion***

Focusing on points D and E in Figure 3.1 the concavity of the elementary utility function implies that the utility of expected income, $u[E(z)]$ is greater than expected utility $E(u)$, i.e.

$$u[Pz_1 + (1-P)z_2] > Pu(z_1) + (1-P)u(z_2) \tag{3.3}$$

This represents the utility-decreasing aspects of pure risk-bearing. It can be thought of in the following way. Two lotteries exist, one that pays $E(z)$ with certainty and another that pays z_1 or z_2 with probabilities $(P, 1-P)$ respectively. Using von Neumann-Morgenstern notation, the utility of the first lottery is $U(E(z)) = u(E(z))$ as $E(z)$ is received with certainty; the utility of the second lottery is $U(z_1, z_2; P, 1-P) = Pu(z_1) + (1-P)u(z_2)$. The expected income in both lotteries is the same, yet it is obvious that if an agent is generally averse to risk they would *prefer* $E(z)$ with certainty than $E(z)$ with uncertainty, i.e. they would choose the first lottery over the second. This is what is captured in Figure 3.1 as $u[E(z)] > E(u)$.

Another way to capture this effect is by finding the "*certainty-equivalent*". Essentially consider a third lottery which yields the income $C(z)$ with certainty. As is intuitively evident from Figure 3.1, the utility of this allocation equates to the expected utility of the random prospect, i.e. $u(C(z)) = E(u)$. Thus, lottery $C(z)$ with certainty is known as the certainty-equivalent lottery, i.e. the sure-thing lottery which yields the same utility as the random lottery. However, notice that the income $C(z)$ is less than the expected income, $C(z) < E(z)$. However, an agent would be indifferent between receiving $C(z)$ with certainty and $E(z)$ with uncertainty. This difference, denoted $p\ (z) = E(z) - C(z)$, is known as the *risk-premium*, i.e. the maximum amount of income that an agent is willing to forego in order to obtain an allocation without risk (Pratt, 1964).

Turning to generalities, letting u: $R \rightarrow R$ be an elementary utility function, z be a random variable with cumulative distribution function F_z, so $F_z(x) = P\{z \leq x\}$. The set of all random variables is denoted by M. For a particular random variable $z \in M$, the expected z is $E(z) = \int_R x \, dF_z(x)$ and the expected utility is $E(u(z)) = \int_R u(x) \, dF_z(x)$. Let $C^u(z)$ denote the certainty-equivalent allocation, i.e. $C^u(z) \sim_h z$ and the risk premium as $\pi^u(z) = E(z) - C^u(z)$ - where the superscript "u" is a reminder that certainty equivalence and risk-premium are dependent on the form of the elementary utility function. Thus risk propensity can be defined as follows:

Risk-Aversion: an agent is *risk-averse* if $C^u(z) \leq E(z)$ or $\pi^u(z) \geq 0$ for all $z \in M$.
Risk-Neutral: an agent is *risk-neutral* if $C^u(z) = E(z)$ or $\pi^u(z) = 0$ for all $z \in M$.
Risk-Seeking: an agent is *risk-seeking* (or is "risk-loving") if $C^u(z) > E(z)$ or $\pi^u(z) < 0$ for all $z \in M$.

3.7.1 Expected Utility Theory

Expected Utility is a normative theory of decision-making relating to how individuals should make decisions under uncertainty. It is a simple and elegant explanation that enables economists to model risk aversion because the utility function over wealth is concave. This diminishing marginal utility of wealth theory of risk aversion is psychologically intuitive, and assists the explanation of individuals' aversion to large scale risk: Individuals dislike vast uncertainty in lifetime wealth because a pound that helps avoid poverty is more valuable than a pound that helps individuals to become rich.

This theory also implies that people are approximately risk neutral when stakes are small. Arrow (1971) illustrates that an expected-utility maximiser with a differentiable utility function will always want to take a sufficiently small stake in any positive expected-value bet. That is, expected-utility maximisers are arbitrarily close to risk-neutral when stakes are arbitrarily small. This also applies to quite sizeable and economically important stakes. Economists often invoke expected utility theory to explain substantial (observed or posited) risk aversion over stakes where the theory actually predicts virtual risk neutrality.

Whilst not broadly appreciated, the inability of expected-utility theory to provide a plausible account of risk aversion over modest stakes has become oral tradition among some subsets of researchers, and has been illustrated in writing in a variety of different contexts using standard utility functions. Rabin (2000) provides a theorem that calibrates a relationship between risk attitudes over small and large stakes. The theorem illustrates that, within the expected-utility model, anything but virtual risk neutrality over modest stakes implies manifestly unrealistic risk aversion over large stakes. As the theorem is exclusively “nonparametric”, it assumes only the utility function being concave. The intuition behind the theorem is that within the expected-utility framework, turning down a modest-stakes gamble implies that the marginal utility of money must diminish very quickly for small changes in wealth. For example if an individual rejects a 50-50 lose £10/gain £11 gamble because of diminishing marginal utility, it must be that the individual values the eleventh pound above his current wealth by at most (10/11) as much as he valued the tenth-to-last pound of his current wealth. Iterating this observation, taking on the same gamble with an increase in wealth, demonstrates a decreasing rate of the value of money. Essentially, the theorem is just an algebraic articulation of how implausible it is that the consumption value of a pound changes significantly as a function of whether the lifetime wealth is £10, £100, or even £1000 higher or lower. From such observations one can conclude that aversion to modest stakes risk has nothing to do with the diminishing marginal utility of wealth.

3.7.2 Loss Aversion Theory

Loss aversion is a more purposeful and accurate account of modest-scale risk attitude and can reconcile substantial risk aversion over modest stakes and non-ridiculous risk aversion over large stakes.

Loss aversion is conceptualised by individuals who are significantly more averse to losses relative to the *status quo* than they are attracted to gains, and more generally that people's utilities are determined by changes in wealth rather than absolute levels. Preferences incorporating loss aversion can reconcile significant modest scale risk aversion with reasonable degree of large-scale risk aversion. A loss averse person may, for instance, turn down one 50/50 lose \$100/gain \$200 gamble but would surely accept one hundred such gambles pooled together.

Kahneman and Lovallo (1993), and Benartzi and Thaler (1995) note that an additional departure from standard assumption is implicated in many risk attitudes. Individuals tend to assess risky choices in isolation and as a result behave differently than if they assessed these risks jointly. One might reject one equal probability lose $100/gain $200 gamble on each of 100 days, but accept all these gambles if they are offered at the same time. Benartzi and Thaler (1995) argue that a related type of myopia is an explanation of the "Equity Premium Puzzle"- the mystery about the curiously large premium on return that investors seem to demand as compensation for the risk associated with investing in stock. Such risk aversion can be explained with plausible loss aversion preferences- if investors are assumed to assess gain and losses over a short run horizon rather than the longer-term horizon for which they are actually investing. This is one example of how recognising that the expected utility model is fundamentally flawed and calibration deficiency can lead to the consideration of behaviourally realistic alternatives that permit us to improve economic analysis.

3.8 Evaluating Risk

Although risk aversion is a fundamental element in standard theories of lottery choice, asset valuation, contracts and insurance, experimental research has provided little guidance as to how risk aversion should be modelled. This section is in the spirit of the above statement. Principal methods to elicit risk preferences will be examined with reference to the results emphasising the diversity of the findings.

One such method of evaluating risk preferences is by eliciting the certainty-equivalent of a given lottery using open-ended valuation procedures as demonstrated by the *Becker-DeGroot-Marschak* procedure (Harrison, 1986; and Kachelmeir and Shehata, 1992).[11] The other method is by observing choices that subjects make over lotteries that vary probabilities of winning different prizes (e.g., Binswanger, 1980, 1981). A structured variant of the latter approach devised by Holt and Laury (2002) has been the method of choice in contemporary laboratory experiments and involves measuring risk aversion through a multiple price listing (MPL).

3.8.1 Risk Aversion and Common Ratio Tests of Expected Utility Theory

The most popular test of expected utility theory relies on observed choices by individuals over pairs of lotteries. The first lottery choice is used to infer the subjects risk attitude, and the second choice to test expected utility theory, conditional on the risk attitude of the subject. Therefore preferences have to be elicited over two pairs of lotteries for there to be a test of Expected Utility Theory at all.

Harrison, *et al*. (2003) state three problems when confronting subjects to present two "real responses" in laboratory settings. Firstly subjects may incur wealth effects or expected wealth effects, when the earnings from one lottery affect the valuations from the second lottery. Secondly, if one choice is selected at random to pay the subject,

11 The *Becker-DeGroot-Marschak* (BDM) mechanism is a common method for eliciting an individual's willingness to pay for an item. Under the BDM, an individual reports a bid for an item; the items cost is randomly drawn. If the bid is above the cost, the individual receives the good and pays the drawn cost. If the bid is below the cost, the individual does not receive the good and pays nothing.

then this assumes independence axiom of Expected Utility Theory is correct.[12] If it is not, then this random payoff device can generate inconsistent preferences even if the underlying preferences are consistent. Thirdly, there could be order effects, although these can be controlled for with sufficient randomisation.

A method developed by Conslik (1989) and Cubitt, *et al*. (1998) circumvents the above problems by imposing subjects to elicit a one choice response, and consequently to assume that different subjects have on average the same preference structures. However, this does require large subject samples, so that randomisation over the characteristics that drive differences in preferences is enough to ensure that on average there is no bias in favour of one lottery or another. This approach nicely solves the problem of wealth effects and having to assume the validity of the random lottery device.

3.8.2 Preference Reversal Choice Tasks

Preference reversals are initiated when an individual confronted with choice alternatives selects a course of action but subsequently attaches a higher value to the rejected option. Lichtenstein and Slovic (1971) provide evidence for the preference reversal phenomenon. Subjects were presented with pairs of gambles, or "bets," of roughly equal expected value. One of the bets, termed "*P*-bet," had a higher probability of winning a smaller amount; the other, labeled "$-bet," had a lower

12 The independence axiom of expected utility theory is a normative account of how individuals analyse risky prospects. For example, an individual weakly prefers risky prospect A over risky

probability of winning a larger amount. Subjects selected which bet they would prefer to play and were presented sequentially with the bets and invited to determine a price on each. They developed three experiments to test the preference reversal. In Experiment *1*, subjects determined the minimum price for which they would be willing to sell the right to play the bet. In Experiment *2*, subjects determined the maximum price they would be willing to pay in order to buy the right to play the bet. In Experiment *3*, the *Becker-DeGroot-Marschak* mechanism was used to elicit prices, and subjects played for real money. The authors predicted that when the *P*-bet was chosen, the $-bet would often be priced higher. Such reversals were termed "predicted." Reversals in which the $-bet is chosen but the *P*-bet is priced higher were termed "unpredicted." The results conformed to the experimenters' expectations. In Experiment *1*: 73% priced the $-bet higher every time they chose the *P*-bet. Unpredicted reversals were uncommon. However; 83% of the subjects never exhibited an unpredicted reversal. In Experiment *2*, 74 subjects were presented with 49 pairs of bets. The proportion of predicted reversals was somewhat lower than in Experiment *1*, and the proportion of unpredicted reversals somewhat higher. In Experiment *3*, 14 subjects were presented with six pairs of bets. Eleven subjects exhibited reversals, and six reversed their preference every time they chose the *P*-bet. Meanwhile, there were few unpredicted reversals. Thus, a significant proportion of subjects exhibited reversals, and there was a clear asymmetry in the kind of reversals exhibited; predicted reversals were much more common than unpredicted ones.

---

prospect B if and only if a p:(1-p) chance of A and C respectively is weakly preferred to a p:(1-p) chance of B or C for arbitrary positive probability p and risky prospects A, B, and C.

The preference reversal phenomenon has been demonstrated in a number of other studies. Lichtenstein and Slovic (1973) replicated the results at a Las Vegas casino, where a croupier served as experimenter, professional gamblers served as subjects, and winnings and losses were paid in real money. The economists Grether and Plott (1979) set out with the explicit intention to "discredit the psychologists' works as applied to economics" (Grether and Plott, 1979, pg. 623), but to their evident surprise merely confirmed the original results. Others have demonstrated reversals in different cultures, when subjects are more carefully informed, when incentives are increased, when expected values of the gambles are negative as well as positive, and when diverse elicitation mechanisms are employed. Though some studies succeed in decreasing the frequency of reversals (Bostic, *et al*. 1990), or even eliminating them (Chu and Chu, 1990), the phenomenon appears on the whole both common and robust. Preference reversals are often considered evidence that expected utility theory is descriptively inadequate, and that irrationality is systematic and widespread. According to Slovic, *et al*. (1990), for example, phenomena like preference reversals "represent deep and sweeping violations of classical rationality," and therefore "it may not be possible to construct a theory of choice that is both normatively acceptable and descriptively adequate" (Slovic, *et al*., 1990, pg. 26). Some have gone so far as to argue that subjects in these studies do not act on the basis of underlying beliefs and preferences at all.

3.8.3 Multiple Price Listing

The Multiple Price Listing is a relatively simple yet elegant framework for eliciting values from a subject. Its principal application is in the context of eliciting risk attitudes: Binswanger (1980) (1981) although it has been utilised in eliciting willingness to pay amongst subjects (Kahneman, *et al*., 1990) and eliciting individual discount rates (Harrison, *et al*., 2002). In the context of eliciting risk attitudes, it confronts the subject with an array of ordered risky choices in a table, two per row, and asks the subject in each row to accept one of the risky choices. The experimenter chooses one of the rows at random which will represent the payout to the subject.

There are disadvantages to the MPL. Firstly, it is restricted to eliciting interval responses as opposed to point valuations. Secondly, the layout of the MPL enables subjects to switch back and forth across rows, implying potentially inconsistent preferences. Finally, the MPL could be exposed to framing effects as subjects could be drawn to the middle of the table, irrespective of their true values.

Holt and Laury (2002) present subjects with a menu of choices that permits measurement of the degree of risk aversion, and also estimation of its functional form. In addition the behaviour under real and hypothetical incentives for lotteries ranging from several dollars to several hundred dollars is examined. This study will be adopted to illustrate the MPL in an experimental setting.

Each subject is confronted with a choice between two lotteries *A* or *B*. Table 3.1 displays the basic payoff matrix presented to the subjects. The first row displays

Lottery *A* offered a 10% chance of receiving \$2 and a 90% chance of receiving \$1.60. The expected value of this lottery is shown in the third-last column as \$1.64, although the expected value columns were not presented to the subjects. Similarly, Lottery *B* in the first row has chances of payoffs of \$3.85 and \$0.10, for an expected value \$0.48. Thus the two lotteries have a relatively large difference in expected values in this case \$1.17. As one proceeds down the matrix, the expected value of both lotteries increases, but the expected value of Lottery B becomes greater than the expected value of Lottery *A*.

The logic behind this test for risk aversion is that only risk loving subjects would take Lottery *B* in the first row and only risk averse subjects would take Lottery *A* in the second last row. The last row is simply a test that the subject understood the instructions, and has no relevance for risk aversion at all. A risk neutral subject should switch from choosing *A* to *B* when the expected value of each is about the same, so a risk neutral subject would choose *A* for the first 4 rows and *B* thereafter.

Lottery *A*		Lottery *B*		EV^A	EV^B	Difference
p(\$2)	p(\$1.60)	p(\$3.85)	p(\$0.10)			
0.1	0.9	0.1	0.9	\$1.64	\$0.48	\$1.17
0.2	0.8	0.2	0.8	\$1.68	\$0.85	\$0.83
0.3	0.7	0.3	0.7	\$1.72	\$1.23	\$0.49
0.4	0.6	0.4	0.6	\$1.76	\$1.60	\$0.16
0.5	0.5	0.5	0.5	\$1.80	\$1.98	-\$0.17
0.6	0.4	0.6	0.4	\$1.84	\$2.35	-\$0.51
0.7	0.3	0.7	0.3	\$1.88	\$2.73	-\$0.84
0.8	0.2	0.8	0.2	\$1.92	\$3.10	-\$1.18
0.9	0.1	0.9	0.1	\$1.96	\$3.48	-\$1.52
1.0	0	1.0	0	\$2.00	\$3.85	-1.85

Table 3.1: ***Payoff Matrix in the Holt and Laury (2002) Risk Aversion Experiments***

These data may be analysed using a variety of statistical models. Each subject made 10 responses. The responses can be reduced to a scalar if one looks at the lowest row in Table 3.1 at which the subject "switched" over from Lottery *A* to Lottery *B*. This reduces the response to a scalar for each subject and task but a scalar that takes on integer values between 0 and 10. Alternatively, one could study the effects of experimental conditions in terms of constant relative risk version (*CRRA*) and constant relative risk aversion characterisation employing an interval regression model. The dependent variable is the *CRRA* interval that subjects implicitly choose when they switch from Lottery *A* to Lottery *B*. For each row of panel *A* in Table 3.1, the implied bounds on the *CRRA* coefficient can be calculated and are reported by Holt and Laury (2002). These intervals are shown in the final column of Table 3.1. Thus, for example, a subject that made five safe choices and then switched to the risky alternatives would have revealed a *CRRA* interval between 0.14 and 0.41, and a subject that made seven safe choices would have revealed a *CRRA* interval between 0.68 and 0.97 and so on.

Holt and Laury (2002) examined two principal treatments with their subjects. They measured the degree of risk aversion over a wide range of payoffs, ranging from several dollars to several hundred dollars and compared behaviour under real and hypothetical incentives.

3.9 Experimental Findings

3.9.1 Experimental Elicitation with Monetary Incentives

A much-debated question at the heart of individual behaviour concerns whether actual monetary incentives are necessary to induce truthful preference revelation. Using lottery choice data from a field experiment, Binswanger (1980) evaluated the choices of farmers in India among several lotteries of varying risk for both low and very high actual rewards. He concluded that most farmers exhibit a significant amount of risk aversion that tends to increase as payoffs are increased. Alternatively, risk aversion can be inferred from bidding and pricing tasks. In auctions, overbidding relative to Nash predictions has been attributed to risk aversion by some and to noisy decision making-making by others, since the payoff consequences of such overbidding tend to be small (Harrison, 1989). Smith and Walker (1993) assess the effects of noise and decision cost by dramatically scaling up auction payoffs. They find little support for the noise hypothesis, reporting that there is an insignificant increase in overbidding in private value auctions as payoffs are scaled up by factors of 5, 10, and 20. Another way to infer risk aversion is to elicit buying and/or selling prices for simple lotteries. Kachelmeier and Shehata (1992) elicited certainty equivalents for a series of lotteries and reported a significant increase in risk aversion (or, more precisely, a decrease in risk seeking behaviour) as the prize value is increased. However, they also obtain dramatically different results depending on whether the choice task involves buying or selling, since subjects tend to put a high selling price on something they "own" and a lower buying price on something they do not, which implies risk seeking behaviour in one case and risk aversion in the other. Independent of the method used to elicit a measure of risk aversion, there is widespread belief that the degree of risk aversion needed to explain behaviour in low-payoff settings would imply absurd levels of risk aversion in high payoff settings. The upshot of this is that risk aversion effects are controversial and often ignored in the laboratory analysis of data. This general approach has caused little concern because most theorists are used to bypassing risk aversion issues by assuming the payoffs for a game are already measured as utilities.

The nature of risk aversion is ultimately an empirical issue, and additional laboratory experiments can produce useful evidence that complements field observations by providing careful controls of probabilities and payoffs. However, even many of those economists who admit that risk aversion may be important have asserted that decision makers should be approximately risk neural for the low payoff decisions (involving several pounds) that are typically encountered in the laboratory. The implication that "low" laboratory incentives may be unrealistic and, therefore, not useful in measuring attitudes toward "real-world" risks, is echoed by Kahneman and Tversky (1979). They prescribe the following alternative:

> "Experimental studies typically involve contrived gambles for small stakes, and a large number of repetitions of very similar problems. These features of laboratory gambling complicate the interpretation of results and restrict their generality. By default, the method of hypothetical choice emerges as the simplest procedure by which a large number of theoretical questions can be investigated. The use of the method relies of the assumption that people often know how they would behave in actual situations of choice, and on the

> further situation that the subjects have no special reason to disguise their true preferences." (Kahneman and Tversky, 1979, pg. 265)

Holt and Laury (2002) discovered that at the low payoff level when all prizes were below $4, approximately two thirds of the subjects exhibited risk aversion. With real payoffs, risk aversion increased sharply to when payoffs were scaled up by factors of 20, 50 and 90. The results were quantitatively similar to that reported by Kachelmeier and Shehata (1992) and Smith and Walker (1993) in different choice environments. An implication of the findings was that contrary to Kahneman and Tversky's (1979) supposition, subjects facing hypothetical choices could not imagine how they would actually behave under high incentive conditions. Moreover these differences are not symmetric: subjects typically under estimate the extent to which they will avoid risk. Second the clear evidence for risk aversion even with low stakes suggests the potential danger of analysing behaviour under the simplifying assumption of risk neutrality.

This procedure has been widely employed in the laboratory (*inter alia*. Harrison, *et al*., 2003). It has also been employed by some field experiments to indicate experiments that use laboratory procedures and commodities with field subjects in an artificial setting. For example Harrison *et al*. (2004) examine the behaviour of Danish citizens confronted with an extension of the Holt and Laury (2002) procedure. They find evidence of risk aversion in general, and considerable heterogeneity associated with observable characteristics of the sample.

3.9.2 Instantaneous Decision Making Models

A relatively untouched approach for estimating risk aversion examines an instantaneous decision for measuring risk. One of the benefits of utilising this method is that it reduces the bias resulting from approximation methods.

Eisenhauer and Ventura (2003) used survey data from the Bank of Italy to estimate risk aversion and prudence for a broad cross-section of households. They asked the following question as a means to estimate the coefficient of relative risk aversion:

> *You are offered the opportunity of acquiring a security permitting you with the same probabilities, either to gain 10 million Lire or to lose all the capital invested. What is the most you are prepared to pay for this security?*

However, within this question lies some ambiguity as the 10 million Lire could be interpreted as either a gross gain (ignoring the purchase price) or a net gain (gross gain minus the purchase price). This problem was addressed by estimating both the gross gain and net gain models and using the upper and lower bounds for each parameter.

For the entire sample, the averages for absolute risk aversion ranged from 0.13 to 0.19 for those with health insurance. Greater variability was displayed in the poor health group ranging from 4.5 to 13.84 due to the wide dispersion of socio-demographic groups. The comparison of relative risk aversion across groups were dominated by differences in income e.g. men exhibited less absolute risk aversion than women, but their higher average income gave males greater relative risk aversion.

In absolute terms, the most risk averse groups were those in poor health and those with only an elementary school education; conversely the least risk averse were the college educated and those with health insurance. Individuals holding risky assets (foreign or domestic stocks, loans or managed savings) displayed less absolute risk aversion than those with risky assets.

Movements in prudence appear to track movements in risk aversion quite closely. Absolute risk aversion and absolute prudence are found to be decreasing in education, financial wealth, tangible wealth and income. Conversely relative risk aversion and relative prudence on the other hand are strictly increasing in education, financial wealth, income, household size and the holding of risky assets.

In the net gain model the average length of risk aversion and prudence were approximately 10%-20% lower than the corresponding value of the gross gain model. Otherwise, the patterns observed in the gross model are essentially replicated in the net gain model.

Fellner and Maciejovsky (2002) study the relationship between individual risk attitudes, as inferred by the procedures of certainty equivalents and lottery choices, and market behaviour on an experimental asset market. As the results of elicitation methods are not positively correlated with each other, the two methods yield no unambiguous classifications. Kirchler *et al*. (2001) report findings of an experimental asset market showing that the higher the degree of risk aversion, the lower the total number of contracts concluded, irrespective of the risk elicitation method. In general, the correspondence of certainty equivalents and binary lottery choices was weak, however. Exploring the effect of the binary lottery procedure in an auction, Rietz (1993) shows that observed behaviour does not follow the predictions of expected utility theory. Davis and Holt (1993), and Roth (1995) doubt the usefulness of individual certainty equivalents as meaningful indicators of individual risk attitude, and Selten *et al*. (1999) call into question the usefulness of the binary lottery mechanism to induce risk neutrality. Binary lotteries perform even worse in this respect. El-Sehity *et al*. (2002) examined (i) the stability of individual risk attitude over a time horizon of four weeks and (ii) the correspondence of differential experimental risk elicitation methods. They found that subjects were less inclined to engage in risk-seeking behaviour as measured by certainty equivalents but more inclined to exhibit risk averse behaviour as measured by lottery choices. Thus, in experiments with delayed or no profits at all an increasing degree of "gambling behaviour" can be expected to occur, possibly generating misleading inferences about risk preferences if generalised. Even more fundamentally the results suggest that there is almost no correspondence between the two risk elicitation methods of certainty equivalents and lottery choices, indicating that different elicitation methods yield different risk classifications. This does not only violate the procedural axiom of normative theory, but also questions the general validity of measuring attitudes towards the risk. If so, empirical findings concerning risk behaviour may suffer from the shortcoming of being moderated by the method employed.

3.10 Conclusion and Links to Experimental Design

Against a backdrop of criticism, experimental economics has provided research with a powerful instrument to obtain and discover novel findings about economics that would be otherwise unavailable in the natural world such as the double-auction trading institution. Naturally there are anomalies and inconsistencies in laboratory work but this is only problematic to the extent that actual behaviour is expected to conform to the inelastic framework of theoretical models. However, much of the criticism is unfounded and based around false assertions. Certainly in individual decision making contexts, experimentation has proved to be the instrument of choice for academics and the findings have revolutionised investment decision making contexts, especially in the sunk cost accounting and entrapment literature.

A potential determinant of evaluating investment behaviour under uncertainty is the individual's ability to govern risk. This chapter has sought to explain the individual's attitude to risk and how it can be elicited with the aim to integrate an assessment of a subject's risk propensity for the experiments that encompass this dissertation.

The thread of the research demonstrates the absence of a definitive, robust methodology to elicit attitudes to risk. These methods include survey questions that aim to elicit a direct measurement of individual attitudes; however, as these are hypothetical questions, there is no guarantee hypothetical behaviour will mimic natural behaviour. Other methods include the MPL, which has become the method of choice amongst economists for eliciting risk as it provides a definitive segregation of an individual's attitude to risk. However, even this method can provide inconsistencies in eliciting risk.

First and foremost the experiments in this dissertation concern the effects of sunk costs upon investment decision making. Thus it is desirable that subjects are able to focus on this principal component of the experiments and not be distracted by time consuming attitudes to risk exercises. Under such a parameter, implementing an MPL mechanism would be undesirable for the above reason. A second parameter is that the experiments only require a broad segregation of a subject's attitude to risk: risk averse and "less risk averse". If risk is proven to be a heavily impacted variable upon investment behaviour then a refinement of the risk attitudes may be necessary but for these initial experiments, a broad segregation is adequate. Following this guideline a binary decision making mechanism is suitable. Not only does it provide a simple *A* or *B* answer to the question but it also facilitates an elegant approach of incorporating the sunk cost for Experiment I into the attitude to risk exercise.

The proposition is to compose a binary decision making problem for subjects where they are instructed to invest in one of two oil sites. They are presented with the potential payoffs coupled with the probabilities. The payoffs and probabilities will be manipulated so that the expected return of *A* is equal to the expected return of *B*. However, the variance of *B* will be greater than *A*. Thus it is hypothesised that risk averse individuals will select *A* and less risk averse subjects will nominate *B*. Whichever option is selected that option will become the sunk cost for subjects in the sunk cost group in Experiment I. It will become the sunk cost because they will be informed that the decision they made incurred a loss. Thus they enter the sunk cost component of the experiment with a prior loss. Subjects will then be reintroduced to the same oil site in the experiment, as it is one of the issues which must be negotiated over in the acquisition of the target company.

Chapter 4:

Impact of Sunk Costs on Corporate Acquisition Strategies

4.1 Introduction

In 1998, Blackburn Rovers paid a club record £7.25 million for Kevin Davies. He was considered one of the brightest prospects in English football and a future England player. However, his performances never lived up to the potential. Despite pressure from Blackburn Rovers fans and the media for Davies to be dropped, Blackburn Rovers relied on their sunk costs and escalated their commitment to the player. They included him in the team for much more playing time than his performance justified. After 1 goal in 26 appearances Kevin Davies was sold in a part-exchange deal to Southampton with Egil Ǿstenstad moving to Blackburn Rovers. Ǿstenstad performed extremely well for Blackburn Rovers guiding them to promotion. Davies continued with lacklustre performances for his new team. Southampton's decision to exchange the player was a poor one. Why then did it do so? The answer may focus on the transmission of the sunk costs associated with Davies's transfer fee to Blackburn and then through to Southampton.

The literature survey presented in Chapter 2 emphasised the inability of decision makers to segregate sunk costs from future investment strategies. These strategies are entrenched in cognitive processes including justification (Festinger, 1957; and Staw, 1976), risk seeking in the domain of losses (Bazerman, 1984; Kahneman and Tversky, 1979; and Whyte, 1986), loss aversion (Arkes and Blumer, 1985; Kahneman, 1992; and Tetlock and Boettger, 1994), and anchoring on past data (Neale and Bazerman, 1991; and Tversky and Kahneman, 1974).

These studies contribute to the proposition that contrary to economic theory, the sunk cost phenomenon as a within person operation is pervasive across human decision-making. Beyond this operation, the literature has failed to address how individuals are affected (if at all!) by the sunk costs of others. For example, in the negotiation of a used car, do the vendor's sunk costs influence the buyer's offer? In this context, is the heuristic that sunk cost accounting is irrational and should be ignored correct? Intuitively, in the negotiation of an asset, if the vendor's sunk costs were included in the purchase price, then such information would be pertinent to the buyer's valuation of the asset.

Secondly, in identifying the sunk cost phenomenon, the generic format has been to position individuals in a decision making situation where subjects may be influenced by sunk costs. Subject behaviour is then observed as the experimenter manipulates the situation. So far, the literature has failed to address how sunk costs are treated when individuals have to make several decisions simultaneously. Does the sunk cost have the same impact? If it does is the sunk cost investment "spillover" into the other decisions? For example, in the allocation of future drilling expenditure for five oil sites subject to a budget constraint, assuming all five produce analogous outputs, if one site features a sunk cost, is this sunk cost acknowledged? If so, does this site attract a disproportionate share of the budget compared to the other four, i.e. is there a "spillover" effect?

Thirdly, the literature examines environments where on average subjects exhibit sunk cost accounting. Whilst the literature has documented evidence, (Heath, 1995; Johnstone, 2003) which suggest sunk costs can promote de-escalation, it has not examined the effect of one sunk cost on another. In other words can an unexpected sunk cost from one decision affect investment behaviour when encountering further sunk costs?

Chapters 4 and 5 are in the spirit of the previous three paragraphs. They develop three experiments that contribute a novel dimension to the current sunk cost accounting literature. Chapter 4 develops two experiments which examine (1) the "spillover" effect in a multi-issue negotiation context and (2) the transmission of sunk costs across bidders in a common value first price-sealed bid auction. The objective of these experiments is to examine how sunk costs affect the bargaining strategy of individuals in corporate acquisitions and how third parties react to the sunk costs of others. Chapter 5 develops an experiment where unanticipated portfolio sunk costs affect trading behaviour in an experimental equity market.

Preceding each experiment will be an account of the experimental decision making context. Thus, in this chapter the study of merger and acquisitions will be discussed with reference to the significance of examining sunk costs in such a framework. This is intended to provide the reader with a flavour of the experimental setting and an appreciation of the motivations for studying it.

4.2 The St Andrews Bargaining Championships

As already emphasised in section 4.1, this chapter is concerned with the reporting of two experiments that involve sunk costs in a merger and acquisition process and in a first price, sealed bid auction. These experiments formed the “St Andrews Bargaining Championships” (refer to Appendix A, for details of the event). Subjects were invited to participate in an interactive bargaining tournament through email with monetary prizes being awarded. The first round of the competition was the merger and acquisition experiment, which for simplicity will be referred to from this point as Experiment I and for the same reason, the auction experiment will be coded Experiment II.

4.3 Experiment I: Multi-isuue Negotiations in Mergers and Acquisitions

4.3.1 The Merger and Acquisition Environment

The academic literature surrounding mergers and acquisitions has mushroomed in the last ten years to support the rapid expansion of global activity in this domain. The thread of research mainly aims to identify organisational motives for the pursuit of such a strategy. It is widely accepted the underlying key principle of acquiring another company is to create shareholder value greater than that of the sum of the companies as a separate entity. Other motivations are concerned with increasing or protecting market share, improving shareholder value, deriving cost savings, improving economies of scale or generating new cross-selling opportunities.

In the current financial environment, characterised by buoyant global equity markets, the merger and acquisitions phenomenon indicates no sign of ending. This is surprising given the significant volume of empirical and anecdotal evidence to suggest that over half of mergers and acquisitions result in failure and an even greater proportion fail to create value. An investigation into merger and acquisitions by Mercer Management Consulting in 1997 demonstrated that 48% of mergers underperform the norm/average of their industry after three years. The obvious question is why? The literature concerns itself with theoretical descriptions of these events but little attention has been focused on the decision makers themselves, i.e. the Chief Executive Officer (CEO). Roll (1986) conjectures the decision making of

CEO's could be a key determinant in understanding the significant failure rate of mergers and acquisitions.

"Economists disregard the evidence on individual decision making because it usually has little predictive content for market behaviour. Corporate takeovers are, I believe, one area of research in which this usually valid reaction of economists should be abandoned, takeovers reflect individual decisions." (Roll, 1986, pg. 1999)

Thus, the motivation for pursuing the role of sunk costs in Mergers and Acquisitions is as follows. CEO decision-making strategies could be subject to psychological biases that affect the average individual. More specifically, these psychological biases may promote sunk cost accounting.

CEO tenure has been negatively correlated to poor corporate performance (Parrino, 1997; and Warner, *et al*. 1988). Several studies postulate that CEO's become entrenched during their tenure and a corollary of this is poor corporate performance (Morck *et al*. 1988; and Hill and Phan, 1991). An alternative theory for the low turnover rate is that is takes time to learn about the CEO's true ability (Gibbons and Murphy, 1998). They believe the variance of expected performance diminishes as the board receives signals about the CEO's real ability. This is reinforced by Allgood and Farrell (2000) who postulate down-side performances are tolerable in the CEO's early tenure, but these become unacceptable later in his/her tenure. If CEO's become entrenched then it is possible they could fall prey to sunk cost accounting and entrapment. Certainly the anecdotal evidence presented in Chapter 1 supports this notion.[13] Thus whilst the principle aim of this experiment is to extend the sunk cost literature it could also facilitate the corporate finance literature by documenting the influence of sunk costs in CEO decision making. The intuition is that current CEO's become exposed to sunk cost accounting which generates entrapment and escalation of commitment, thus rendering the CEO with a myopic perspective of the firm.

4.3.2 Experimental Design

This experiment examines an M&A process in the laboratory based on the simplest case of sequential decision-making: a sequence of decisions in two successive periods. More specifically decision making in the face of sunk costs. A contextually rich scenario is implemented to enhance the verisimilitude of the experiment with the aim of facilitating the decision making process as realistic as possible subject to experimentation confines. Many experimental economists believe experiments should be designed within a simple framework. In many contexts such as establishing the general presence of sunk cost accounting in a decision making context it is an appropriate strategy but what these experiments lack is the verisimilitude of natural world experiments. This is one of the principle reasons for experimentation. Laboratory results are trivial (at best!) if they cannot be extended beyond this artificial environment. To generate findings that understand how CEO's behave it is important to design an experiment that is compelling to the subject and engages behaviour that is as realistic as possible to that of an actual CEO. Therefore, all the experiments in this dissertation involve contextually rich scenarios that maintain the necessary

13 For example, the demise of Enron.

control and are engaging investment situations for the subject. This kind of setting is what Hey (1991) believes should be the future of experimentation in economics. "We need to move to more complex decision problems…plunge into the sea of ill-defined experiments…. Well-defined experiments constrain economics to operate within the straitjacket of well-defined worlds, in which the only admissible reason for suboptimal behaviour is poor decision-making ability on the part of economic agents". (Hey, 1991, pg. 228,)

The experiment including all previous and prior communication was conducted through an email interface. The experiment was split into two sections (the experimental structure is illustrated in table 4.1). Section *1* involved an attitude to risk assessment through a simple binary decision game and in section *2*, subjects were invited to play the part of a CEO and asked to submit a takeover bid for a rival company subject to a budget constraint.[14] The bid is a function of five issues: *Share Price*, *R&D* (*Venture A*), *R&D* (*Venture B*), *Level of Debt* and *Number of Overseas Offices to Close*. One of the issues has a sunk cost attached to it and the aim of the experiment was to determine how the sunk cost issue affects the bidding of the other issues. Specifically did the sunk cost "spillover" into the other issues? To address this question the bidding behaviour of subjects with sunk costs was compared against a group of subjects without sunk costs. In addition, to establish the impact attitudes to

14 It should be noted that both experiment I and II conform to an auction environment, i.e. there are n bidders who are asked to place a value v_i and submit a bid b_i. However, the objective of experiment I is to examine the nature of sunk costs in a negotiation setting and an M&A context permits this analysis whilst maintaining external validity. The auction and its design is anticipated has no relevance to subject behaviour and they're bid strategy so an analysis of auctions is deemed unnecessary.
Phillips, Battalio and Kogut (1991) adopt a similar strategy when they address sunk costs in auctions. An account of auctions and theory will be presented in experiment II.

risk and budget constraint had on bidding behaviour two treatment variables were introduced, firstly, assessing subjects' attitude to risk and secondly varying the magnitude of the budget constraint across subjects.

Read Instructions	
Attitude to Risk Assessment	Subjects select which investment opportunity (*A* or *B*) they will invest in
Merger and Acquisition Round 1	Subjects submit a bid for the target company.
Merger and Acquisition Round 2	Subjects are invited to modify their initial bid by one increment +/- in a maximum of three issues.
The winning bidder is paid a payoff which is a non-linear function of the amount bid.	

Table 4.1: ***Structure of the Merger and Acquisition Experiment***

4.3.2.1 Attitudes to Risk and the Sunk Cost (Section *1*)

Section *1* of the experiment established the sunk cost and provided an estimate of the subject's attitude to risk through an uncomplicated binary decision making game (refer to Chapter 3.92 for a detailed description).[15] Subjects were endowed with an initial amount of money (£100,000) that they could invest in one of two investments (*A* or *B*) masqueraded as oil drilling sites. Each site had three possible payoffs and the probabilities of these payoffs were displayed (refer to appendix C). The expected return of the two sites is identical but *B* had a greater variance. It was therefore hypothesised that risk averse subjects would choose *A* and less risk averse subjects would select *B*. Although each investment offers the chance for subjects to make a profit, the investment outcome is manipulated so that all subjects break even or incur a £100,000 loss (net).

Measuring the attitude to risk permits the observation of risk effects in decision-making contexts. Furthermore, in this design it provides a succinct method of incorporating the sunk cost. As subjects selected their preferred oil site they were also initiating their sunk cost. These two oil sites are manifested as two of the issues in the experiment (*R&D Venture A*, and *R&D Venture B*).

4.3.2.2 Break Even versus Loss Condition (Section *1*)

In the binary decision making game subjects were randomly assigned to the break-even condition i.e. the £100,000 invested in an oil site generated a payoff of £100,000 or the loss condition: the £100,000 invested generated no return. In this case subjects started the game with £100,000 less.

This treatment was introduced for two reasons: Firstly, the experiment was concerned with searching for a sunk cost effect and therefore a control measure was required of a "no sunk cost" group to examine inter-investment behaviour. Secondly, this manipulation permitted examination of how the change in endowment affects subjects' risk taking behaviour during the experiment.

---

15 As a robustness test this game was presented to a class of undergraduate economic students. In a sample of 61 subjects, 39 selcted Option *A* and the remaining 22 subjects selected Option *B*.

4.3.2.3 Multi-Issue Negotiations (Section *2*)

In this experiment subjects played the role of a CEO in a multinational oil company who was considering a takeover bid for a rival company. Subjects were endowed with £500,000. For subjects who lost the £100,000 from section *1*, they started section *2* with £400,000 (£500,000 – £100,000). To negate the opportunity of subjects implementing the maximum amount possible across the five issues, subjects were informed that they would receive a real payoff which was negatively correlated with the price they acquired the company for. Thus, the cheaper the acquisition price the greater was the payoff. Secondly, subjects were informed of two rival bidders and the least competitive bid of the three from the 1st round of bidding would be eliminated and excluded from the 2nd round. In actual fact, subjects were not competing against other bidders. The justification for adopting this rationale was two-fold. Firstly eliminating two-thirds of the subject pool after Round *1* would significantly reduce the power of Experiment II (in terms of volume of subjects). Secondly, it was important to the experimental validity that subjects believed they were competing against others because it was hypothesised that this precluded subjects from submitting the minimal bid across issues (i.e. the bid that generates the maximum payoff). From the subjects' perspective this scenario was plausible as the majority of merger and acquisitions involve competing acquiring companies and the object of the experiment is to identify behaviour in such a process. Furthermore, this kind of plausible deception is unlikely to be detected by subjects. As Bonetti (1998) observes: "The typical experimental subject will always attend to cues, information and hunches about features of the experimental design. Deception is a way in which the attention of the subjects can be effectively distracted, thus ensuring that the behaviour which is measured is more natural and spontaneous and less affected and contrived." (Bonetti, 1998, pg. 386)

Under each issue, subjects were confronted with ten values from which they must select their offer. In addition a description of each issue was presented and detailed the following information. Figure 4.1 provides an example.

Firstly*, the strategy to maximise the subjects' payoff*. Subjects were made aware of the optimal bid that would generate the largest payoff for them. In all instances this was the lowest bid. Secondly*, the average decrease per concession.* Subjects knew the average payoff decrease for every concession made and thirdly, *the lower and upper bound limits*.

Issue 1: Future R&D expenditure (Tierra del Fuego). Negotiate future R&D expenditure for drilling at Tierra del Fuego . This is the expenditure you will give to drilling for oil at this site should you take over the company.

Your aim is to minimise the expenditure. Your payoff decreases on average by £2800
.
The expenditures start at £1.25 m and increase in £0.5 m increments to £5.75 m. You must make an offer on this issue between those amounts.

1.25 m, 1.75 m, 2.25 m, 2.75 m, 3.25 m, 3.75 m, 4.25 m, 4.75 m, 5.25 m, 5.75 m.

Figure 4.1: ***Example of information presented to subjects***

Subjects were allocated 15 minutes to submit a bid. Unknown to participants 88% of all bids were accepted and there was no minimum requirement to proceed to the next round.[16] A potential strategy would be to offer a high bid to qualify for the second round and then decrease the bid so as to incur a greater payoff if the bid is accepted. To preclude this behaviour in the second round of bidding, subjects were restricted to manipulating a maximum of three of the five issues by one increment plus or minus of the initial bid.

4.3.3 Experimental Procedure

The experiment was conducted at the University of St Andrews School of Economics and Finance. The subjects were 45 (16 female and 29 male) economics undergraduate students with a median age of 21 (mean = 20.6, standard deviation =1.1 years). The experiment is a computer-based experiment via an instant messenger email interface. Subjects were recruited by offering them the opportunity to participate voluntarily in a paid experiment on decisions under risk. The average time to complete the session was 37 minutes. Subjects were randomly assigned to one of two treatments: Experimental (sunk cost treatment) and Conditional (no sunk cost treatment). The selection of undergraduate economics students was considered (for both the mergers and acquisitions experiment and the subsequent auction experiment) an appropriate sample for the following reasons:

16 88% was chosen to ensure the subject pool was large enough to produce "meaningful" results from

1. Their interest and understanding of mergers and acquisitions could be expected to be greater than that of the average undergraduate student.
2. Their knowledge of mergers and acquisitions could be expected to be reasonably uniform across the group. Thus, their behaviour could be expected to follow rational economic utility optimisation.
3. By incorporating performance in the exercise into financial rewards, meaningful rewards and punishments could be incorporated into the game.
4. Their attention and continuous availability was reasonably assured.
5. Their motivation could be confidently expected on the basis of the engaging tasks the subjects were required to carry out and the competitive spirit encouraged within the experiments.

4.3.4 Competing Hypotheses

This section emphasises the theoretical and experimental literature, which serve as a forecast for the outcomes of Experiment I.

4.3.4.1 The Self-Justification Hypothesis

A major explanation of escalation of commitment derived from cognitive dissonance theory is self-justification theory (Staw, 1976). The self justification hypothesis states that individuals stick to a course of action because they feel the need or desire to

---

experiment II.

justify or rationalise their initial decision in the face of losses. "Put simply, people do not like to admit that their past decisions were incorrect, what better way to reaffirm the correctness of those earlier decisions than by becoming even more committed to them." (Brockner, 1992, pg. 41)

Under the self-justification hypothesis it is conjectured escalation of commitment would occur, i.e. increased risk taking following a loss, and it is expected escalation of commitment to be most pronounced in the less risk averse sunk cost treatment.

In contrast to the other major proponent of escalation of commitment: prospect theory, the self-justification hypothesis predicts variable behaviour in the experimental and conditional treatments. In the case of experimental treatments the investment decision is undertaken freely and with the understanding that adverse outcomes are possible. Such a condition is favourable to the creation of Cognitive Dissonance (Festinger, 1957), which according to self-justification hypothesis promotes a preferential attachment with the initial decision later on. In the case of the conditional treatment, the investment decision results in no sunk cost being incurred. Essentially, in the conditional treatments there is no decision "to be justified" in later decisions. So in these treatments, the motive of self-justification should be absent. If self-justification is the driving force behind escalation of commitment in this experiment, then it is projected any tendency towards escalation of commitment will be more pronounced in the experimental treatment.

Hypothesis 4.1*: Self-Justification*

Escalation of commitment should be absent from the no-sunk cost treatment

A direct consequence of escalation and self justification in this experiment would be for subjects to commit resources in the sunk cost issue to the extent that the surrounding issues are offset to compensate, i.e. the sunk costs of the issue "spillover" across the four remaining issues.

Hypothesis 4.2*: Self justification*

Self-justification will cause subjects to escalate commitment in the sunk cost issue, generating a "spillover" effect across the remaining four issues

4.3.4.2 Escalation of Commitment

Thaler and Johnson (1990) argue that a prior loss decreases an individual's risk taking propensity. There is, however, some evidence, experimental and otherwise, that indicates the opposite behaviour. The psychological literature on escalation of commitment (e.g. Staw, 1997) studies repeated (rather than one-shot) decision making under uncertainty in the face of negative feedback about prior decisions. It documents the tendency to stick to or even intensify risky courses of action (e.g. investment projects) following losses. Contrary to the evidence in Thaler and Johnson (1990), escalation of commitment indicates greater risk taking after a loss than a gain.

One major explanation for escalation of commitment is based on the value function from prospect theory (e.g. Brockner, 1992). Consider the case when subjects use the wealth they bring to the experiment plus any initial endowment in the experiment as the reference point. In this case, any loss during the experiment will be perceived as a loss, not as a reduced gain. The intuition is that due to the convex shape of the value function over losses, following a loss any further losses are not as intense as the initial loss and any gains are particularly welcome as they offset some or even all of the previous losses.

Result 4.1: *If initial wealth serves as a reference point in any decision of the sequence, maximisation of the expectation of an S-shaped value function, that is strictly convex for losses and strictly concave for gains, implies that risk taking after a loss is at least as great as initial risk taking.*

Hypothesis 4.3: *Escalation of Commitment*

A rejected bid in the first period leads to an increase (or no change offer) in the sunk cost issue.

4.3.4.3 Expected-Utility Theory

Under expected utility maximisation prior gains and losses can affect risky choice because any prior outcome changes current wealth, which in turn determines risk aversion. Increased risk taking following a gain is consistent with expected utility maximisation if the utility function exhibits decreasing absolute risk aversion. Increased risk taking following a loss is consistent with expected-utility maximisation if risk aversion is an increasing function of wealth. If risk aversion is constant there is no prior effect of prior outcomes on risky choice.

Without restrictions on the shape of the utility function, expected-utility maximisation is consistent with different kinds of behaviour within a single treatment. Additional restrictions yield sharper predictions. Suppose the following two modifications of the utility function. Firstly a restriction is imposed so that the utility functions of the subjects are “reasonable” in the sense that they represent reasonable preferences over large-scale gambles. Secondly, the utility function is differentiable. These restrictions imply subjects should go for maximum risk in every single decision, a point that is made forcefully in Rabin (2000). This result is just an application of the local risk-neutrality property of expected utility maximisation with a differentiable utility function (Arrow, 1971). Local risk neutrality implies that subjects always take maximum risk in “small” gambles.

Whilst the attitude to risk exercise in the experiment ultimately offers subjects a scenario of “breaking-even” on their £100,000 investment i.e. no gain can be accrued from this exercise in the first round, it should be assumed that only losses can affect risky choice in the second part of the experiment. In this experiment, risky choice would be defined as conceding little to the opponent in the negotiation component of acquiring the target company. Therefore a prior loss in the attitude to risk exercise changes the current wealth of the subject, which in turn determines risk aversion.

Hypothesis 4.4: *Under expected utility maximisation, a prior loss outcome in the attitude to risk exercise will affect negotiation behaviour in the direction of fewer concessions to the subjects' opponents.*

4.3.4.4 Prior Outcomes Influencing Risky Choice

There is documented evidence to suggest that risk taking behaviour is a function of prior monetary gains or losses. Demonstrating this behaviour, i.e. how prior gains and losses can affect an individual's willingness to embrace risk, is the example from Thaler and Johnson (1990)

1. You have just won $30. Choose between:
    (a) A 50% chance to gain $9 and a 50% chance to lose $9 (82%)
    (b) No further gain or loss (18%)

2. You have just lost $30. Choose between:
    (a) A 50% chance to gain $9 and a 50% chance to lose $9 (36%)
    (b) No further gain or loss (64%)

There is a clear influence of prior outcomes on risky choice. Following a gain, a large percentage of subjects are risk-seeking. The gains "desensitise" the individual to future losses. Conversely, after a loss the majority of subjects are sensitive to future investments of a similar magnitude and are risk averse. Thaler and Johnson (1990) interpret their findings as indicating, "a prior gain can increase subjects' willingness to accept gambles. … In contrast, prior losses can decrease the willingness to take risks." (Thaler and Johnson, 1990, pg.643-644).

Thaler and Johnson (1990) coded the phenomenon that prior gains fuel risk taking the *house-money effect*. This precept is so called the house-money effect because it captures the tendency of individuals to be more reckless with future bets with money they have just won in the casino. Conversely, prior losses decrease the willingness to take risk translates into the following hypothesis:

Hypothesis 4.5: *Increased sensitivity following a loss in the attitude to risk exercise propagates small (or zero) concessions in that issue during negotiation.*

A loss in the investment decision game lead*s* to a simple hypothesis regarding the reference point that may explain such behaviour. The initial endowment in the experiment decreases after the initial loss in the investment decision component. Thus subjects in the experimental treatments commence the negotiation component at a loss and subsequently positioned in the "loss part" i.e. the convex part of the value function. This part assumes the mathematical function $v(x) = -\lambda(-x)^{\beta}$ for $x<0$. λ is a loss aversion parameter which is >1 to accentuate the negative aspect of losses. In Experiment I it is conjectured subjects in the experimental treatment adopt this principle and concede little to their opponents in the issue they have just lost money in.

4.3.4.5 Gender Differences

Recent work in experimental economics as well as in psychology and political science, suggests that gender is an important determinant of economic and strategic behaviour. A dominant theme in the literature concerns how men and women behave when confronted with "risky" situations. Women are believed to be more risk averse than their male counterparts in investment decision-making, which is illustrated in the findings of Jiankoplos and Bernasek (1998) and Grable and Lytton (1998). A unified explanation for these differences in risk has yet to be elucidated but it has been postulated that the variation could be a result of genetic makeup, the social environment, or an amalgam of the two (Gutter *et al*. 2003)

A derivative of propensity to risk between males and females is the level of altruism. Females in voluntary public goods games demonstrate this behavioural trait. The evidence in the experimental literature suggests women are more un-selfish than men in the allocation of resources to a public good (Nowell and Tinkler, 1994; and Seguino *et al*., 1996). In ultimatum bargaining Eckel and Grossman (2001) find women are prepared to offer greater capital and are more likely than men to accept a given offer. Furthermore, Eckel and Grossman (1998) claim men accept lower offers from women than they do from men. Solnick (2001) in contrast finds that players of both sexes demand more from women than from men. Both studies found that offers were lower to women than to men, and that offers from women and men were not significantly different.

Other researchers have investigated gender effects in dictator games.[17] Eckel and Grossman (1998a) found that women give more than men in these games, while Bolton and Katok (1995) found no significant difference. Andreoni and Vesterlund (1998) compared gender behaviour in dictator games as the monetary value of the tokens was varied between the players. They found that women gave more overall and demonstrated a greater propensity to divide the tokens more evenly despite different monetary values while men became less generous as the value of their tokens increased relative to the value of the responder's tokens. Finally, Eckel and Grossman (1996) examined gender differences in a punishment game, where subjects could choose to divide evenly a $10 or $12 pie with someone who had previously been ungenerous counterparts by choosing to divide the $8 pie.

As Eckel and Grossman (1999) have observed, the findings regarding gender seem to be conditional on the level of risk present in the experiment. In decisions where risk is involved, such as the proposer in ultimatum games, there appear to be no systematic differences in behaviour across genders. However, for decisions involving no risk such as for dictators or "punishers" women tend to be more generous and socially orientated in their behaviour.

---

17 In the dictator game, one player, the allocator, is given a fixed amount of money to divide between himself and another player, the recipient. The allocator chooses a division, and the money is divided as proposed. This is not a game in a formal sense, but rather an individual decision problem.

In the context of corporate takeovers Cadsby and Maynes (2005) find no significant systematic tendency of females to tender more shares than males in the equal endowment and unequal endowment treatments. Thus in the context of the acquisition experiments designed in this dissertation (Experiments I and II) it is predicted there will be no systematic differences in bids across genders.

Hypothesis 4.6: *There will be no systematic differences in patterns of behaviour or bargaining strategy across genders.*

4.3.5 Results

Ordinary least squares regression analysis (OLS) is used to perform the statistical analysis and is presented in Table 4.2. The regression function is specialised as follows:

$$BIDISSUE_i = B_0 + \beta 1\mathrm{TREATMENT} + \beta_2\, GENDER + \beta_3\, RISK + \varepsilon_i \qquad (4.1)$$

The dependent variable $BIDISSUE_i$ is the bid submitted in each issue and in both periods for every individual. The three independent variables all contain qualitative data regarding the subjects and are hence dummy variables defined as follows:

The *TREATMENT* variable is coded 1 if subjects are assigned to experimental treatment and 0 if assigned to the conditional treatment. *GENDER* variable is coded 1 for males and 0 for females. The *RISK* variable is coded 1 for "less risk averse" subjects and 0 for risk averse subjects.

What is strikingly apparent is the strength of the risk and experimental variables on subjects *own R&D* issue. As expected attitude to risk affected subjects *own R&D* issue, which is the sunk cost issue. Furthermore, the experimental variable had a strong affect on subjects *own R&D*. Risk as an independent variable on subjects *own R&D*, Period1 ($t = 3.37$, $P < 0.01$); subjects *own R&D*, Period 2 ($t = 3.27$, $P < 0.01$); subjects *other R&D* Period 1 ($t =-3.50$, $P < 0.01$); and subjects *other R&D*, Period 2 ($t = -3.83$, $P < 0.01$). The Experimental variable was significant on subjects *own R&D*, Period 1 ($t = 2.31$, $P < 0.05$), *own R&D*, Period2 ($t = -2.50$, $P < 0.05$). In addition, subject's *other R&D* Period 2 was significantly influenced by the experimental variable at the 10% level ($t = -1.55$, $P <0.10$). Gender effects were present in *Closure of overseas offices issue*, Period 1 ($t = -2.35$, $P < 0.05$) and in both periods of the *debt issue* ($t = 2.16$, $P < 0.05$) and ($t = 2.16$, $P < 0.05$). Manipulation checks confirmed none of the independent variables had any effect on the remaining three issues. In contrast to the predicted direction there was no spillover of the sunk cost into the other three conditions.

To understand why there is such a strong experimental influence in subject's own sunk costs the subject's average valuation of every issue for each treatment is examined.

	Independent Variables			
	Treatment	Gender	Risk	Adjusted R-Squared
Price (1)	0.04 (0.32)	0.04 (0.25)	-0.04 (-0.30)	-0.07
Price (2)	0.05 (0.43)	-0.02 (-0.14)	-0.18 (-1.60)	-0.01
R&D Site A (1)	0.02 (0.10)	0.06 (0.26)	-0.15 (-0.66)	-0.06
R&D Site A (2)	0.08 (0.30)	0.05 (0.18)	-0.21 (-0.81)	-0.05
Closure of Overseas Offices (1)	-0.31 (-0.97)	-0.78 (-2.35)**	0.14 (0.46)	0.07
Closure of Overseas Offices (2)	0.12 (0.35)	-0.41 (-1.16)	0.39 (1.16)	-0.00
R&D Site B (1)	0.26 (1.42)	0.22 (1.18)	0.27 (1.51)	0.05
R&D Site B (2)	0.21 (0.99)	0.28 (1.30)	0.21 (1.02)	0.01
Debt (1)	0.06 (0.32)	0.39 (2.16)**	0.01 (0.07)	0.04
Debt (2)	-0.04 (-0.25)	0.40 (2.16)**	0.12 (0.66)	0.05
Own R&D (1)	0.52 (2.31)**	0.37 (1.58)	0.75 (3.37)***	0.26
Own R&D (2)	0.55 (2.50)**	0.30 (1.28)	0.72 (3.28)***	0.25
Other R&D (1)	-0.33 (-1.98)	0.11 (0.46)	-0.74 (-3.50)***	0.21
Other R&D (2)	-0.45 (-1.55)*	0.05 (0.24)	-0.88 (-3.83)***	0.27

Table 4.2: ***Ordinary Least Squares Regression Statistics for Experiment I***

Specified as follows: $BIDISSUE_i = B_0 + \beta_1 TREATMENT + \beta_2 GENDER + \beta_3 RISK + \varepsilon_i$

This table displays ordinary least squares regression statistics for the experiment. The statistics are calculated by regressing each of the 5 issues in Period 1 and Period 2 against three independent variables, which are dummy variables: gender treatment and risk. For each independent variable, the coefficient, (t-statistic), and significance level is reported coupled with the adjusted R Square.

***** = significant at 1% level**
**** = significant at 5% level**
*** = significant at 10% level.**

Table 4.3 reports the average bid across issues in Periods 1 and 2 for subjects in the risk averse experimental treatment. In addition, the percentage increase in the bid across periods is also displayed coupled with its t-statistic. Figure 4.2 provides the average bids across issues represented as the concession ranking. It is strikingly apparent that subjects in their sunk cost issue (*R&D, venture A*) are prepared to concede much less to the vendor. To recap, a concession ranking of 1 equates to the bid that generates the maximum payoff for a given issue, and 10 equals the bid that yields the minimum payoff, but is the largest bid. Thus subjects require a greater payoff in this issue to offset the money lost in section *1* of the experiment. In the other four issues, the general strategy is to submit a bid that is approximately around the mid-concession point (Concession Ranking 5) and to increase the bid up to concession ranking 6 in the second period. Thus non-significant differences across these issues are observed.

	R&D Venture A £(million)	R&D Venture B £(million)	Price/Share £	Number of Overseas Offices to Close	Level of Debt £(million)
Period 1 Mean	2.32	4.4	1.80	1.50	2.63
Period 2 Mean	2.56	4.64	2.00	1.36	2.70
% Increase	9.23	5.52	11.11	-9.52	2.86
t-statistic	0.92	1.05	1.31	0.35	0.37

Table 4.3: ***Statistics for Risk Averse/Experimental Treatment***

This table displays the mean bid in the experimental treatment across the five issues in Period 1 and Period 2. In addition its percentage (in brackets) of the maximum bid possible is illustrated. The percentage increase is the mean increase in each issue from Period 1 to Period 2

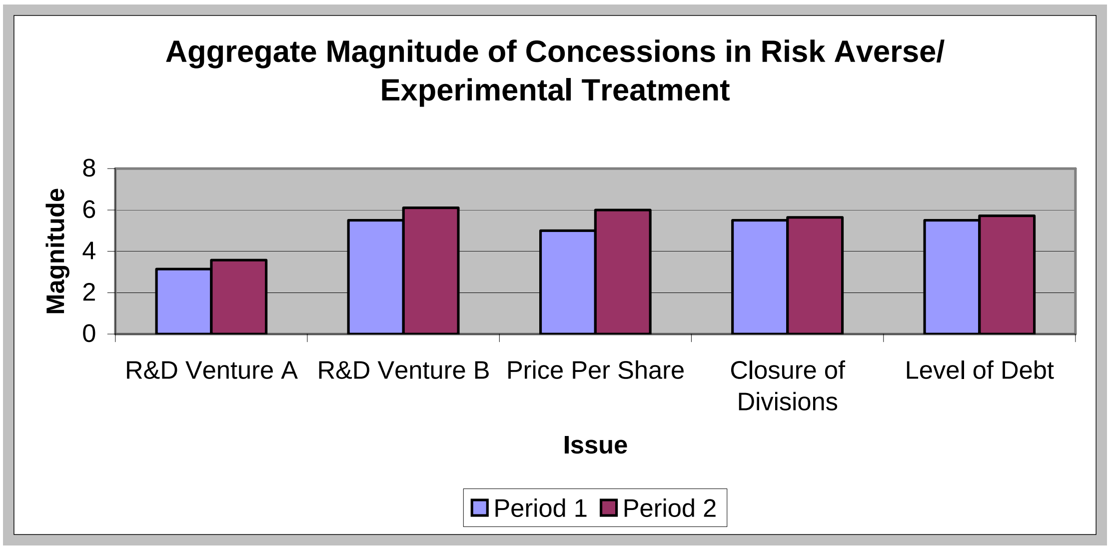


Figure 4.2: ***Magnitude of Concessions in Risk Averse/Experimental Treatment***

This chart displays the magnitude of concessions of the Risk Averse/Experimental Treatment. For each issue, subject's are confronted with ten concessions of which they must pick one to submit their bid. The Magnitude axis illustrates how much of a concession the subject's make in both periods. The greater the magnitude the, the greater the concession, and thus the smaller the payoff.

The differences in risk averse/conditional treatment are evident. In this treatment subjects broke even on their investment from the attitude to risk exercise. Table 4.4 reports subjects on average constructed a bid that was approximately the mid ranked concession in each issue. This is certainly in line with theoretic predictions. Subjects have engaged no sunk costs and therefore have no incentive to deviate away from the middle concession. This confirms the findings from Table 4.4, which reports differences as significant. As with the previous treatment, subjects increase their concessions from Period 1 to Period 2, which is in line with predictions.

	R&D Venture A £(million)	R&D Venture B £(million)	Price /Share £	Number of Overseas Offices to Close	Level of Debt £(million)
Period 1 Mean	3.02	3.91	1.89	1.73	2.55
Period 2 Mean	3.25	4.24	2.02	1.18	2.74
% Increase	7.52	8.37	6.73	-50	7.50
t-statistic	0.75	1.05	1.12	1.44	0.75

Table 4.4: ***Statistics for Risk Averse/Condition Treatment***

This table displays the mean bid in the conditional treatment across the five issues in Period 1 and Period 2. In addition its percentage (in brackets) of the maximum bid possible is illustrated. The percentage increase is the mean increase in each issue from period 1 to period 2.

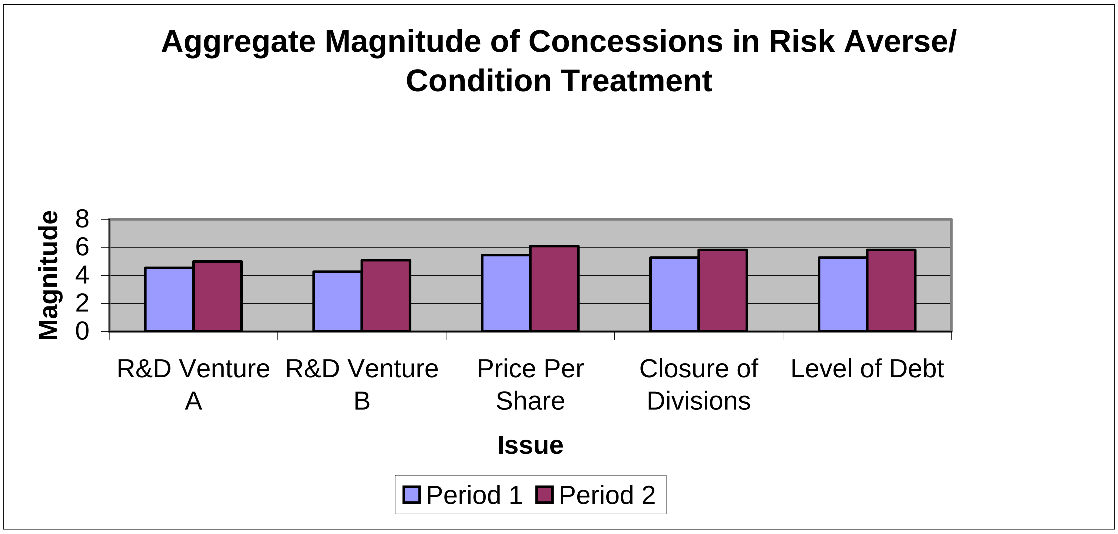


Figure 4.3: Magnitude of Concessions in Risk Averse/Conditional Treatment

This chart displays the magnitude of concessions of the Risk Averse/Conditional Treatment. For each issue, subjects are confronted with ten concessions from which they must pick one to submit their bid. The Magnitude axis illustrates how much of a concession the subject's make in both periods. The greater the magnitude, the greater the concession, and thus the smaller the payoff.

Next consider the "less risk averse"/experimental treatment. Analogous to the risk averse/experimental treatment, subjects "irrationally" concede less in their own sunk cost issue (*R&D Venture B*). This is in accordance with expectations, i.e. subjects require a greater payoff in this issue to recoup the loss from Section *1* of the experiment. Likewise, with the risk averse/experimental treatment, subjects display non-significant deviations away from the mid-ranked concessions across the remaining four issues.

	R&D Venture A £ (million)	R&D Venture B £ (million)	Price per Share (£)	Number of Overseas Offices to Close	Level of Debt £ (million)
Period 1 Mean	3.43	3.25	1.98	1.82	2.58
Period 2 Mean	3.75	3.36	2.00	1.64	2.77
% Increase	9.27	3.35	0.92	-10.00	7.45
t-statistic	0.98	0.37	9.22E-01	0.34	0.64

Table 4.5: ***Statistics for "Less Risk Averse"/Experimental Treatment***

This table displays the mean bid in the experimental treatment across the five issues in period 1 and period 2. In addition its percentage (in brackets) of the maximum bid possible is illustrated. The percentage increase is the mean increase in each issue from period 1 to period 2.

Table 4.6 reports the "Less Risk Averse"/Conditional Treatment. These results are analogous to the risk averse/condition treatment. Subjects submit a bid composed of concessions in the range of 4-6 (order of magnitude) across the five issues in accordance with theory as zero sunk costs have been initiated. Magnitude of concessions increases across periods.

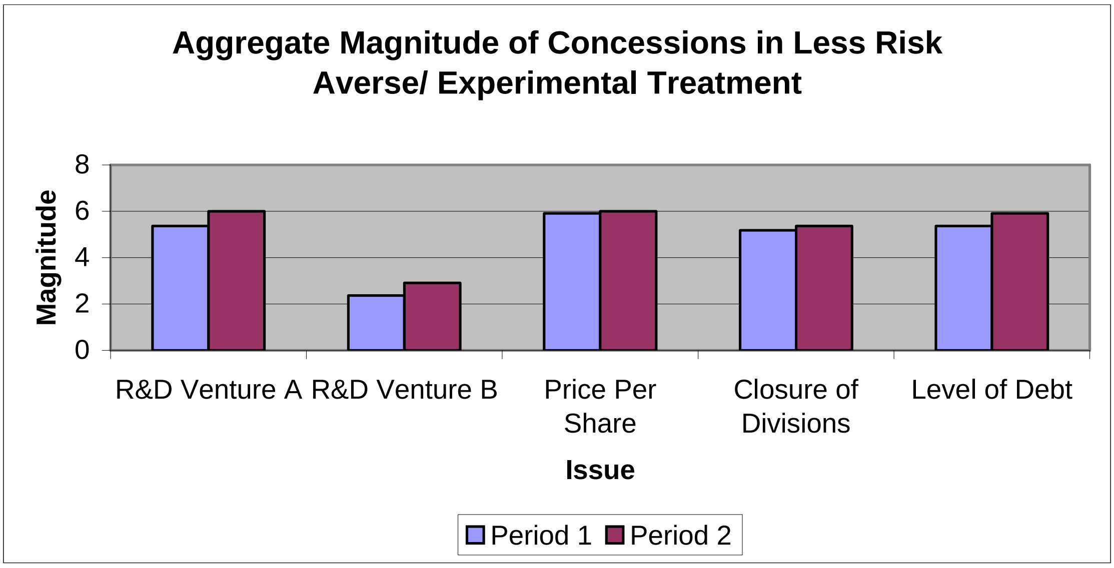


Figure 4.4: ***Magnitude of Concessions in Less Risk Averse/Experimental Treatment***

This chart displays the magnitude of concessions of the Less Risk Averse/Experimental Treatment. For each issue, subjects are confronted with ten concessions from which they must pick one to submit their bid. The Magnitude axis illustrates how much of a concession the subjects make in both periods. The greater the magnitude the, the greater the concession, and thus the smaller the payoff.

	R&D Venture A £ (million)	R&D Venture B £ (million)	Price per Share (£)	Number of Overseas Offices to Close	Level of Debt £ (million)
Period 1 Mean	3.19	3.63	1.80	1.88	2.54
Period 2 Mean	3.25	3.88	1.85	1.88	2.67
% Increase	1.96	2.74	2.78	0.00	5.17
t-statistic	0.19	0.34	0.23	0.00	0.39

Table 4.6: ***Statistics for "Less Risk Averse" Conditional Treatment***

This table displays the mean bid in the experimental treatment across the five issues in period 1 and period 2. In addition its percentage (in brackets) of the maximum bid possible is illustrated. The percentage increase is the mean increase in each issue from period 1 to period 2.

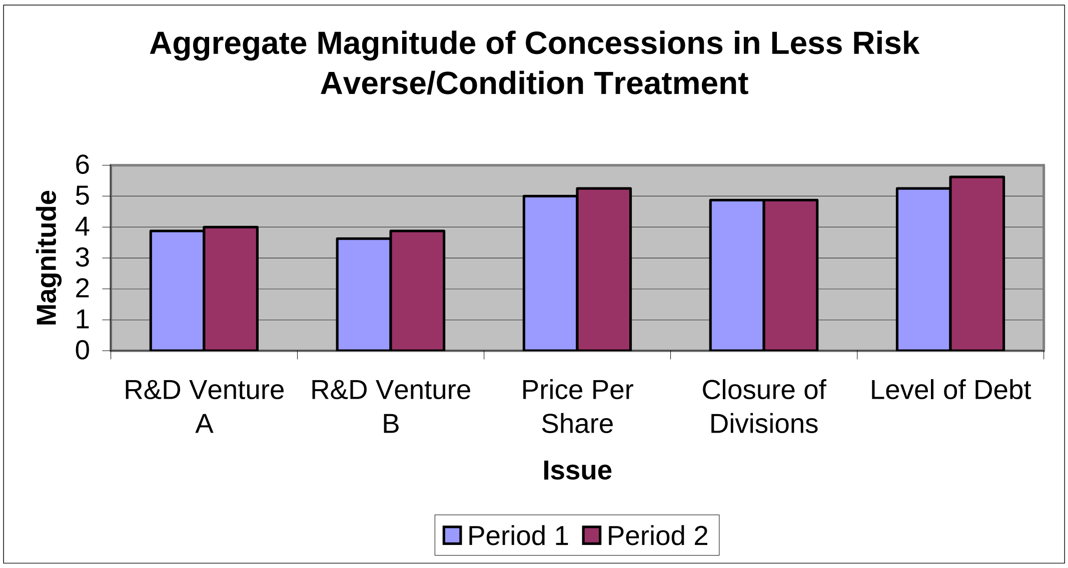


Figure 4.5: ***Magnitude of Concessions in Less Risk Averse/Conditional Treatment***

This chart displays the magnitude of concessions of the Less Risk Averse/Conditional Treatment. For each issue, subjects are confronted with ten concessions from which they must pick one to submit their bid. The Magnitude axis illustrates how much of a concession the subjects make in both periods. The greater the magnitude, the greater the concession, and thus, the smaller the payoff.

4.3.5.1 Probit Model

To evaluate the effects of independent variables upon concession ranking, a probit regression model was developed under the following equation:

$$BIDISSUE_i = \mathrm{B}_0 + \beta 1\mathrm{TREATMENT} + \beta_2\, GENDER + \beta_3\, RISK + \varepsilon_i \quad (4.2)$$

This model incorporated identical independent variables as the ordinary least squares model (treatment, gender, risk and a constant error term) but the dependent variable which was $BIDISSUE_i$ was coded 1 for a bid that was in concession ranking (1-5) and a 0 for concession ranking 6-10. Thus, the results are displayed in Table 4.7.

Findings suggest that subject's own R&D issue in both periods was significantly influenced by the experimental variable (whether subjects were consigned to the *no sunk cost group*, or *sunk cost group*). For subject's own R&D, Period 1 ($t = 2.24$, $P < 0.05$) and Period 2 ($t = 2.67$, $P < 0.01$).

	Own R&D (1)	Own R&D (2)	Other R&D (1)	Other R&D (2)
Experimental	0.30 (2.24)**	0.37 (2.67)***	0.02 (1.07)	-0.03 (-0.29)
Gender	0.19 (1.33)	0.23 (1.53)	-0.04 (-0.35)	-0.00 (-0.04)
Risk	0.08 (0.58)	0.01 (0.08)	-0.11 (-1.14)	-0.06 (-0.57)
Adjusted R-Squared	0.08	0.12	-0.04	0.06

Table: 4.7: ***Probit Regression Results***

This table displays probit statistics for the experiment. The statistics are calculated by regressing each of the 5 issues in period 1 and period 2 against three independent variables, two of which are dummy variables: experimental and risk. For each independent variable, the coefficient, (t-statistic), and significance level is reported coupled with the adjusted R Square.

***** = significant at 1% level**
**** = significant at 5% level**
*** = significant at 10% level.**

4.3.6 Discussion

The experiment was designed to address two questions. In a multiple issue negotiation context, do sunk costs from one issue "spillover" into others and if they do what factors influence this? The experiment reports no "spillover" of the sunk cost into other issues but what is demonstrated is that subjects base their bid around the sunk cost issue by requiring a greater payoff in the sunk cost issue relative to the other four. This strongly depends upon the attitude to risk of the individual and is independent of demographic information such as age and gender.

Consistent with expectations, attitude to risk affected individual's own R&D issue. Results show that risk averse subjects committed greater resources to their sunk cost issue than the "less risk averse" subjects. On the face of it this behaviour would appear quite irrational. Subjects were given similar information regarding each of the issues. If the subjects ignored sunk costs, they should have made similar offers across all five issues.[18] This pattern was only observed in three of them. Subjects offered significantly lower bids in the sunk cost issue, suggesting the subjects were aware of the money they had lost in the preliminary game (Section *1*) and this subsequently influenced their bidding strategy.

The findings of this behaviour make sense in the light of the literature on escalation of commitment. In the experimental treatments where the initial attitude to risk exercise is also an initiation of a sunk cost there is strong escalation of commitment by trying to acquire the firm with a "non-competitive" bid in the sunk cost issue which equates to a small concession to the subject's opponent. Furthermore, this escalation is reinforced by only a small average increase from Period 1 to Period 2. In the conditional treatments where there is no sunk cost carried over to the negotiation stages of the game, there is no escalation of commitment.

18 Of course, subjects could display idiosyncratic preferences over one issue. However, at the aggregate level it is hypothesised that these preferences would offset each other.

There are different explanations for escalation of commitment. Most prominent are the self-justification hypothesis and framing effects based on prospect theory. However, escalation of commitment in this experiment does seem to be driven by the desire for self-justification rather than prospect theory.

Although this behaviour can seem irrational it is consistent with self justification theory (Rubin and Brockner, 1975; Staw, 1976; and Tegar, 1980). This theory acknowledges the desire of individuals to persevere in a chosen course of action when previous expenditures in the chosen decision have not produced the desired outcome. This theory is widely accepted and there is much evidence to suggest that it is ubiquitous in managerial decision-making (Rubin and Brockner, 1975; Staw, 1976; Tegar; 1980, Brockner, 1992; and Monk, 1999).

4.3.6.1 Alternative Explanations

The results are open to alternative explanations. Perhaps the behaviour in the experimental treatment reflects a belief that a loss in the investment decision game signals a “weak investment”. Thus, when it comes to the negotiating component the behaviour is to concede little as they have already lost money in this venture and don’t want to bid high in this issue.

Contrary to expectations no “spillover” effect was found across the issues. There are several explanations that could account for this. One is that the sample size was not sufficiently large to detect such an effect. Another could be to analyse the “spillover” effect on issue-issue. It is not inconceivable that the negative and positive "spillovers" cancelled themselves out producing a zero "spillover" effect. As a redesign, the number of issues could be reduced to three, especially eliminating the closure of overseas offices issue. This issue is contextually separate from the other four.[19]

Whilst subjects were explicitly instructed to treat the five issues as components of one bid they may have isolated and evaluated each issue independent of the other four. This would certainly preclude the event of a "spillover" effect.

4.3.6.2 Challenges

The results can be challenged within the following parameters: Firstly, there was no capacity for subjects to learn during the experiment, and secondly the experiment lacked the verisimilitude of "real" monetary losses.

Subjects participated in only one sequence of two periods. They were not given the opportunity to become acquainted to the experimental set-up and through trial rounds and there was no learning from "prior plays". Note that all experimental treatments are the same in this respect, but there may still be a concern to what extent behaviour in the experiment reflects deliberate choice or just confusion.

19 In the sense that the remaining four issues are concerned with monetary valuations.

Repetitions were precluded in the design so as to avoid tiring the subjects by asking the same (or very similar questions) over and over again. This means however, that the data fails to permit analysis on the question of learning. However, previous experimental work that has used similar set-ups with many repetitions concluded that there was non-significant behaviour from "early plays" to "late plays."

Finally, the experiment does not involve real losses in the sense that it was not possible that subjects do not encounter downside risk and thus it was impossible for subjects to leave the experiment at a loss. It is plausible that risk-taking behaviour is influenced by whether real losses in this sense are possible.

4.3.6.3 Relation to Pre-Existing Evidence

This experiment demonstrates that sunk costs influence decision-making in multi-issue negotiations and the extent of the escalation depends upon the individual's propensity to risk. As the statistics illustrate, the results are significant so there is a degree of confidence in the validity of results in the context of the experiment. Using negotiations within a corporate acquisition context provides a novel and elegant approach to investment decision-making in the face of sunk costs and as a consequence there is little literature to directly compare findings. Fundamentally subjects demonstrated sunk cost accounting, a phenomenon frequently documented in decision-making literature. So, to that extent subjects in this experiment were well calibrated relative to previous findings.

The experiment reinforces the entrenchment of CEO's that fall prey to irrational decision-making. From a policy perspective shareholders and board of directors should monitor the CEO and he or she should be made accountable for decisions that produce adverse performance. This is particularly pertinent in the early stages of CEO tenure as irrational decision-making that isn't criticised in the early stages is very likely to occur again at a future date.

4.4 Experiment II: First-Price, Sealed-Bid Auction

4.4.1 Experimental Design

This study examines a simple case of bidding strategy within the framework of a first price sealed-bid common-value auction. First it is necessary to establish what an auction is. "An auction is a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from the market participants." (McAfee and McMillan, 1987, pg. 700). In this arena a number of potential agents compete for a valuable asset. The agents' bid is a function of public and private information about the asset. Potential buyers submit sealed bids and the highest bidder is awarded the item for the price he/she bid. The study of auctions is highly desirable for their application to theoretical, empirical and practical work (Klemperer, 1999). Auctions provide a platform for the exchange of assets between buyers and sellers in a number of contexts. These include the sale of houses, cars, and livestock. Governments sell firms for pending privatisation as well as treasury bills and foreign exchange currency. Finally, the release of companies for takeover is conducted by auctions.

This study focuses on whether bidders' strategies and decisions are based on their competing bidders' sunk costs. Identical to Experiment I, a contextually rich scenario to capture external validity was adopted. Subjects are again invited to play the role of a CEO and asked to submit a bid for a rival company based upon information provided and a budget constraint. A synopsis of the stages of the experiment are presented in Table 4.8

Read Instructions	
Pre-bidding question	Subjects are offered the opportunity to purchase a more accurate valuation of the asset.
Bid-submission	Subjects invited to submit a bid for the asset.
The winning bidder is paid according to the amount bid.	

Table 4.8: ***Overview of Experiment II***

Upon reading the description of the experiment subjects were offered a range estimate of what the target company is worth to them.[20] Alternatively for £0.5million they could purchase a specific point value of what the target firm was worth.

Subjects were made aware prior to bidding whether opposing bidders purchased the point valuation or not. The area of interest is whether the purchase of the point valuation (the sunk cost) affects the bidding strategies of the subjects. Specifically are sunk costs transmitted across bidders? The transmission of sunk costs across individuals is an important concept to isolate for the following reasons: It could be a pertinent instrument in bargaining and negotiating contexts and in auction strategies if an agent is aware of their rivals' sunk costs. Symmetrically, it has benefits to the seller. Making the buyer aware of your sunk costs may assist in raising revenue for the selling asset. To address this, bidding behaviour was compared of subjects whose opposing bidders had purchased information against those who hadn't.

4.4.1.1 Attitudes to Risk

As all the subjects in Experiment II had participated in Experiment I, the subjects' attitude to risk had already been determined. Measuring the attitude to risk permitted observation of the effects of risk in a bidding context. However, unlike experiment I, the subjects' budget constraint for bidding was independent of the outcome of the attitude to risk exercise.

4.4.1.2 Information versus No Information Condition

In this experiment, subjects were randomly assigned to the information condition i.e. subjects opposing bidders would all purchase the information (*information* condition) or all reject it (*no information* condition). The latter treatment was introduced because the experiment intended to examine the presence/absence of a sunk cost effect and therefore a control of a "no sunk cost" group to determine whether inter-investment behaviour was required.

4.4.1.3 The Sealed-Bid, First-Price Auction

Subjects were presented with a scenario that positions them as the CEO of a multinational groceries company. This company is formulating a bid for the subsidiary of a rival company that has recently been forced into liquidation. Subjects

20 For example the company is worth £3.2-3.7 million.

were endowed with £5 million and were awarded a payoff, which was negatively correlated with the price they acquire the company for i.e. the cheaper the price, the greater the payoff. If they didn't win the auction they would receive nothing. Subjects were provided with information detailing the current ownership of the company and its financial uncertainty, hence it being a suitable takeover target coupled with a range estimate of £0.4 million (for example £3.6-£4.0 million) of what the company was worth.[21] For an extra £0.5 million they could purchase information providing a single point valuation of the company. It was important that some "less risk averse" subjects would perceive the £0.5 million as too costly and not purchase but at the same time it was hoped a proportion of the subject pool would invest in the information to achieve the broadest spectrum of behavioural findings possible.

Subjects were allocated five minutes to read the information and to declare their intentions, i.e. whether they would or would not purchase the information. Once this decision had been reached subjects were notified whether opposing bidders had purchased the information. They were then allocated a further 5 minutes to table a bid. There was only one round of bidding.

4.4.2 Experimental Procedure

The experiment was conducted at the University of St Andrews School of Economics and Finance. The subjects were 40 male and female undergraduates mostly majoring

21 For the experimental information please refer to appendix B.

in economics with an average age of 21.2 (standard deviation of 1.6). The experiment is a computer-based experiment via an instant messenger email interface. This experiment formed the 2^{nd} round of the St Andrews Bargaining Championships. Successful students from the first experiment were permitted to compete in Experiment II.

4.5 Competing Hypothesis

4.5.1 Fundamental Auction Models

Auctions assume several guises and the format of an auction is often dependent on the composition of the selling asset. Traditionally an auction will conform to one of the following four formats: English auction, Dutch auction, sealed-bid, first-price and sealed-bid, second-price. This experiment adopts a First-Price, Sealed-Bid Auction. In such an auction the $N > 1$ (N = number of bidders) bidders submit a sealed bid. The asset is awarded to the highest sealed bid and the bidder is requested to pay a value equal to the submitted bid.

There are two well-documented models in the auction literature: the *independent private-value model* and *the common-value model*. In a private value model, the accepted definition is: "each bidder knows how much she values the object for sale, but her value is private information to herself." (Klemperer, 1999, pg. 233). The common value auction assumes "the actual value is the same for everyone, but bidders have different private information about what that value actually is."(Klemperer, 1999, pg. 233). The differences in the models represent the differences in the bidders' valuation of an asset. McAfee and McMillan (1987) mathematically illustrate the foregoing statement. Firstly in the independent private value model, a bidder i, $i = 1, \ldots, n$, will draw his/her valuation v_i from a probability distribution F_i. Only the bidder observes his/her valuation v_i but all bidders are aware of the probability distribution F_i. All the valuations are statistically independent from any other bidder's valuation. In the common-value model, the asset will have an objective value but bidders are unaware of what this value is and therefore speculate on the value. Take V as the unobserved true value, then bidders' perceived values v_i, $i = 1, \ldots, n$, are independent draws from a probability function $H(v_i | V)$. All bidders are aware of the distribution H.

4.5.2 Determining the Experimental Model

In order to understand and hypothesise how subjects will behave in the auction experiment it is necessary to assign the theoretical model, which most closely corresponds to the experimental model. The central feature of the experiment is the absence/presence of asymmetric information across bidders. As there are two manipulations of the experimental design the subjects rival bidders will either (1) all purchase the extra information (sunk cost treatment) or (2) will all accept the basic, free information (condition treatment). Therefore, as the subjects' themselves have the option of purchasing the extra information within each manipulation treatment, there are four possible configurations that a subject and his or her competing bidders will conform to. These are illustrated in Table 4.9.

In the spirit of the preceding statements, this experimental auction conforms to the common value auction or a derivative of it dependent upon the manipulation observed. In Manipulations (1) and (4), the auction will correspond to a pure common value auction as all bidders (the subjects and rival bidders) have access to identical information. In Manipulation (2), asymmetry of information exists across bidders as the subjects have purchased a more precise valuation. In situations where small asymmetries exist between bidders the auction conforms to an *almost common value model*. (Klemperer, 1999) This model assumes that with $n + 1$ bidders, n bidders have symmetrical information. Thus, this derivative of the common value auction does not extend to an auction where there are n bidders and n-1 bidders have symmetrical information. This situation characterises manipulation number (3). As such there have been no prior explanatory mechanisms to document how one bidder will bid when all opponents have an information advantage.

Manipulation	Subject's Option	Rival's Option
1	Purchase Information	Purchase Information
2	Purchase Information	No Purchase
3	No Purchase	Purchase Information
4	No Purchase	No Purchase

Table 4.9: ***Possible Permutations of Treatment Manipulation***

This section will systematically present theoretical literature on the common value and almost common value auctions with a reference to the relation to the experimental auction design. Experiment II is concerned exclusively with buyers' strategies and as a consequence the theory and literature pertaining to selling strategies in auctions will be precluded from this dissertation.[22]

4.5.2.1 The Common Value Auction

The common-value auction involves firms bidding for an item of unknown common value. Since the value of the item is unknown, the winner's bid can exceed the value and thereby lose money. A corollary of this is what has been described in the literature as the *winner's curse*. Originally used to explain offshore oil valuations in the 1950's, it is today frequently used to explain bidders' behaviour in initial public offerings (IPOs). The winner's curse occurs if the winners of auctions systematically bid above the actual value of the objects and thereby systematically incur losses. The phenomenon has been observed in the bidding for natural resources such as mineral rights where the value of the mineral is unknown but each firm has an estimate of the value. In addition observations have been cited in auctions for book publication rights (Dessauer, 1981), and professional baseball's free agency market (Cassing and Douglas, 1980; and Blecherman and Camerer, 1998). Roll (1986), links the winner's curse to takeover attempts in corporate acquisitions, posting decision makers in acquiring firms pay too much for their targets on average. However, due to the reliability of field data, economists fail to acknowledge the existence of the winner's curse exclusively upon these observations.

22 For a review on the literature of sellers strategies, refer to McAfee and McMillan (1987)

The inherent ambiguity of field data provided the motivation for experimental studies of the winner's curse. Early experiments confirmed the presence of the winner's curse (Bazerman and Samuelson, 1983; Kagel and Levin, 1986; and Kagel *et al.*, 1989). In fact the winner's curse has been such a pervasive phenomenon in the laboratory that most of these initial experiments have focused on its robustness and the features of the environment that might attenuate its effects.

Bazerman and Samuelson (1983) present the seminal experimental analysis of the winner's curse. Using MBA students, subjects were invited to value a series of four jars, each containing goods exclusive to that jar. Unknown to the subjects, each of the jars was valued at $8.00. In addition to the valuation, subjects were requested to provide a best estimate of the value of the goods coupled with a 90% confidence interval bound around these estimates.

Results exhibited an average value of $5.13 ($2.87 lower than the true value). In contrast the average winning bid was $10.01 ($2.01 greater than the true value). Further winning bids were higher than the true value in approximately half of all the auctions.

At the individual level, bids were positively related to individual estimates conforming to an adverse selection problem.[23] Regression analysis of the average winning bid generated the result that winning bids were positively and significantly related to the number of bidders in the auction and winning bidders are more aggressive than other bidders.

The results explained the winner's curse could be easily observed in an experimental setting. However, economists have questioned the external validity of the results objecting to subjects with no prior experience and no feedback regarding outcome of decision.

Kagel and Levin (1986) sought to reconcile these objections by implementing a series of auction experiments incorporating feedback regarding outcomes. Bidders were given a cash balance from which losses and profits could be subtracted/added. In contrast to Bazerman and Samuelson (1983), Kagel and Levin (1986) opted to control for uncertainty as opposed to observing it. This was implemented by randomly choosing a variable x_0, from a distribution of $[\underline{x}, \bar{x}]$.

Under the assumption of symmetric information each bidder observes a private signal x which is independently drawn from a distribution over the interval $[x_0 - \varepsilon, x_0 + \varepsilon]$ where ε is a known positive number set by the experimenter. In a first-price, sealed bid auction bids are ranked from highest to lowest with the high bidder paying the amount bid and earning profits equal to $x_0 - b_1$, where b_1 is the highest bid. Losing bidders receive zero.

---

23 Adverse selection describes the market process in which bad results occur due to information

In this design the strategy of bidding, max $[x-\varepsilon,\underline{x}]$, is a risk free strategy that fully protects the bidder from negative earnings since it is the lower bound estimate of x_0 which was computed for subjects along with an upper bound estimate of x_0, ($\min[x+\varepsilon,\bar{x}]$). Following each auction bidders were provided with the complete set of bids, listed from highest to lowest, along with the corresponding signal values, the value of x_0 and the earnings of the high bidder.

4.5.2.2 Theoretical Considerations

Wilson (1977) was the first to develop the Nash equilibrium solution for the first-price common-value auctions and Milgrom and Weber (1982) provide significant extensions and generalisations of the Wilson model. The following analysis is restricted to signals over the interval $[\underline{x}+\varepsilon\langle x\rangle\bar{x}-\varepsilon]$ where the bulk of the observations lie. Within this region, bidders have no end point information to help in calculating the expected value of the item.

For risk neutral bidders the symmetric risk neutral Nash Equilibrium bid function ă(x) is given by

$$\breve{a}(x) = x - \varepsilon + h(x) \qquad (4.3)$$

---

asymmetries between buyers and sellers.

$$h(x) = [\frac{2\varepsilon}{(n+1)}]\exp[-\left(\frac{n}{2\varepsilon}\right)\left(x - (x+\varepsilon)\right)] \tag{4.4}$$

In common value auctions bidders usually win the item when they have the highest or one of the highest estimates of value.

$E[x_o \mid X=x_{1n}]$ to be the expected value of the item conditional on having x_{1n}, the highest among n signal values. For signals in this region:

$$E[x_o \mid X=x_{1n}] = \left[\left(\frac{n-1}{n+1}\right)\right]\varepsilon \tag{4.5}$$

This provides a convenient measure of the extent to which bidders suffer from the winner's curse since auctions in which the high signal holder always wins the item, as bidding above $E[x_o \mid X=x_{1n}]$ result in negative expected profit. Further with zero correlation between bids and signal values, if everyone else bids above $E[x_o \mid X=x_{1n}]$, bidding above $E[x_o \mid X=x_{1n}]$ results in negative profit as well. As such, if the high signal holder frequently wins the auction, or a reasonably large number of rivals are bidding above $E[x_o \mid X=x_{1n}]$, bidding above $E[x_o \mid X=x_{1n}]$ is likely to earn negative expected profit.

Recall that within this region, $(x - \varepsilon)$ is the smallest possible value for x_0, and that x is the unconditional expected value of x_0 (the expected value, *independent* of winning the item), so that the expected value conditional on winning must be in-between (x -

ε) and x. Thus from equation 4.5 it is clear that the amount bids ought to be reduced, relative to signal values (the "bid" factor), just to correct for the adverse selection effect from winning the auction, is quite large relative to the range of sensible corrections ε: with n = 4 the bid factor is 60% of ε and with n = 75% of ε. Put another way, for signals in the region 2 the risk neutral Nash equilibrium function is well approximated by ă(x) = x - ε (the negative exponential term $h(x)$ in equation 4.4, approaches zero rapidly as x moves beyond $\underline{x}+\varepsilon$). Thus the bid factor required just to avoid losing money, on average, represents 60% of the total bid factor with n = 4, and 75% with n = 7. Equation 4.5 also makes it is clear that the correction for the adverse selection effect is relatively large and increasing with increases in the number of bidders.

Strategic considerations account for the rest of the bid factor, $\frac{2\varepsilon}{(n+1)}$. The strategic element results from the fact that if just correcting for the adverse selection effect, the winner would earn zero expected profits, which is not a very attractive outcome. As such, a bidder would find it profitable to lower her bid from this hypothetical benchmark (Equation 4.5) since zero expected surplus is lost by doing so even if this causes her not to win the item, and strictly positive expected surplus is awarded should she win the item with the lower price. The interplay of these strategic considerations between different bidders results in the additional discounting of bids relative to signal values beyond equation 4.5.

In Manipulation Treatment 4, (where no subject or rival bidder purchases the point estimate information, the auction conforms to a pure common value auction) at the aggregate level, subjects should bid higher than the range estimate valuation as they observe the winner's curse: a characteristic feature of common-value auctions.

Hypothesis 4.7: *In manipulation (1) and (4), subjects display the winner's curse in the environment of the rejection of the point estimate across all bidders and subjects.*

4.5.2.4 The Almost Common Value Auction

The pure common value auction is a precursor of the almost common value auction and has been widely adapted to model small asymmetries across bidders. Such asymmetries may arise in corporate acquisitions when the target company has greater synergy with one of the bidders (Klemperer, 1999). The academic literature has demonstrated that these small asymmetries can affect who wins and at what price. In standard ascending auctions for common value objects, small advantages can improve the bidder's probability of winning the auction and simultaneously reduces the price he/she pays. The intuition is giving a bidder a slightly higher value when he/she wins makes him/her slightly more aggressive. This result whilst small, in a common value auction has a potentially much larger effect in an almost common value auction. The bidder's competitors face an increased "winner's curse". The logic follows: the bidder's competitors will have to bid higher to win the auction against aggressive bidders, so these bidders will have to bid more conservatively. Thus, the advantaged bidder has a reduced winner's curse and can subsequently intensify this bid even more, and so on. This translates to almost a "snowballing" effect for one bidder, as what at first is recognised as a minor advantage becomes a distinct strategic advantage in an ascending common values auction.

Klemperer (1999) utilises the "Wallet Game" as a benchmark to explore derivatives of this in explaining almost common value auctions. The typical Wallet Game adopts an ascending auction framework with two bidders. The following mathematical analysis is based upon the analysis described by Klemperer (1999) who demonstrates the existence of multiple symmetrical equilibrium points in the game.

There are two students i = 1, 2. Each student is asked to determine the amount of money present in his or her wallet. They are then invited to participate in an auction, where a prize is offered to the higher bidder that equates to the value of the combined contents of the wallets.[24] To present the existence of symmetrical equilibria, it is important to consider the following stylised facts:

1. Each bidder i is aware of the amount t_i of money present in his/her wallet.
2. The bidders are bidding for a prize of common value, conceptualised by:

$$v = t_1 + t_2 \tag{4.6}$$

24 In an ascending auction with two bidders, the higher or winning bid is determined when one of the bidders withdraws from the auction.

Using this information, students should remain in the auction up to the point price p equates to $2t_i$. If the opponent adopts the identical strategy then the student who wins the auction at price p can determine that the actual value is:

$$v = t_1 + (p/2) \tag{4.7}$$

This result is greater than p if $p < 2t_i$ and thus, the player obtains positive economic rent. In this setting both players' strategies conform to symmetric functions of the signals and thus the strategy exhibits a symmetric equilibrium.[25] This is not the only symmetric equilibrium, however. For instance, equilibrium can be established if player i remains in the auction up to a price $10t_i$ and player j quits at $(10/9)t_j$. In this framework the actual value player i will receive is:

$$v = t_i + (9p)/10 > p <=> p < 10t_i \tag{4.8}$$

Conversely, if player j wins at p then:

$$v = t_j + p/10 > p <=> p < (10/9)t_j \tag{4.9}$$

In this equilibrium player i will win more often than player j, and at any given price at which he/she finds money in player j's wallet, he/she makes more money than in the symmetric equilibrium. However, player j wins much less frequently and finds less money in i's wallet when he/she does win, so he/she is worse off.

25 However, if player i wins the auction and bids a price p above $2t_i$ then this results in i losing money.

Klemperer (1999) extends this game to describe auctions when small bidding costs are present using anecdotal evidence from the Glaxo-Wellcome merger in 1995.

The exact value of Wellcome was uncertain but was worth approximately the same to the six bidders, with the exception of Glaxo who had particular synergies that made Wellcome worth more to them. The situation is characterised by a “variant of the wallet game in which one bidder has a small private advantage.” However, there was also the presence of non-trivial bidding costs.

Glaxo bid £9 billion and the response from Wellcome was to invite counteroffers in excess of Glaxo’s bid. Two companies: Zeneca and Roche prepared reported bids of £10 billion and £11 billion respectively if they could guarantee winning. Unfortunately, neither firm was prepared to participate in an auction that they expected to lose. Thus, Zeneca and Roche declined to bid and Wellcome was sold to Glaxo for the initial £9 billion - and shareholders received significantly less than had been anticipated.

In the context of Experiment II, the sunk cost, while not an entry cost to the auction, is still a cost. The cost of £0.5 million pounds provides the subject with a more precise valuation of the company. Under the manipulation of (2) from Table 4.9, the subject faces an environment with which he/she has an information advantage over his/her rivals. In such a situation, having paid for the information, subjects will submit a bid that guarantees them the highest bid.

Hypothesis 4.8: *In manipulation (3), subjects will submit a bid that is greater than the valuation to justify the competitive advantage they have over their competitors*.

4.5.2.5 Attitudes to Risk and Bidding Behaviour

Bidding behaviour can be conceptualised as a function of the flow of information between bidders and sellers. More specifically an individual's bidding propensity is a function of the asymmetry of information across bidders. In fact "asymmetry of information is the crucial element of the auction problem" (McAfee and McMillan, 1987, pg. 704). This asymmetry of information develops uncertainty in auction markets and a bidder's response to uncertainty is centred around their attitude to risk. According to Milgrom (2004) "A bidders' risk aversion increases bids in a first-price auction, because raising one's bid slightly in a first price auction is analogous to buying partial insurance: it reduces the probability of a zero payoff and increases the probability of winning, although with a lower profit margin." (Milgrom, 2004, pg. 122-123)

In this experiment under the no sunk cost treatment, (i.e the auction assumes a standard first-price sealed-bid common-value auction) risk averse subjects bid higher than their valuation to increase the likelihood of winning the auction.

Hypothesis 4.9: *Attitudes to risk will promote systematic differences in the valuation of the asset.*

Hypothesis 4.10: *Risk averse subjects will submit a bid that is higher than their valuation*.

4.5.2.6 Transmission of Sunk Costs

The rationale for investigating the transmission of sunk costs across parties is to extend the pervasive within-person analysis of the phenomenon to a "broader" interpersonal examination.

Results in this field can almost exclusively be attributed to the work of Diekmann *et a*l. (1996) who examine this concept in a property negotiation. Consequently with little experimental and empirical evidence it emphasises the potential to discover novel findings pertinent to corporate decision-making. However, their study did confirm the ubiquitous acknowledgement of sunk costs in the domain of transmission between buyers and sellers. Whilst this experiment is concerned with the transmission across bidders in a competitive environment, one would expect analogous behaviour. Specifically bidders will be influenced by the sunk costs of opposing bidders and will bid in the direction of the sunk costs.

Hypothesis 4.11: *Sunk costs of opposing bidders will affect the subject's offer in the direction of these sunk costs.*

4.5.2.7 Gender Differences

As already described in Section 4.3.4.5, the experimental literature has found behavioural variation across genders in previous economics experiments. However, little variation has been obtained involving bargaining and auction experiments, so for that reason, there is unlikely to be any systematic variation in patterns of behaviour across genders in this experiment.

Hypothesis 4.12: *There will be no systematic differences in patterns of behaviour or bidding strategy cross genders*.

4.5.3 Results

To examine any significance the independent variables have upon the subject's bidding we implement an ordinary least squares analysis to examine the effects of the independent variables on the dependent variable (*BID*). The regression equation is specified as follows:

$$BID = B_0 + \beta_1 TREATMENT + \beta_2 GENDER + \beta_3 INFORMATION + \beta_4 RISK + \beta_5 VALUATION + \varepsilon_i \quad (4.9)$$

The dependent variable *BID* in the bid submitted by each subject in the experiment. B_0 is a constant. Four of the five independent variables are dummy variables and are defined as follows:

The *TREATMENT* variable is coded 1 if subjects are assigned to experimental treatment and 0 if assigned to the conditional treatment. *GENDER* variable is coded 1 for males and 0 for females. The *INFORMATION* variable is coded 1 for subjects who purchased the point estimate information and 0 for subjects who selected the range estimate. The *RISK* variable is coded 1 for "less risk averse" subjects and 0 for risk averse subjects

The fifth independent variable *VALUATION* contains information regarding the valuation given to the subjects. In the case of subjects receiving the range valuation, i.e. for those subjects in the conditional treatment, the mid-point of the valuation is used in the regression equation.

These values of the regression analysis are reported in Table 4.10. What is instantly apparent is that the treatment variable is highly significant. Thus submitted bids are influenced by the sunk costs of the subject's opponents in the direction which increases their bid ($p = 0.00$). Such a finding confirms hypothesis 4.11.

Independent Variable	Bid
Constant	1.60 (1.85)*
Treatment	0.00 (3.92)***
Gender	0.36 (0.93)
Risk	0.03 (2.33)**
Valuation	0.00 (3.28)***
Adjusted R-Squared	0.34

Table 4.10: ***Ordinary Least Squares Statistical Analysis for Experiment II***

Defined by:

$$BID = \beta_0 + \beta_1\, TREATMENT + \beta_2\, GENDER + \beta_3\, INFORMATION + \beta_4\, RISK + \beta_5\, VALUATION + \varepsilon_i$$

This table displays ordinary least squares regression statistics for Experiment II. The statistics are calculated by regressing the dependent variable-bid against four independent variables, in which three are dummy variables: gender, treatment and risk. For each independent variable, the coefficient, (t-statistic), and significance level is reported coupled with the adjusted R Square.

***** = significant at 1% level**
**** = significant at 5% level**
*** = significant at 10% level.**

Specifically, the group of subjects in the experimental treatment bid higher than the consultancy valuation (18 out of 20). Such behaviour is consistent firstly with the stated hypothesis of 4.10 and secondly with the findings from Diekmann, *et al*. (1996) who observed the transmission of sunk costs between buyers and sellers in a property negotiation.

The ordinary least squares regression identifies bidding behaviour was influenced by the subject's attitudes to risk (p = 0.03) which supports the findings of McAfee and McMillan (1987). This accepts the hypothesis that attitudes to risk affect bidding behaviour.

The valuation variable was “strongly” significant in the bidding behaviour of the subjects (p = 0.00) which is not surprising as subjects were given a minimal amount of information so it was highly probable subjects would base their bid to a certain extent on the valuation provided. This finding is in the direction of the anchoring heuristic which states that: (a) an arbitrarily chosen reference point will significantly influence value estimates and (b) value estimates will be insufficiently adjusted away from the reference point toward the true value of the object of estimation.

Finally, gender effects had no influence on bidding strategy, analogous to findings observed in ultimatum games by Eckel and Grossman (1999) who documented no gender effects in games that required subjects to make decisions under risk. Conversely, games in which there is no risk they report women to be more socially oriented in their actions.

4.5.3.1 What Drives the Transmission of Sunk Cost Behaviour?

The regression analysis identified that the experimental variable was strongly significant (p = 0.00) and had an effect on bidding behaviour. To understand how this effect arises, the mean valuations across the four treatments (sunk cost treatment/point estimation, sunk cost treatment/range estimation, conditional treatment/point estimation, conditional treatment/range estimation) are compared against the average bids submitted in these treatments. These values are reported in Table 4.11. A non-parametric Mann-Whitney Wilcoxon test provides a statistical measure of whether there are significant differences between the valuation and the bid.[26] The test indicates there is a significant difference in the sunk cost/range estimation (p = 0.01). This effect is almost mimicked in the sunk cost/point estimation (p = 0.05). Therefore, the data implies the difference between bidding and the valuation is driven by the sunk costs (the bid is driven in the direction of these sunk costs) of the competitors and this effect is not inhibited by the absence/presence of the subjects' individual sunk costs. This is reinforced by the insignificant values generated from the conditional treatments, where the bid approximately replicates the valuation. In fact on average a decrease in the conditional treatments of £0.07 million and £0.05 million respectively is observed for the conditional/point estimation and the conditional/range estimation. These observations imply that not only is bidding behaviour driven by the sunk costs of others but also an increasing bid relative to the valuation is exogenously fuelled by the sunk costs of others. These observations are consistent with the findings of Diekmann *et al*. (1996).

26 This test is a "non parametric" test on two independent samples of numerical or ordinal values. These do not need to contain the same number of observations, or even refer to the same variable. It is an identity test because it estimates how likely it is that two given sets of numerical (or ordinal) values

	MEAN VALUATION (V)	MEAN BID (B)	DIFFERENCE	MANN-WHITNEY-WILCOXON TEST
SunkCost Treatment Point Estimation	£4.09 million	£4.26 million	£0.17 million	(*P* = 0.05)
Sunk Cost Treatment Range Estimation	£4.07 million	£4.33 million	£0.26 million	(*P* =0.01)
Conditional Treatment Point Estimation	£4.1 million	£4.03 million	£-0.07 million	(*P* = 0.40)
Conditional Treatment Range Estimation	£4.1 million	£4.05 million	£-0.05 million	(*P* = 0.30)

Table 4.11: ***Mean Valuations and Bids across Treatments***

4.6 Discussion

This experiment was designed to address two questions: What is the effect of interpersonal sunk costs in a bidding process and does this have a stronger effect than within person sunk costs when both are present in the decision making process? It is found that submitted bids are driven by an exogenous effect and this effect depends strongly on the sunk costs of the subjects' competitors but it does not depend on the sunk costs of the individual.

The analysis of the results suggests subject behaviour on average was irrational. In the experimental condition subjects were informed their opponents had paid for a single point estimate of the asset under auction. Regardless of the subjects own

originated from the same distribution. It is "non parametric" because it makes no assumption whatever on the analytic form of this common distribution.

information they increase their bid. In the absence of sunk costs, bidders should have made similar offers to the valuations they were given. In the case of subjects accepting the standard range estimate it would be considered "normal" for subjects to take the mid range value. However, in the experimental condition this rationale was not adopted as 72% of subjects increased their bids from the valuation given. Of the 72% the average increase was £0.27 million, suggesting that the competitors' sunk costs had an influence on the buyers' behaviour.

Whilst this appears to be irrational to base one's decisions on another's sunk costs, it can be a strategically rational decision if the other party is in fact influenced by the analogous sunk costs. Whilst the sunk cost of the opposing bidders influenced subjects with or without the sunk cost information, the strongest effect was observed for the subjects who didn't buy the information. Thus, the greater the difference between the sunk costs of opponents and the sunk costs of the subjects', the greater the influence of opponents' sunk costs to the subjects' bids. In this instance an asymmetry of information exists among the bidders and to offset this psychological disadvantage bidders respond by bidding higher than their valuation. Essentially subjects attach greater importance to the sunk costs of their competitors than they do to those of their own.

These results make sense in the light of what is known about the asymmetry of information in auction markets. To be specific, asymmetry of information is found to influence bidding behaviour by creating uncertainty. Whilst these results demonstrate that attitude to risk had no effect on bidding behaviour, subjects bidding behaviour is influenced by the sunk costs of opponents and they increase their bid in excess of their valuation.

4.6.1 Alternative Explanations

The results could be subjected to alternative explanations. The behaviour in the sunk cost treatment reflects a belief that the asymmetric information drives subjects to raise their bid in a misguided belief to offset the advantage their opponents have with the point estimate. However, this fails to explain the increase in the group that purchased the point estimate themselves.

Perhaps the increase in the sunk cost treatment reflects the misunderstanding that the strategy of others who are endowed with the point estimate will submit a bid approximately that value, i.e. a strong anchoring effect. Subjects may assume that the point estimate will be approximately the mid-point of the range estimation so subjects bid in the upper-region of the valuation in the belief that this bid will be the highest.

4.6.2 Challenges

The results can be challenged on the following grounds. Firstly, there was no capacity for enhancing investment decision making in the experiment. Secondly, the experiment lacked the verisimilitude of real world losses and amounts at stake were small.

Subjects participated in a single period auction experiment. They were not given the opportunity to become acquainted with the experimental set-up through trial and error. Note that all experimental treatments are the same in this respect, but there may still be a concern to what extent behaviour in the experiment reflects deliberate choice or just confusion. Subjects were free to ask questions after they had read the instructions and our subject pool consisted of highly educated individuals so it is unlikely confusion was a principle driver of the observed behaviour.

Repetition in the design was again avoided as it could promote tiredness and imprecise responses from the subject pool. Furthermore the aim of all the experiments conducted in this dissertation is to make them realistic. Real life investment decisions often lack instant and unambiguous feedback on success, which makes learning difficult.

The experiment does not involve real losses in the sense that it was not possible that subjects would leave the experiment with less money than they brought to the experiment. It is possible that bidding behaviour is influenced by whether real losses in this sense are possible.

It could be argued that the attitude to risk exercise is not an appropriate instrument to grade an individual's propensity to risk. As already discussed, measuring risk has become a large area of study not only because of its importance in the discipline of economics but equally because previous research based on field and experimental data has not yet been able to provide an unambiguous answer. For the purpose of this experiment and the multi-issue negotiation experiment, a binary decision making problem is adequate in defining a broad classification of risk and is simple to elicit from the experimenter's perspective.

4.6.3 Relation to Pre-Existing Evidence

The experiment demonstrates that bidding behaviour can be influenced by outside parties. As the statistics show, these results are significant so there is confidence in the validity of the results in the context of this experiment. As this experiment represents a new direction of research in sunk cost accounting, there is very little documented evidence to compare our results with. However, in the broadest analysis the findings that this experiment has exhibited subjects altering behaviour in the face of sunk costs. Furthermore, non-experimental evidence from actual bidding processes suggests that some individuals display a similar pattern of behaviour to subjects in the sunk cost treatment.

Sunk costs in a first-price sealed-bid auction is essentially a very simple dynamic problem of sunk cost transmission and relates to a previous study by Diekmann *et al*. (1996). They find strong evidence of the transmission of sunk costs between sellers and buyers. Similarly, that experiment documents a strong transmission of sunk costs between buyers.

4.7 Conclusion

Sunk cost accounting is not exclusive to within-person experimental designs. This dissertation presents two experiments that illustrate sunk costs transmit across parties and have a strong influence on the decision-making strategies of individuals. Furthermore subjects are quick to identify sunk costs in discrete settings.

When confronted with a multi-issue negotiation scenario, subjects in the experimental treatment identify the sunk cost and make fewer concessions on this to their opponent. Furthermore across periods subjects demonstrate a stronger commitment in this issue, i.e. subjects are reluctant to modify the concession in the second period. This behaviour of increased risk taking by making fewer concessions in the sunk cost issue after a loss in the attitude to risk exercise reflects escalation of commitment (Staw, 1976). Thus, subjects irrationally attempting to justify their initial investment, which was sunk in the attitude to risk exercise, can explain these results. This behaviour favours self-justification theory.

The break-even treatment as expected displayed no escalation of commitment or no self-justification (as there were no prior losses to justify). The general negotiation strategy is to adopt a “middle-of-the-road” approach and submit a bid which is approximately making half of the concessions.

In the first-price sealed-bid auction subjects assigned to the experimental condition exhibit a propensity to be influenced by the sunk costs of competing bidders. In fact, subjects attach a greater weight to their opponents' sunk costs than they do their own, driving the bid in the direction of these sunk costs. This behaviour mimics the observations of a previous study on the transmission of sunk costs between bidders and sellers (Diekmann *et al*. 1996). Furthermore, attitude to risk was identified as a significant variable in the formulation of the subjects' bid. Specifically, the bid increases with greater risk aversion, which is in agreement with the theoretical framework of McAfee and McMillan (1987).

The experiments suggest the phenomenon of sunk cost accounting is not exclusive to the within person designs as in interactive bargaining and bidding, peripheral sunk costs are just as pertinent and salient to future decision making as within-person sunk costs.

Chapter 5:

The Disposition Effect in Financial Markets

"Markets can remain irrational longer than you can remain solvent"

John Maynard Keynes (1883-1946)

5.1 Introduction

The previous chapters have documented the pervasive nature of sunk costs in investment decision-making and its application to corporate acquisitions. This chapter extrapolates the phenomenon and focuses on a similar anomaly to the sunk cost effect which is prevalent in financial markets. This phenomenon has been labelled the

Disposition Effect (Shefrin and Statman, 1985). The literature in this field draws upon evidence to suggest individual investors exhibit deviating systematic behaviour from predictions of rational theory.

The disposition effect describes the phenomenon of selling previously purchased shares that have appreciated relative to the purchase price and a reluctance to sell shares that have depreciated in price since they were purchased. Such behaviour violates rational behaviour as posited by economic theory.

This dissertation presents an experimental investigation of the disposition effect at the aggregate and individual level. Implementing a modified version of the Weber and Camerer (1998) experimental stock market model the study examines whether subjects exhibit the disposition effect i.e. the tendency to realise "winning" shares and hold "losing" shares. If the disposition effect is present, individuals demographic characteristics (such as gender) will be explored to examine if some individuals exhibit a greater propensity for this phenomenon than others. Furthermore a group of subjects are exposed to a pre-trading sunk cost to discover whether the sunk cost impacts investment behaviour.

The experiment makes several contributions to the existing literature on the behaviour of investors (Ritter, 2003) experimental stock markets (Camerer, 1998) and behavioural finance (Thaler, 1993).

Central to the explanatory theories of the disposition effect is prospect theory (refer to Section 2.2.2). Chapter 2 discussed how prospect theory predicts outcomes that are labelled as gains or losses relative to a reference point, and decision makers are risk-averse in the gain domain and risk-seeking in the loss domain. The use of a reference point to determine gains and losses will henceforth be called a "reference point effect". The difference in risk attitudes for gains and losses is called a "reflection effect"

Reference point effects have been studied in a variety of economic settings (e.g., Thaler, 1985 on marketing; and Bowman *et al*. 1999, in a consumption savings models). In a financial setting the reference point effect explains the disposition to sell winning stocks too early and ride losing stocks too long.

Empirical studies demonstrate the disposition effect is present (Odean, 1998). However, a conclusive test of the disposition effect using real market data is usually difficult because the investors' expectations, as well as individual decisions, cannot be controlled or easily observed in markets like the London Stock Exchange (LSE). If an effect is found at the aggregate level there are often competing plausible hypotheses to explain it. This paper therefore presents an experimental investigation of the disposition effect.

The fundamental elegance of this experiment provides a direct test of the disposition effect. Specifically as individual trading accounts can be analysed in equilibrium, the prices at which assets are traded is clearly acknowledged.

The analysis strongly confirms the findings of previous studies (Weber and Camerer, 1998; Odean, 1998; and Grinblatt and Kelohraju, 2001b) that individuals exhibit on average the disposition effect. However, consistent with the hypothesis, the group of subjects who faced a pre-trading brokerage fee propagated behaviour on average that diminished the disposition effect. Such behaviour is generated through uncertainty, a lack of information and the belief that maintaining the status quo is preferable to the synthesis of it. This behaviour has been widely documented in a different guise as tax motivated trading (Stiglitz, (1983); Constantinides, (1984); Ritter, (1988); Poterba and Weisbenner, (2001); Grinblatt and Moskowitz (2004); and Zoran *et al*. (2004). Furthermore, the disposition effect reduces over time, implying that repeated trading experience might ameliorate investors "out of" the disposition effect.

These findings have pertinent implications for further academic research and the investment management industry. First, certain investors are more susceptible to the disposition effect than others. Private client investment firms should adopt a policy of informing investors about this phenomenon. Second, the importance of "tax-free" motivated investing is likely to generate the disposition effect so investors should again be advised about this event. The increase in self-investing emphasises the role of government and private organisations in making investors aware of cognitive biases which more often than not result in a sub-optimal trading strategy.

The remainder of this chapter is structured as follows: Sections 5.2-5.4 review the literature pertaining to the disposition effect and cognitive biases associated with the phenomenon. Section 5.5 details the experimental design, Section 5.6 highlights the competing hypotheses, Section 5.7 presents the experimental findings and statistical analysis and Section 5.8 concludes with a discussion and competing explanations.

5.2 Related Literature

The term "disposition effect" was coined by Shefrin and Statman (1985) to describe the tendency to "sell winners too early and ride losers too long" (Shefrin and Statman, 1985, pg. 778) relative to a normative theory of investment behaviour. As they acknowledge, the disposition effect is part of the "general folklore about investing" (Shefrin and Statman, 1985, pg. 778). Furthermore there is strong empirical evidence in favour of the disposition effect.

The early empirical literature on the disposition effect looks at consequences of the disposition effect in aggregate data. Lakonishok and Smidt (1986) find that current trading volume is positively correlated with past price changes in line with the disposition effect. Ferris, Haugen and Makhija (1988) demonstrate for small stocks that contemporary volume can be predicted with historic volume at differential price levels. If there was high volume at higher than current prices in the past i.e. there are many investors sitting on a loss, current volume is low. The opposite is true if there was high volume at lower prices in the past.

These studies are important because they suggest that the disposition effect may not be exclusive as an aggregate level phenomenon but also for the existence of the disposition effect since there are many competing explanations for the price-volume relationship. One alternative explanation is that investors re-balance their portfolios so as to keep the weights on each individual asset constant across time, which would be optimal under the assumption of expected utility maximisation with constant relative risk aversion and normal log-returns. Such behaviour implies the selling of stocks with returns above the portfolio average and the purchase of stocks with returns below average.

To be able to distinguish among alternative explanations of behaviour the more recent studies use disaggregate data. Odean (1998) demonstrates on average investors sell winners more readily than losers using data on individual discount brokerage accounts. Investors realise 15 percent of their gains and only 10 percent of their losses.[27] Moreover, Odean (1998) shows that this behaviour is not justified by subsequent portfolio performance, which makes it difficult (though not impossible) to argue that the preference for realising gains rather than losses is in accordance with some

27 Realised Gains = Shares sold at a price greater than the purchase price/ Shares sold at a price greater than the purchase price + Shares kept which are trading at a price greater than the purchase price.

normative theory of investor behaviour. Similarly, Heisler (1994) documents the disposition effect for a sample of small Treasury futures speculators on the Chicago Board of Trade.

Psychological biases are not exclusive to the "part-time" investor. There is strong evidence that "professionalism" or investor sophistication does not bring immunity. For instance, Coval and Shumway (2005) analyse the trades of Chicago Board of Trade professional market makers. They discover traders with losing mornings (a) place more trades, (b) place trades with larger average size and (c) assume greater total dollar risk than those with profitable mornings. However, Shapira and Venezia (2000) find that while the disposition effect is pervasive it is significantly weaker among professional investors than among amateurs in Israel, where stock market gains are tax-free. They support the conclusion that greater investor sophistication is associated with less susceptibility to the disposition effect. Locke and Mann (2005) review the trading behaviour of professional futures traders and find that while all traders hold losers longer than winners, the least successful traders hold losses the longest, while the most successful traders hold losses for the shortest time.

Notwithstanding that both ostensibly sophisticated and unsophisticated investors display varying susceptibility to the disposition effect in general, there is evidence that investors override their biases in cases where the benefits of doing so are salient, such as when tax payable may be minimised. Tax-paying investors may minimise tax payable by postponing stock sales into future tax periods and realise capital losses by selling shares to shield other taxable income (Bremer and Kato, 1996). In line with this proposition, Odean (1998) finds that although investors realise a greater proportion of gains than losses for every month of the year, the highest proportion of losses realised is observed in December (the US fiscal year-end). Importantly, this remains true over different time periods and across different groups of traders based on trade frequency. Given that trade frequency is correlated with investor sophistication, Odean's (1998) findings indicate the benefits of tax minimisation are salient to all investors.

Weber and Camerer (1998) find evidence for the disposition effect in an experimental asset market. They have participants in an experiment trade risky assets at exogenously determined prices. Even though participants are correctly informed that the price process for each risky asset has a fixed trend, and that price changes are independent across time and assets, participants on average prefer to sell winners rather than losers.

A competing explanation of the disposition effect is the momentum effect. Momentum traders condition themselves on past prices. Specifically investors will purchase assets that have been "winning" assets and sell assets that have been "losers" in the past. Empirical research has produced evidence of unconditional positive autocorrelation of (excess) returns over horizons between 3-12 months. Cutler Poterba, and Summers (1990) find momentum in excess returns stock, bonds, foreign exchange, and real estate markets. There is also a large literature on positive serial correlation on cross sections of individual stocks (e.g. Jegadeesh and Titman, 1993 for the U.S.A and Rowenhurst 1998 for Europe).

Fama and French (1996) remark that the momentum findings of Jegadeesh and Titman (1993) constitute the "main embarrassment" (Fama and French, 1996, pg. 81) for their three-factor model. The difficulty in reconciling the momentum effect with traditional theories of asset pricing has given rise to a number of behavioural models. Daniel, Hirschleifer and Subrahman (1998) focus on a risk neutral representative investor who is prone to the overconfidence bias. This bias can be conceptualised as "systematically overestimating the accuracy of one's decisions and the precision of one's knowledge." (Dittrich *et al*. 2005, pg. 492) Overconfidence leads to initial overreaction to news about fundamentals that is on average followed by even more overreaction due to biased self-attribution, which implies momentum. Barberis *et al*. (1998) also assume that prices are driven by a representative agent, who, in their case, suffers from conservation bias, i.e. the representative investor updates his/her priors only insufficiently when new information about a stock becomes available. If this under reaction is corrected over time, it implies momentum. Hong and Stein (1990) use Copeland's (1976) idea that sequential information arrival together with the failure to extract information from observed prices creates under reaction and momentum. Their approach is different from Daniel *et al*. (1998) and Barberis *et al*. (1998) in that they appeal to plausibility rather than psychology to justify their assumptions.

In the microfoundations of behavioural finance, De Bondt and Thaler (1995) postulate that overconfidence is a prominent psychological trait amongst individuals According to Benartzi and Thaler (2001) this is manifest in two guises. First, individuals are poorly calibrated when estimating probabilities: events they think are certain to occur actually occur less frequently, and events they deem impossible occur with greater frequency. Second, the confidence intervals people assign to their estimates of quantities, for example the level of the FTSE 100 Share Index in a year, is far too narrow. Their 98% confidence intervals, for example, include the true quantity only 60% of the time.

Models of financial markets with overconfident investors predict that trading will be excessive and many psychological studies have shown that men are more prone to overconfidence than women (for example, Lundenberg *et al*. 1994). If overconfidence causes overtrading, then men should exhibit their greater tendency toward overconfidence by trading more. Using account data from 35,000 households of a large brokerage house Barber and Odean (2001) found men exhibited a greater desire to trade - 45% more than women. Trading reduced men's net returns by 2.65 percentage points a year as opposed to 1.72 percentage points for women.

Finally there are two papers that signal a conflicting argument against the disposition effect. Barberis *et al*. (2001) examine the impact of past investment performance on asset demand in a model of the previously explained house money effect (see Section

4.3.4.4), the notion that gamblers increase their risk propensity following a gain. They assume that investors become less risk averse after gains and more risk averse after losses. Klein (2001), studies the capital gain lock-in effect. He argues that capital gains taxes induce a tendency not to sell stocks with capital gains (winners) and to sell stocks with capital losses. Since both Klein (2001) and Barberis *et al*. (2001) assume behaviour is opposite to traditional explanations of the phenomenon, they get opposite results: They find reversals in equilibrium returns. The fact there are contrasting theories pertaining to investment behaviour drives the experiment implementation in this dissertation. However, to date the three empirical papers that examine whether investors trade through the tax motivated strategies of Klein (2001), Barberis *et al.* (2001) or by the disposition effect (Coval and Shumway, 2005; Odean, 1998; Ferris *et al*. 1988 ;and Lakonishok and Smidt, 1986) elicit evidence to support the latter.

5.3 The Impact of Cognitive Biases in Financial Markets

Disposition effect and momentum strategies are two non-exclusive strategies in explaining the anomalous trading patterns of investors. This section presents a flavour of the competing biases in financial markets.[28]

28 For a comprehensive survey refer to Thaler (1993).

5.3.1 Representativeness

Kahneman and Tversky (1974) argue that when individuals try to determine the probability that a data set (A) was generated by a model (B), or an object (A) belongs to a class (B), they often adopt the representativeness heuristic. This means that they evaluate the probability by the degree to which (A) reflects the essential characteristics of (B).

The effect of representativeness in investment decisions can be seen when certain shared qualities are used to classify stocks. Two companies that report poor results may both be classified as poor companies, with bad management and unexciting prospects. This may not be true, however. A tendency to label stocks as either "bad-to-own" or "good-to-own" based on a limited number of characteristics will lead to errors when other relevant characteristics are not considered.

Representativeness may also be related to the tendency of stock prices to reach extremes of valuation. If poor earnings and share price performance has a stock branded as "bad", representativeness will tend to delay the reclassification of the stock as one investors would like to own. On the other hand, "good" stocks may continue to be classified as such by investors well after the firm's prospects for either earnings or price appreciation have diminished significantly.

Contrarian or value strategies seek to exploit just such erroneous classifications. If a firm has been classified by most investors as a bad one and the stock as a loser, initial changes in the company's outlook may leave the classification in investors' minds essentially unchanged. This collective classification can lead to stocks being unloved and under priced. A value investor seeks to buy the stocks others classify as “bad”, ideally at the time when the greatest majority holds this view. When fundamentals have started to deteriorate but the majority of investors have not yet reclassified the stock in their minds, it is often an ideal time to sell.

5.3.2 Anchoring

The anchoring heuristic (Kahneman and Tversky, 1973; Kahneman *et al*. 1982; and Northcraft and Neale, 1987) is a well-documented behaviour pattern and provides a compelling explanation as to why investors hold-on to “losing” stocks. The underlying reasoning behind anchoring is as follows: when individuals are asked to make quantitative evaluations they are often influenced by suggestions. These suggestions are known as *anchors*. They impact the assessment regardless of their relevance to the assignment (Mussweiler and Strack, 2000a).[29] Tversky and Kahneman (1974) invited subjects to indicate if the percentage of African countries in the United Nations was higher or lower than a random number generated (numbered 1-100) by spinning a wheel.[30] The subjects were then required to estimate this percentage. The results displayed the median estimates of the percentage of African countries in the United Nations were 25 and 45 for groups that received 10 and 65 respectively as random starting points. They concluded payoffs for accuracy do not reduce the anchoring effect.

Tversky and Kahneman's (1974) study was a pre-cursor to many others in this field and as a consequence, anchoring effects draw resonance in a variant number of domains such as economic transactions (Galinsky and Mussweiler, 2002; Joyce and Biddle, 1981; Mussweiler *et al*. 2000; and Northcraft and Neale, 1987), public policy assessments (Plous, 1989), judicial verdicts (Englich and Mussweiler, 2001), and interpersonal perceptions (Gilovich *et al*. 2000; and Gilovich *et al*. 1998). Northcraft and Neale (1987) examine anchoring in a real-world setting. Undergraduate business school students and professional real-estate agents were given information about a house currently available for sale. The information was correct, with the exception of the seller's asking price for the house. This price was different for every subject and it was hypothesised, it might act as an anchor for subjects' estimates of the house's value. Subjects visited the house and its neighbourhood and then provided four estimates of its value (its appraised value, an appropriate advertised selling price, a reasonable price to pay for it and the lowest offer they would accept if they were the seller). For both

---

29 It should be noted that anchors are quite distinct from the reference points observed in prospect theory. An anchor reflects the valuation an individual makes, a reference point determines how a valuation is perceived. (Kahneman, 1992)

amateurs and experts, the sellers asking price was a highly significant anchor for each of the estimates of the value of the house. However, it must be noted, experts seemed much less aware that they were being influenced by the anchor! When asked what factors had influenced their valuations, 56% of the amateurs mentioned the asking price, while only 24% of the experts did.

With reference to stock market trading, in the absence of reliable information, investors are likely to anchor on to past prices or more specifically the purchase point of the stock. As a consequence investors will be reluctant to sell at prices less than the purchase point and under react to negative information concerning stocks that are below the purchase price. It is intuitive that this methodology of stock market trading is irrational; past prices have little significance for future prices.

5.3.3 The Longshot Bias

A competing explanation to the mean reversion beliefs of investors is taken from the psychology and economics literature. It is referred to as the *favourite-longshot bias* or *longshot bias* (Coleman, 2004). This behavioural anomaly is conceptualised within gambling markets in particular the betting markets for horse racing. The literature on horse racing markets extends over six decades with Griffith's, (1949) paper. The focus of the research has been to determine whether horse race betting markets are efficient

---

30 Kahneman and Tversky had manipulated the wheel, so that it always generated the numbers 10 or 25.

(Snyder, 1978; Ali, 1979; Busche, 1994; Hausch *et al*. 1994). If betting markets are deemed "efficient" they must satisfy the following criteria. Firstly all bets should yield non-positive expected values and secondly all bets should have expected values of $(1-\alpha)b$, where α is the bookmakers costs and *b* is the amount bet. However, the expected returns from a unit bet increases montonically with the probability of the horse winning. Favourites win more often than the subjective probabilities imply and longshots less often. This observation suggests favourites are much better bets than longshots.

Whilst the bias is widely documented within the sports betting arena, its observations are transferable as an explanatory description of the tendency of investors to purchase shares that have shown recent depreciations in value. Further, betting markets possess many analogous features to those of financial markets (Shin, 1992; Vaughan Williams and Paton, 1997), which permit the application of such a behavioural bias to this domain desirable. These features include: an extensive pool of investors with potential access to widely available information sets, but also the property that each asset possesses a finite point characterised by a definitive value. Further, the opportunity for the use of inside information to generate abnormal returns from horse race betting is analogous to the operation of conventional markets, but in some respects easier to measure and assess. Another beneficial aspect of betting markets is the elimination of demand uncertainty, which arises from psychological tastes and beliefs, and endowments of other investors in stock markets. Once all bets are placed at the track prior to a given race, the result of the race and the corresponding payoffs depend only on nature.

The favourite longshot bias has been extensively examined over the last fifty years and serves as a robust indicator of investment behaviour. It is for this reason that findings from the body of research should be extended to other observations in economics and finance. Coleman (2004) is a proponent of this view and links the favourite longshot bias to the propensity of individuals to overestimate the probability of unlikely events. "The longshot bias then becomes pervasive throughout finance, management and society and causes the return from investment to fall as the probability of loss increases. The return from risky investments such as developing markets are less than expected. So too is the payout from mergers and acquisitions, research and development, mineral exploration and innovative business models." (Coleman, 2004, pg. 316)

A further example occurs with the purchase of "high risk" common stocks. They are found to generate inferior returns to the level of associated risk (McEnally, 1974). Such an observation is consistent with the favourite-longshot bias. A number of explanations have been offered for the poor return of "risky stocks". Firstly, the impact of an excessive number of investors with relatively limited risk aversion who are willing to offset the high risk for high expected returns, but lacking access to the borrowing necessary to lever up the returns from the lower risk stocks, seek out high risk stocks and bid down their returns. Secondly, there is the tendency of investors to be overly optimistic in appraising the potential performance of high risk common stocks. These observations draw resonance with the findings of Thaler and Ziemba (1988) who document that less informed individuals bet on “outsiders” while sophisticated gamblers are attracted to favourites.

5.3.3.1 The Generic Racetrack Betting Market

Before exploring the features of a racetrack betting market it is important to discriminate between the two principal betting mechanisms. These are: the parimutuel system or totalizator (Tote) and the bookmakers. In a parimutuel betting market, bets are accepted up to the start of the race. The money bet on the winning horse is pooled together and divided by the number of bets on that horse. Bookmakers offer fixed odds for each horse in a race. Thus bets with a bookmaker are at a marginal price, whereas dividends paid by the tote are an average; in practice the distinction is minimal as most bets are placed close to the start of the race.

Racetrack betting markets are active for a “short”, finite period (20-30 minutes) during which time the investors may place bets on any number of the competing horses in the upcoming race. For any given race, the investors are confronted with a series of stylised bets that range from fundamental bets such as betting for a horse to win outright, or to finish in the top three to more “exotic” bets which depend on the joint outcomes of two or more of the horses. All participants who have bet on a horse to win yield a positive return only if the horse wins, while a place bet realises a positive return if the horse is first or second.[31] Regardless of the outcome, all bets have limited liability.[32] Analogous to the stock market, security prices (i.e. the “odds”) are jointly determined by all participants and a rule governing transaction costs (i.e. the track “take”). In the simplest case, for a win, all bets across all horses to win are aggregated to form the win pool. The nomenclature adopted in the following derivations is commonly adopted in the longshot bias literature following on from Griffith (1949), Ali (1977) and Coleman (2004).33 Let *H* represent the total number of horses in a race and they are numbered in decreasing order of favouritism. 1,2. . . *h*, *H*. X_h represents the amount bet for a win on horse *h*. The total win pool on the race is *W*, where

$$W = \sum_{h=1}^{H} X_h \tag{5.1}$$

In parimutuel markets the operator takes an amount α out of the pool to cover the costs and government taxes. Thus the win dividend paid on any horse is:

$$D_h = \frac{(1-\alpha)W}{X_h} \tag{5.2}$$

31 The place bet is dependent upon the number of participants in the race. The greater the number of participants the greater the number of positions available to realise the place bet.
32 Limited liability in this context is defined as the maximum the investor will lose on a horse *i* is equal to the money the investor has put on horse *i*.

The win odds on any horse, a_h, equal (D_h-1):1 and so

$$a_h = \frac{\{(1-\alpha)W - X_h \}}{X_h} \tag{5.3}$$

The subjective probability that any horse will win P_h is established by bettor preferences and is equal to the proportion of the pool that is bet on any horse.

$$P_h = \frac{X_h}{W} = \frac{(1-\alpha)}{(1+\alpha_h)} = \frac{(1-\alpha)}{D_h} \tag{5.4}$$

The objective probability that any horse will win π_h, is calculated as the proportion of times a horse starting at any particular position has historically won.

The expected return R_h is calculated as follows:

$$R_h = \pi_h \times D_h - 1$$

$$R_h = (1-\alpha)\frac{\pi_h}{P_h} - 1 \tag{5.5}$$

The longshot bias is evidenced through the objective probability, π_h, exceeding the subjective probability, P_h, for short priced favourites and by π_h being lower for

---

33 The derivation has no direct impact on the direction of this dissertation but is intended to assist in the understanding of the longshot-bias.

longshots. When there is a longshot bias, the value of π_h/P_h increases as P_h rises and so the expected return rises as P_h rises.

5.3.3.2 What Drives the Longshot Bias?

The underlying driving force of the longshot bias has so far been inconclusive. Coleman (2004) synthesised results from 18 studies on the longshot bias and generated five stylised observations about the phenomenon. This dissertation focuses on three of them: Firstly, bookmaker markets have a stronger longshot bias than parimutuel markets. Secondly, the longshot bias is not significantly different between thoroughbred races, harness races and greyhound races[34] and finally, the longshot bias is independent of time.

Prior to Coleman (2004), the literature identified inaccurate empirical data as a possible explanation of the longshot bias. In light of Coleman's study, this statement would appear false. The literature documents its existence across variable size races, sample sizes, and types of races. Further it is robust across boundaries (i.e. the bias has found to be present across several continents). Such evidence reinforces the accuracy of the results. Coleman (2004) supplements this further by doubting any statistical pretence. If there were it would be as a result of the methodology behind the odds calculations.

34 Coleman found at the 65% confidence level the values of β for harness racing and greyhound racing are equivalent to thoroughbred racing.

A potential defect could arise in the methodology of calculating the odds. It is common practice to round the odds down or *breakage,* as it is known. Such a method has been the focal point of several studies (Busche and Hall, 1988; Busche and Walls, 2001). The rationale behind this practice is as follows: Rounding down reduces the expected odds in relation to the dividend. Thus it has a greater impact on the shorter-priced horses as the return generated from backing favourites is greatly reduced. Therefore, this diminished return from backing favourites implies a weakening of the longshot bias.

Busche and Walls (2001) test the effects of breakage by rounding dividends using previously generated data from Ali (1977). They postulate an *index of breakage* equal to the product of odds on the horse and bet fraction.

$$\textit{Breakage Index} = a_h P_h = (D_h - 1)\{(1-\alpha)/D_h\} = (1-\alpha)(1-\frac{1}{D_h}) \qquad (5.6)$$

Their data have been used to derive the following expression:

$$z = -2.2 + 3.6(\textit{Breakage Index}) + 0.39(\textit{Position of the Horse in Betting Market}) \qquad (5.7)$$

Adopting a mean index of breakage of 0.26, the formula illustrates a longshot bias with a subjective probability that is less than the objective probability for the first three horses. "Thus whilst breakage has an impact it inevitably weakens the longshot bias which exists despite breakage, not because of it." (Coleman, 2004, pg. 321)

Henery (1985) examines the bookmakers' strategies and determines that betting on the favourites exhibits greater competition amongst the bettors. In order to attract bets on these favourites the bookmakers purposely raise the odds. To offset this process, the bookmaker will simultaneously lower the price on "outsider" horses. This is the explanatory finding of supply side causation of the longshot bias.

Bruce and Johnson (1999) extended Henery's (1985) findings to the examination of bookmakers and parimutuel markets operating in competition with one another. Such a format is pervasive across the majority of UK race meetings. They explored the bookmaker starting price and parimutuel Tote odds on 2109 UK thoroughbred races in 1996 and discovered a strong longshot bias in bookmaker markets. This evidence was reinforced by Julienne and Salanié (2000) in their analysis of an earlier UK dataset.

Certainly the presence of supply side factors may partially determine the longshot bias, but it is the actions of the investors that many academics believe are the major instruments of the longshot bias. Investors may distort the market with their behavioural actions. Coleman (2004) classifies these investors as *conscious embrace of risk* and *misjudgement of true probabilities*.

It is widely acknowledged amongst economists that risk seeking individuals gamble more money on longer odds horses than is justified by their objective chances of winning. Thaler and Ziemba (1988) argue that in the absence of short selling wagering markets, less informed bettors support longshots whilst more sophisticated bettors place money on favourites.

Quandt (1986) postulates that bettors are risk loving.[35] Bird *et al*. (1987) attribute bettors' decisions to a preference for positive skew in returns that provides an occasional longshot win to compensate for the negative expected return.

In financial markets, the purchase of "high risk" common stocks is found to generate inferior returns to the level of associated risk. Such an observation is consistent with the favourite-longshot bias. A number of explanations have been offered for the poor return of "risky stocks". Firstly, the impact of an excessive number of investors with relatively limited risk aversion who are willing to offset the high risk for high expected returns, but lacking access to the borrowing necessary to lever up the returns from the lower risk stocks, seek out high risk stocks and bid down their returns. Secondly, the tendencies of investors to be overly optimistic in appraising the potential performance of high risk common stocks. These observations draw resonance with the findings of Thaler and Ziemba (1988) who document less informed individuals bet on "outsiders" while sophisticated bettors are attracted to favourites.

---

35 This observation is naturally intuitive. Risk averse individuals would disconnect themselves from gambling markets as by definition, risk averse agents would prefer to receive an expected value of an uncertain alternative rather than the uncertain alternative. Therefore individuals entering such a marketplace are consistently expected to be at least risk neutral in their attitude to risk.

The *gambler's fallacy* states that individuals mistakenly believe the probability of an event occurring deviates from its fixed value depending on recent occurrences. Such an argument reinforces claims that gamblers systematically avoid betting on a recent winning number, for example, in the selection of lottery numbers (Morrison and Ordeshook, 1975). According to Terrell (1997), in greyhound races at Woodlands, Kansas the number of the winning dog was the same as the number of the preceding winner on 13.8% of occasions, but gamblers' only backed it 13.0% of the time. The same bias was found by Clotfelter and Cook (1993) in the Maryland lottery: support for any particular winning number fell by a third within a day or two of being drawn and was still 10% two months later.

Metzger (1985) made a comprehensive study of the gambler's fallacy using over 11,000 US thoroughbred races and concluded that betting on favourites is more common after a series of longshot winners (which is defined as any horse other than first or second favourite). Results provide evidence for the gambler's fallacy as support for the favourites decreases with the length of their run of success. However, as the winning streak of less favoured horses extends their support grows. Coleman (2004) likens this latter observation to a fallacy termed *hot hands*, which is pervasive in basketball. Players are more likely to score a basket after just making one than after missing a shot.[36] The *gamblers fallacy* assumes that outcomes mean revert and is analogous to the mean reversion in stock markets, whereas *hot hands* is momentum

36 The same observation is observed in golf. Golfers who "hole" putts in the early holes will generally continue to hole putts in fewer strokes than golfers who "miss" putts in the opening holes.

following. Significantly both approaches incorporate Bayesian probabilities, rather than assuming the absence of any statistical link between independent events.

Upon inspection, Metzger's (1985) study involved two populations of gamblers: those backing favourites who believe they can only win a fixed proportion of races; and those who back longshots and believe they can have runs of success.

Another possibility is that decision makers going for the longshot may be adopting the *Laplace Rule of Insufficient Reason* which states that all outcomes are equally likely (at least on a risk-adjusted basis) and therefore decision makers should invest in the outcome that yields a large payoff.[37]

5.3.3.3 Insider Trading

In the domain of speculative markets it is widely accepted that inside information benefits the investor as this information is precluded to the public domain. Under this observation, empirical research has sought to explain the favourite-longshot bias as an optimal supply-side response to market uncertainties. In a series of studies, Shin (1991, 1992) examined the fixed-odds bookmaking system (in the United Kingdom) as a case of adverse selection in which the bookmaker faces a number of bettors who possess superior information, the proportion and identity of whom are unknown. Assuming that the incidence of insider trading is not larger when a favourite is tipped to win than when a longshot is tipped to win, it is shown that equilibrium prices will exhibit a favourite-longshot bias.

Furthermore, Shin (1993) provides an estimate of the extent of insider trading as a function of the size of the bid-ask spread in the market and the prevalence of insider trading. Central to this is the notion that the direct effect of insider trading on bookmakers' margins will tend to increase as the number of runners (and therefore the size of the odds) increases. Employing a sample of 136 UK races, Shin (1993) finds a strong positive correlation between the sum of bookmakers' prices and the number of runners. By isolating this effect from other influences on the bookmakers' margin, he finds the incidence of trading in his data set to be about 2%.

Vaughan Williams and Paton (1997) believe Shin's (1993) results are ambiguous and are dependent upon "accepting the insider trading explanation of the observed correlation between the number of runners in a race and the sum of prices offered about runners in such races" (Vaughan Williams and Paton, pg. 2, 1997). As a consequence they believe Shin's observations could be consistent with explanations other than insider trading.

---

37 A corollary of the argument is that the longshot bias should be absent in games involving pure chance and no skill.

Vaughan Williams and Paton (1997) extrapolate Shin's (1993) findings to construct a model which exhibits a linear relationship between the number of horses and the sum of the bookmakers' prices that can be explained not only by the presence of insider trading but also by bettors counting only a fixed fraction of their losses.

They assume that bookmakers in general are risk-neutral agents who compete on price up to the point that they expect the subjective returns to the set of bettors on each horse to be zero. Under this principle two assumptions are used. Firstly, bookmakers have zero costs and secondly, bettors are also risk-neutral and that both bettors and bookmakers have access to all publicly available information.

In a field of n horses, the objective probability of winning for horse *i be given by* P_i (i = I to n). The bookmakers' over-round (*OR*) is defined as the sum of the winning probabilities implied by the odds of all horses in a race minus I. If bettors count all their losses, the odds reflect the objective winning probabilities and the over-round is zero. However, if only a fixed fraction of losses, f is counted by bettors (as in Henery, 1985), the subjective probability of any horse is $fq_i = f(1-P_i)$, where q_i is the objective probability of losing for horse i. The winning probabilities implied by the equilibrium odds are now I – fq_i.

OR may be defined as follows

$$
\begin{aligned}
OR &= \sum_{i=1}^{n}(1 - fq_i) - 1 \\
OR &= n - f\sum_{i=1}^{n} q_i - 1 \\
OR &= n - 1 - f\sum_{i=1}^{n}(1 - p_i) \\
OR &= (n-1) - f(n-1) \\
OR &= (n-1)(1-f).
\end{aligned}
\tag{5.8}
$$

The over-round is linearly related to the number of runners, which is precisely Shin's (1993) result. Thus insider trading is not the only theoretical explanation of a link between the sum of prices and the number of runners.

One way to distinguish between these two alternative explanations is to isolate those races in which insider trading is likely to be more prevalent. In order to identify and distinguish such situations, Crafts (1985) suggests separating handicap races (where horses are allocated weights so as to equalise as far as possible their chances of winning) from non-handicaps. In the latter, therefore, bookmakers are likely to believe there to be greater possibilities for betting on the basis of privately held information.

It is possible that insiders may use public information to improve their private information. For this reason Vaughn and Williams and Paton (1996) consider only higher grade handicaps as indicative of the absence of useful information. The reason is that these race types are the subject of particular media attention and might be expected by bookmakers to offer very little opportunity for non-disclosure of useful private information and that the informational content of any private information available about these race types is expected to be close to zero.

Further more, the market may reveal *ex-post* information as to whether bookmakers perceive certain races to be subject to insider trading through movement in the odds. At the opening of the market, bookmakers are unlikely to know on which horse private information is held. Thus they may post less favourable odds on all horses in races where they suspect insider trading will be prevalent. As the market progresses, bookmakers reduce the odds of those horses which are heavily backed. In races where insider trading is not suspected, bookmakers are less likely to adjust prices during the life of the market. Following suggestions in Crafts (1985, 1994) and Bird *et al*. (1987), they single out races in which the odds on the winning horse have decreased significantly over the course of the market.

The data set consists of observations on 5,903 horses running in 510 races in the 1992 UK flat season. The following equation taken form Shin (1993) is used to estimate the results:

$$D^* = const + z(n - \mathrm{I}) + \sum_{k=0}^{k=2} a_k n^k VarP + \sum_{k=0}^{k=2} b_k n^k (VarP)^2 \tag{5.9}$$

Where D^* = sum of starting prices in each race, n = number of runners in each race, Var P = vector of Shin's variance of winning probabilities in each race.

Shin (1993) interprets z as the incidence of insider trading which he finds to be 2%. The value of z is then used to estimate the variance of probabilities and the equation re-estimated. The process is repeated until convergence is achieved.

The estimates of z are slightly lower than Shin's (1993), although at convergence the difference is marginal (0.019 compared to 0.02). On the basis of Shin's (1993) theoretical model, this positive link between the sum of prices and the number of runners provides evidence of insider trading at work in the market. However, demand size explanations of the longshot bias can also bring about this result.

5.3.3.4 The Favourite-Longshot Bias in Futures and Options

Complementary domains for the longshot bias transcend sports betting markets and one such arena that has received attention is the option and futures market. The motivating factor underlying this research is that these markets provide a platform for investors to occupy long or short positions and thereby at a fundamental level offering a similar market to that of horse race betting.[38] Individuals invest in options as primarily a vehicle for hedging but also investors do purchase put options for pure speculative purposes. A call option will generally serve as an instrument that is sold against existing holdings of equity.

The expectation of a favourite longshot bias in options markets is not a relatively new observation. Figlewski (1989) conjectured investors perceive out of the money call options as low-cost, large payoff gambles. Such an activity can be described as irrational. Furthermore, Dumas *et al*. (1998) suggest stock index put options are purchased at higher prices due to the demand for insurance. Certainly, the dynamics of an option market are similar to the horse race betting market as the option market provides a platform for investors to occupy long or short positions.

Hodges *et al*. (2002) examined returns from investments in put and call options on stock index futures and assessed whether average returns are biased against high leverage situations. They examined the S&P Futures Options Market, which is dominated by institutional investors purchasing insurance. The authors connoted the bias would be most evident with retail investors so they examined another market with

38 A long position exists when an investor purchases a contract to create a market position and has not yet closed this position through an offsetting sale. A short position on the other hand, exists when an investor has sold a contract to create a market position and has not yet closed this position through an offsetting purchase. These features are analogous to “backing” and “laying” in horse race betting markets.

greater retail activity. This market was the Financial Times Stock Index (FTSE) 100 Futures.

The results demonstrated a negative expected return for out of the money call options on the S&P 500 Futures and the FTSE 100 Futures.[39] During the period 1985-2002, the expected returns for a $1 investment on a 3-month call option in the probability range of 0%-5% was less than 0.7 and 3.7 cents for the S&P 500 and the FTSE 100 respectively. In addition investments in deep in the money 3-month call options demonstrated expected returns that were in excess of the investment (on average). Such behaviour is similar to the findings of the favourite longshot bias in racetrack markets. The results from the put options were in accordance with the hypothesis from Dumas *et al*. (1998) who believe investors overpay for puts. However, it should be noted the degree of overpaying is not uniform. "[o]verpaying for these options increases monotonically as the probability of finishing in the money decreases." (Hodges *et al*. 2002, pg. 19) Unlike 3-month options, the 1-month options displayed no sign of a favourite longshot bias.

39 In finance literature the term "out-of-the-money" refers to a call or put option that has a zero intrinsic value. For example, a call option which is "out-the-money", has a price, which is less than the exercise price.

5.4 Reflection and Reference Points in Financial Markets

In most decision situations there are several possible reference points. In a financial setting, the purchase price of a stock is a natural reference point for evaluating the stock. Shefrin and Statman (1985) found evidence that "investors tend to sell winners too early and ride losers too long" (Shefrin and Statman, pg. 778, 1985). Investors judging gains and losses relative to their initial purchase price and being risk averse toward gains and risk seeking toward losses can explain this disposition effect.

5.4.1 Subjective Valuation

An extension of reference point effects is that based on subjective valuation (see e.g. Lakonishok and Smidt, (1986), and Harris and Raviv, (1993)). According to this line of reasoning, an investor who bought a stock for £11 only to see the price subsequently drop to £10.50 may rationalise that if buying at £11 was a transaction with a positive, or at least zero net present value, holding the stock at £10.50 is even more profitable ex ante. This of course requires that the investor perceives the price drop as an overreaction by the market.

Changes in subjective valuation as time passes depend on how the investor interprets new information versus how the market capitalises it on the stock price. Suppose the investor valued the stock at £12 when he/her bought it at £11. Just prior to the stock declining to £10.50 the company made an earnings announcement that fell short of expectations. Now the investor re-estimates the stock's value in light of this new information. If he/she agrees with the market about the decrease in value he/she arrives at an estimate of £11.50 (12-0.50), in which case the net present value (NPV) of the investment is still a positive £1. However, the investor may well disagree with the market and attach a greater or lesser significance to the information. A subjective estimate of a negative impact in excess of £1.50 would bring the subjective value below the market value of £10.50, and the investor would then sell the stock.

Naturally, the prediction of the subjective valuation hypothesis with respect to the disposition effect depends entirely on the model investors adopt for updating their beliefs. At one extreme, suppose an investor never changes his/her subjective valuation. This would imply that the investor never sells at a loss, and always sells if the stock price exceeds the subjective valuation, which, by definition, is higher than the purchase price. A market populated with many such investors with heterogeneous valuations would produce the disposition effect with the following pattern: the likelihood for observing realised losses is low and invariant to the magnitude of the loss, and the likelihood for observing realised gains is much higher, and the distribution of the gains realised reflects the distribution of the subjective valuations across investors. In this pathological case the disposition effect would be entirely a result of belief-based trading.

The disposition effect can thus be rationalised by saying that the investor simply acts on his/her beliefs. He/she would sell when the market price exceeds his/her subjective valuation and hold on to the stock when the price is below the level. Clasping to this argument, investors would then be expected to often purchase a greater number of those stocks that decline in value. Odean (1998) shows that this does happen to some degree, but stocks with heavier paper losses are accumulated much less to the portfolio than stocks with smaller losses.

As another extreme example, consider a scenario where the prior beliefs of the investor are different from the representative investor, but the interpretation of further signals is identical between the two. In this case the investor disagrees with the market about the "fair" value of the stock at all times. This motivates the initial purchase, but never a sale, as the stock would never reach the investor's reservation price.

Testing the subjective valuation hypothesis requires imposing some weak assumptions on the manner of how investors update their beliefs. Assume that the set of events deemed value-relevant by the investor is at least partially, but not perfectly, overlapping with the set of events associated with market price changes, and further, that the investor's set of events is equal or smaller. This position can be based e.g. on the work by Shiller (1981), Roll (1984), and Campbell and Ammer (1993), which suggests that asset prices move much more than justified by changes in expected cash flows.

Consequently, subjective valuations would be "sticky" with respect to the market price changes. However, the further the market price deviates from the starting point, the more likely it is that the investors' subjective valuation changes.

The disposition effect should be considerably weakened after revisions in subjective valuation have occurred. The subjective valuation may still later coincide with the purchase price, particularly around stock price levels near the purchase price. However, generally it will be different from that because the market price and the investors' subjective valuation level do not move in lockstep. Another reason that would weaken the disposition effect is that the market price may exceed subjective valuation, also at levels that are not close to the purchase price.

In summary, as the price moves significantly in either direction, the investors original target price should lose its status as a reservation price, if the investor is not reluctant to realise losses *per se*, but is only acting based on subjective valuation.

5.5 Experiment III: A Test of the Disposition Effect in Securities Markets

5.5.1 Research Design

In this experiment subjects made portfolio decisions before each of the 14 periods in a virtual stock market game. Before each period they could buy and sell 12 risky stocks at announced prices. A random process (described below in more detail) generated prices of the risky stocks. Prices were independent of the subjects trading actions, as in many market experiments, because it was important in isolating disposition effects – the tendency to buy and sell at different prices – from the process of price formation.

Each subject was given a fictitious sum of £10,000 at the beginning of the experimental session. At the end each subject's portfolio value was converted into a mark that contributed to the subjects overall module mark. Subjects could not "leverage" their portfolio or sell stocks short.[40]

The experiment utilised 12 fictitious stocks, labelled A-L.[41] Subjects were given a brief description of the company coupled with financial data, which encompassed: Stock price, price variability and leverage. From the 12 stocks listed subjects were instructed they must construct an initial portfolio of 6 stocks and decide whether to invest £1000, £2000, or £3000 in each of them. An overview of the experiment is presented in Table 5.1.

40 Leverage refers to funding an investment through debt instruments.

Read Instructions	
Portfolio selection	Subjects invest in six companies from a list of twelve
Period 0: No trading	Subjects observe the price of their portfolio stocks, but are prohibited from trading.
Period 1-14	Subjects can actively trade throughout at the end of each period.
Subjects final portfolio balance is positively correlated to a percentage	

Table 5.1: ***Overview of Experiment III***

The instructions provided detailed explanations of how the prices were formed. In each period it was determined whether the price of each stock would rise or fall. The 12 stocks had different probabilities of rising, falling, or zero change. These probabilities were fixed for each stock during the entire 14 periods of the experiment. The chances of a price increase/no price movement were 65% for 2 stocks, 55% for two stocks, 50% for 4 stocks, 45% for 2 stocks, and 35% for 2 stocks. The stocks assigned these probabilities are shown in Table 5.2. Figure 5.1 displays the price variations across the 14 periods for the 12 stocks. Unlike Weber and Camerer's (1998) design this model featured a market composed of stocks which have the ability to show trans-period price stability (i.e. zero price change from period-period) The underlying rationale across periods for this modification is constant price level stocks over a given period *p* are pervasive in global financial markets and such a feature enhances the verisimilitude of the experiment. In addition, it is important to understand how individuals behave towards stocks that remain constant in price in relation to reference points.

41 Refer to Appendix F for the descriptions of the stocks.

Stock	Probability Rating	Price at t=0	Price at t=14	Percentage Increase
A: Imperial Chemicals	45%	£3.30	£2.90	-12.1
B: Lantro Group	50%	£4.60	£3.90	-15.2
C: RMA	50%	£1.00	£1.30	30.0
D:AH Land Consultancy	50%	£2.70	£2.00	-25.9
E: Synergist	35%	£1.50	£0.90	-40.0
F: S. Robinson	65%	£4.80	£5.60	24.3
G: Easydough	35%	£1.30	£1.10	-15.3
H: Sintra Investments	55%	£8.80	£9.30	5.7
I: Peninsula Banking	65%	£6.40	£7.60	18.8
J: Interaction	55%	£3.30	£3.70	12.1
K: Utilium	45%	£4.40	£4.20	-4.5
L: Oceanic Drilling	50%	£1.10	£1.10	0

Table 5.2: ***Probability Rating of Assets***

This table describes the probability of each stock appreciating in any given period together with the actual starting price of the company and the price at the close of the experiment. A computer programme generated the probabilities randomly.

If the stocks were deemed to rise or fall, it was determined randomly whether the price would rise or fall by 1, 3 or 5%. All three possibilities were equally likely, and were independent, across the 12 stocks. Price sequences were predetermined before the experiment, using a random number table. Predetermination of prices permitted identical sequences of share prices in the experiment, so data could be pooled from different subjects.

In this design, subjects had to infer the distribution underlying each stock's share price movements from past data. A Bayesian subject would continually update their probabilities that each of the six stocks had each of the six increase probabilities, based on observed price movements. The optimal Bayesian method corresponds to a simple heuristic way to judge which of the twelve stocks has which trend: count the number of times the share price doesn't fall. The stocks displaying this feature were likely to be the ones that had a 65% chance of appreciating.

This design had an important advantage. Since the stocks that had increased the most frequently were most likely to be the 65% stocks, the investors should be least eager to sell; similarly the most frequent losers were most likely to be the 35% stocks and investors should have been keen to sell. Thus, a disposition effect is clearly a mistake in this setting.

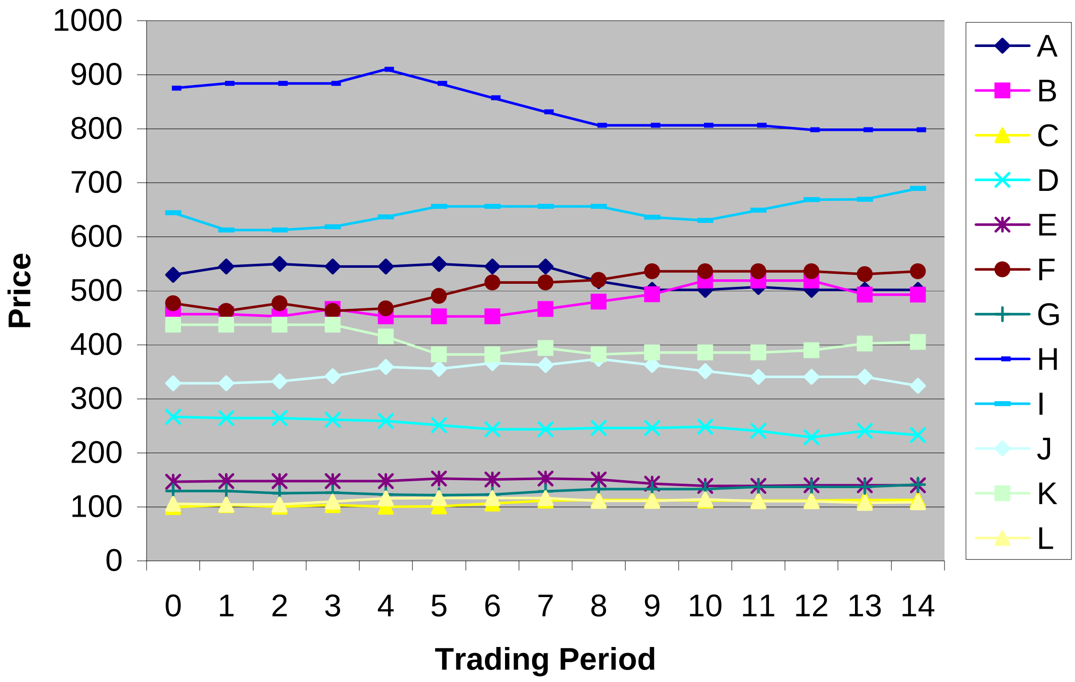


Figure 5. 1: ***Share Price Movements of Companies across Periods***
This graph displays the share price movement in each of the fourteen periods of the experiment. In total there were 59 price appreciations, 59 price depreciations and 62 zero price movements.

5.5.1.1 Brokerage Fee versus No Brokerage Fee Condition

In this manipulation, subjects were informed that they had an initial fund of £10,000 to invest but £2,000 has to go to a stockbroker as a one-off administration charge. Whilst the subject had to make this obligatory payment, the cost is most definitely sunk and it would be interesting to see if this had any effect upon trading behaviour.

5.5.2 Experimental Procedure

The experiment was conducted at the University of St Andrews. The subjects were 37 (22 male and 15 female) postgraduate students majoring in economics with an average age of 24. The experiment was a paper-based experiment. This was a compulsory task for the postgraduate students enrolled in a "Strategic Thinking" module. Their performance was converted into a mark that contributed to their final module mark. The experiments took about 100 minutes. All parts of the written instructions were collected after the experiments.[42]

Economics Postgraduate students were considered an appropriate sample because of the following:

1. Their interest in financial markets could be expected to be greater than the average individual and representative of lay investors.
2. Their knowledge of financial markets could be expected to be uniform, though not well developed. In this case they could be expected to reasonably mirror the profile of the majority of private investors. Their behaviour could be expected to follow rational economic utility optimisation.
3. By incorporating performance in the exercise into subject assessment, meaningful rewards and punishments could be incorporated into the experiment.

---

42 A parallel experiment using identical methodology was conducted using professional investors from Deutsche Bank. Unfortunately the sample size of eight subjects was insufficiently large enough to provide any meaningful and accurate conclusions between the disposition effect and investor sophistication.

4. Their attention and continuous availability was reasonably assured.
5. Their motivation could be confidently expected on the basis of the game's learning potential and the competitive spirit encouraged within the experiment.

5.5.3 Competing Hypotheses

5.5.3.1 Prospect Theory

Prospect Theory can be considered a pre-cursor to the disposition effect in securities trading. As already discussed in Chapter 2 and 3, under prospect theory, investors behave as though they are maximising an S-shaped value function. The value function is defined on the basis of gains and losses rather than levels of wealth. Critical to this value function is the reference point from which gains and losses are measured.

The following example is taken from Oehler *et al*. (2003) and demonstrates how the reference point and the reflection effect cause the disposition effect in investment situations.

An investor purchases a stock at £65 and adopts this price as the reference point. Suppose the stock rises to £70, the investor has made a gain relative to the purchase price. Now, suppose the price of the stock rises to £73 or falls to £67 with equal chance. In the first case the gain would be £3 and in the latter case the loss would be £3. Thus the absolute gain would be equal. As a consequence of the concave nature of the value function the possible loss is valued as a much larger decrease. For that reason the investor does not hesitate to sell the stock in order to realise the value added. The investor is risk averse in the domain of gains.

The same investor purchases another stock for £65 and continues to adopt the purchase price as the reference point. This stock depreciates to £60 and thus the investor has made a £5 loss. The price may decrease further to £57 or increase to £63 with equal probability. Due to the convex nature of value function in the domain of losses the additional value of £3 is valued as a small increase, but the possible loss reduction is valued as a much larger decrease. In this situation the investor maintains the stock because there is still a chance the stock may rise to at least the purchase price in the future. The investor is risk seeking in the domain of losses.

Hypothesis 5.1: *Subjects sell more shares when the sale price is above the purchase price than when the sale price is below the purchase price.*

5.5.3.2 Mean Reversion

The disposition effect is restricted to predicting the variation in the number of shares sold. By adopting an experimental setting the effect of stock price movement on buying behaviour can be examined. Buying behaviour is equally important because the prospect-theoretic account may not be the only possible explanation for investors selling shares after they rose in value than after they fell. A competing explanation is that subjects expect mean reversion. There are many definitions of mean reversion, the broadest definition and the one which shall be used in this dissertation is as follows:

An asset model is mean reverting if asset prices tend to fall (rise) after hitting a maximum (minimum).[43]

In this experiment a disposition effect could occur if subjects believe that winning stocks would fall and losers would rise. Andreassen (1988), observes subjects in an experimental setting trade stocks as if they expected short-term mean reversion. Shiller (2000) presents questionnaire results showing that investors believe the market is more likely to bounce back up after a day of heavy losses than to fall further, although the same investors also believe stock returns to be mostly unpredictable.

Empirical studies demonstrate that in the short run (a period up to a month) returns reverse (Lo and MacKinlay, 1988; Lehman, 1990; and Jegadeesh, 1990), However, this trend does not continue when returns are measured over the interval of 3-12 months (Jegadeesh and Titman, 1993) and, for periods greater than 12 months, returns tend to follow the momentum effect. (DeBondt and Thaler (1985)). Of these deviations from the random walk model, the profits generated by the momentum strategy show most robustness to alternative statistical methods and the inclusion of transaction costs.

43 This proposition follows the heuristic that in the long run stocks are cyclical.

However, in this design belief in mean reversion is irrational because stocks that rise are more likely to be positive-trend stocks and are more likely to rise again; similarly losers are likely to continue losing. Nonetheless subjects may mistakenly believe in mean reversion. If they do they should buy stocks that have gained in price more than they buy stocks which lost.

Hypothesis 5.2: *Subjects purchase "losing trend stocks" rather than stocks that have "winning trends"*

5.5.3.3 Status Quo Bias

Research shows that decision makers are often biased toward alternatives that perpetuate the status quo because the disadvantages of exiting appear larger than the advantages (Kahneman *et al*. (1991)). Samuelson and Zeckhauser (1988) label this the *status quo bias*. Psychologists code this a "comfort zone" bias based on research suggesting that breaking from the status quo is, for most people, emotionally uncomfortable. It requires increased responsibility and opening oneself up to criticism. For example, if you introduce a lower-cost/lower-quality version of an existing product to your product line, you may have to confront the trade off between increased profits and the risk of damaging your brand image. Sticking to the status quo is easier because it creates less internal tension.

There are often good reasons, of course, for leaving things unchanged. But, studies show that people assign too much value to the status quo. In one experiment, for example, each participant in a group of students was randomly given a gift consisting of either a coffee cup or a candy bar. When offered the chance to trade with each other, few wanted to exchange for the alternative gift. Apparently, "owning" what they had been given made it appear more valuable.

Lack of complete information, uncertainty, and too many alternatives promote holding to the status quo. For example, many organisations continue to support failing projects due to lack of solid evidence that they've failed. Killing a project may be a good business decision, but it is often uncomfortable for the people involved. Many companies question why so many of their projects fail, but a better question may be, "Why don't they fail sooner?"

Hypothesis 5.3: *Subjects in the brokerage fee group will exhibit less trading than the conditional group as they will remain with the "status quo" in their portfolio having spent £2000 into their selection already.*

5.5.3.4 Documenting the Disposition Effect at the Individual Level

Previous studies differ in the methodology adopted to measure the disposition effect. Shefrin and Statman (1985) and Shapira and Venezia (2001) calculate the length of the round-trip holding period for winners and losers in investors' portfolios. Odean (1998) calculates the disposition effect as the difference between investors' propensity to realise winner and loser stocks in their portfolios. This study utilises the construct proposed by Odean (1998). By assuming individual trades or accounts are independent, Odean (1998) shows there exists the disposition effect at the aggregate level. This study focuses on calculating the *Realised Gain*, *Realised Loss*, *Paper Gain* and *Paper Loss* at the aggregate and individual investor level as these measures facilitate the examination of the cross sectional variation in the disposition effect for individuals with different characteristics.

Particularly, *Proportion of Gains Realised* (*PGR*) and *Proportion of Losses Realised* (*PLR*) are defined as:

$$PGR = Realised\ Gain/(Realised\ Gain + Paper\ Gain) \tag{5.10}$$

$$PLR = Realised\ Loss/\ (Realised\ Loss + Paper\ Loss) \tag{5.11}$$

"Realised Gain/Loss" is defined as the number of winner/loser stocks sold in a portfolio. If a stock's price is higher/lower than its purchase price at the time of calculation, it is considered a winner/loser. The "Paper Gain/Loss" is defined as the number of winner/loser stocks in an investor's portfolio at the time of calculation. The disposition effect is defined as the difference of each investor's *PGR* and *PLR*:

$$\textit{Disposition Effect } (DE) = PGR\text{-}PLR \tag{5.12}$$

A positive disposition effect is considered evidence that this particular investor is more likely to realise gains than losses in his/her portfolio. The bigger the disposition effect, the more likely one investor is to realise winners than losers. Table 5.2 displays the published aggregate values of the disposition effect. Whilst these results are exclusively attributed to aggregate trading data, the same methodology can be employed for individual disposition effects. Whilst the methodology and data may vary there is a common thread to the results: they all report a positive *PGR-PLR* value, i.e. the presence of the disposition effect. Further the global nature of these results discourages the notion that cultural identity has a significant impact on trading behaviour.

There are several reasons why it may be pertinent to measure the disposition effect for each investor. First, as Odean (1998) notes; the aggregate description of average investors will "mask considerable cross-sectional variation" (Odean, pg.1295, 1998) in understanding individual investment behaviour. One limitation of calculating the disposition effect at the aggregate level is that the *PGR* (Proportion of Gains Realised) of one investor does not necessarily correspond to the *PLR* (Proportion of Losses

Realised) of the same investor. As a result, aggregating the total number of paper gains and realised losses is equivalent to treating all investors as one representative agent. This may blur the matching between *PGR* and *PLR* of each individual and disguise the difference in the disposition effect across investors. The focus on computing *PGR*, *PLR* and the disposition effect for each investor thus may sharpen the measurement of the effect.

Study	**Data Description**	***PGR***	***PLR***	***PGR-PLR***
Brown *et al*. (2005)	Australian stock exchange data for investors in 480 IPO and index stocks.	1.02	0.65	0.37
Chiu *et al*. (2003)	Mutual funds in Taiwan, 13377 investor accounts	0.638	0.517	0.21
Dhar and Zhu (2002)	50,000 investors accounts between 1991 and 1996.	0.27	0.16	0.11
Frazzini (2004)	Stock returns and accounting data for 29812 mutual funds between 1980 and 2002.	0.176	0.145	0.031
Odean (1998)	Trading records from 10,000 accounts from brokerage house	0.148	0.098	0.05
Oehler *et al*. (2002)	Experimental market, 490 subjects across call market, continuous trading market and dealer market.			0.20
Raymond *et al*. (2005)	UK managed funds from September 2001 to September 2004	0.9	0.78	0.12
Mean		0.53	0.39	0.16

Table 5. 3: ***Published Aggregate Values of the Disposition Effect***

At the aggregate level, examining the absolute magnitudes of *PGR* and *PLR*, even for two investors with the same disposition effect, their investment behaviour is not necessarily the same. For example, one investor selling 90% of his/her winners and

80% of his/her losers exhibits a disposition effect of 0.1. On the other hand, another investor exhibiting disposition effect of 0.1 sells 20% of his/her winners and 10% of his/her losers. Although, these two investors have the same disposition effect, they are quite different in their overall tendency to trade stocks. Hence, the disposition effect does not depict a complete picture about investors' overall tendency to sell winners and loser stocks. Measuring *PGR* and *PLR* at the individual level allows one to differentiate these investors by examining potential differences in investor characteristics.

Measuring the disposition effect at the individual level could reveal traits pertaining to the individuals' decision-making profile, which would be precluded under an aggregate analysis. Grinblatt and Keloharju (2001) link investor sophistication with the disposition effect. They find a negative correlation between investor sophistication and the propensity of investors to involve themselves with behavioural biases.

Defining an investor as sophisticated is determined by evaluating the underlying demographics of the individual. The more sophisticated demographic groups which have better access to information or better understanding of market forces in setting prices have a smaller disposition effect.

The composition of the subject pool in Experiment III fails to permit an analysis of investor sophistication. However, gender and investor experience are independent variables that can be examined. Investor experience is hypothesised to influence the disposition effect, the rationale being as investors repeat tasks they familiarise themselves with the objectives and perform better than those individuals who perform the same tasks less frequently. This can be distilled into the following pair of hypotheses.

Hypothesis 5.4: *At the individual level, investors will observe the disposition effect.*

Hypothesis 5.5: *Trading Frequency reduces the magnitude of the disposition effect.*

5.5.4 Results

5.5.4.1 Selling Behaviour

The data used in this experiment contains the trading records of 37 subjects. The descriptive statistics are contained in table 5.4a and 5.4b. These display the aggregate trading volume of shares and sales per period across the experimental and conditional treatments. The tabulation of this data permits the inspection of trading patterns amongst subjects within the experiment. The data demonstrates key patterns amongst investor behaviour. Firstly, subjects initiate less trading in the brokerage fee treatment compared to the conditional treatment. Secondly, subjects have a greater propensity to trade in the earlier periods than the later periods. In fact no trading was recorded for any subject in the last 3 periods. Such a trend implies subjects were sensitive to early price movements in their search for the stocks with the highest probability of price rises. Once the subjects believed they had acquired a portfolio weighted by these stocks they appear satisfied to remain with the status quo.

Aggregate Number of Shares Sold Per Period		
Period	Conditional	Experimental
1	11678	2222
2	5010	4950
3	10295	9876
4	7122	3292
5	13040	3532
6	4298	3326
7	6392	1750
8	10250	2178
9	5052	3023
10	340	3502
11	2266	3124
12	0	3250
13	0	0
14	0	0
Total	75743	44025
t-statistic	1.98 (p=0.07)	

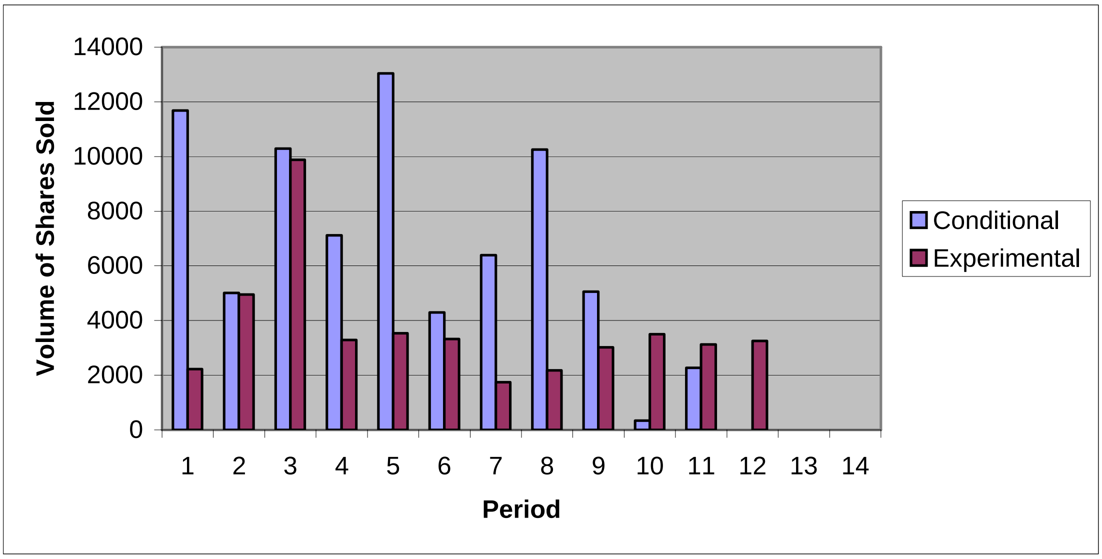


Table 5.4a and Figure 5.2a: ***Aggregate Number of Shares Sold per Period across Treatments***

This table displays the aggregate number of shares sold per period by all subjects in the conditional (£10,000) and experimental (£8,000) treatment. A graphical representation is illustrated in figure 5.2 a.

Aggregate Number of Sales Sold Per Period		
Period	Conditional	Experimental
1	20	2
2	11	11
3	18	21
4	17	6
5	19	7
6	7	16
7	12	10
8	12	12
9	14	6
10	1	12
11	1	5
12	0	5
13	0	0
14	0	0
Total	132	113
t-statistic	0.62 (p=0.55)	

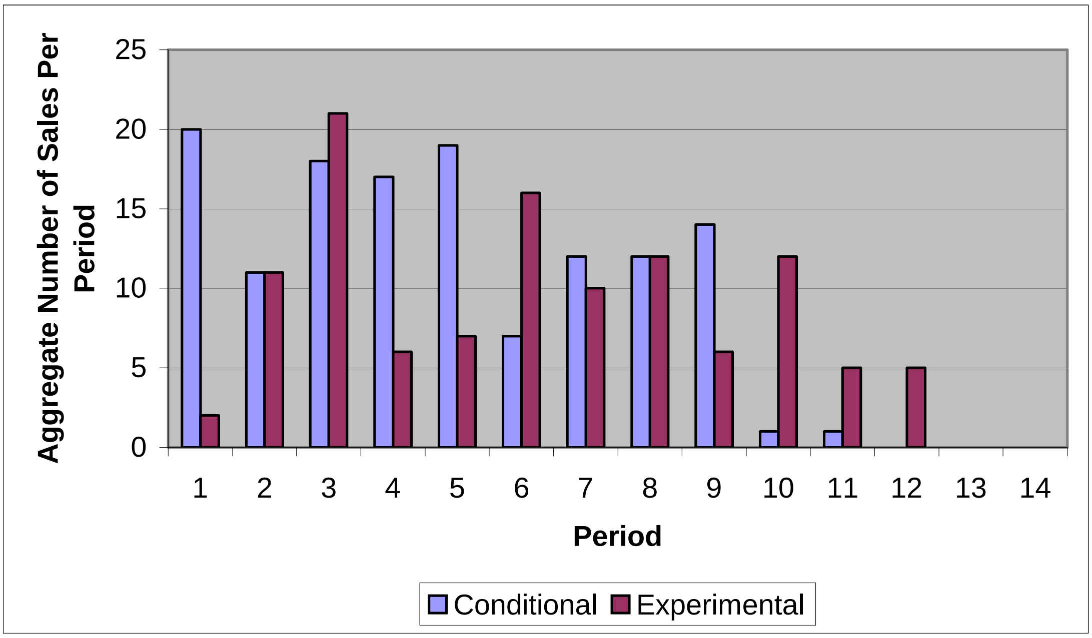


Table 5.4b and Figure 5.2b: ***Aggregate Number of Sales per Period across Treatments***

This table displays the aggregate number of sales per period by all subjects in the conditional (£10,000) and (£8,000) treatments

Hypothesis 5.1 stated that subjects sell more shares when the price is above the purchase price than when the price is below the purchase price i.e. subjects would generate an aggregate level disposition effect. This hypothesis can be determined using a number of quantitative techniques and for robustness of results each will be utilised in this section. Firstly, extracting data from both treatments, segmenting the number of shares sold for each subject across the 12 stocks into gains, break-even and losses subject to the purchase price provides a comparison of the number of shares sold in each of these three categories. If subjects exhibit the disposition effect, the percentage of shares sold that gained in price relative to the purchase price should be greater than the percentage of shares sold that lost or stayed the same in price relative to the purchase price. The accounting method adopted was the "first-in, first-out" (FIFO) principle which assumes that the shares which are sold are those which were bought first.[44]

Table 5.5a and 5.5b shows the number of shares sold after making a gain, breaking even, or making a loss in the £10,000 and £8,000 treatments. Aggregation across the 12 stocks in each treatment illustrates that 62% and 31% respectively of the shares sold were winners and 22% and 41% of the shares sold were losers. Thus, intuitively across treatments there exists a stark contrast in the selling behaviour of the subjects and upon closer inspection one in which there is a significant difference (t=2.09, p=0.05). Certainly in the £10,000 treatment there is clear evidence of the disposition effect, which is consistent with previous research (Weber and Camerer, 1998). Across the 12 stocks, the disposition effect was evident in nine of them. For share E, (0.35 probability period-period share decrease) there was no disposition effect because the stock demonstrated sequential price decreases throughout the game and subsequently the share price never displayed a period-period increase for subjects to display the disposition effect. To a lesser extent the same applies to shares G (0.35 probability period-period share decrease) and K (0.45 probability period-*period share* decrease). Both showed price increases in only two out of the 14 periods. Intuitively in these

44 The other accounting principle is the "last in, first out" (LIFO) principle which assumes that shares which are sold are those which are bought last. This method was also adopted but there were no

stocks, the disposition effect would be difficult to observe because there is only a small proportion of periods to observe period-period price increase.

COMPANY	GAIN	%	EVEN	%	LOSS	%
A	6178	84	710	10	466	6
B	4508	54	922	10	2996	36
C	11634	79	3094	11	0	0
D	2278	62	410	11	986	27
E	504	13	302	8	3073	79
F	3522	91	0	0	200	9
G	1856	21	2200	24	4980	55
H	733	91	72	9	0	0
I	888	96	0	0	37	4
J	1000	67	231	15	267	18
K	805	47	682	39	243	14
L	12978	64	3352	18	3636	18
Total	46884	62	11975	16	16884	22

Table 5.5a: ***Total Number of Shares Traded for £10,000 Treatment using FIFO Method***

This table compares the number of shares that were sold after a gain in price, a loss in price and a no price change relative to the purchase price in the £10,000 treatment (sunk cost treatment). Under the First-In-First-Out (FIFO) assumption, the purchase price in determining realised gains and losses is the average price of earlier purchase(s).

In the £8,000 treatment (Table 5.5b) a much "weaker" disposition effect is observed. Only 31% of the total numbers of shares sold were "winners". Upon first inspection, subjects in this treatment would appear to adopt a more "rational" strategy in portfolio maintenance by identifying the stocks with the smallest probabilities of price appreciation and selling them. However, under closer analysis the disposition effect is observed in 50% of the 12 stocks (C, F, H, I, J and L). Indicative of the disposition

substantial differences in results using the two methods .

effect these stocks exhibit the greatest number of period-period price increases in the experiment thus implying subjects still exhibit a propensity to realise "winners".

COMPANY	GAIN	%	EVEN	%	LOSS	%
A	1782	38	960	21	1930	41
B	554	30	231	12	1084	58
C	2000	51	954	25	909	24
D	779	28	485	17	1511	55
E	0	0	4000	46	4640	54
F	808	73	0	0	300	27
G	468	7	2589	39	3633	54
H	843	68	200	16	200	16
I	648	88	89	12	0	0
J	1327	78	0	0	400	23
K	382	18	400	19	1335	63
L	4243	50	2256	26	2085	24
Total	13834	31	12164	28	18027	41

Table 5. 5b: ***Total Number of Shares Traded for £8,000 Treatment using FIFO Method***

This table compares the number of shares that were sold after a gain in price, a loss in price and a no price change relative to the purchase price in the £8,000 treatment (conditional treatment). Under the First-In-First-Out (FIFO) assumption, the purchase price in determining realised gains and losses is the average price of earlier purchase(s).

Continuing the analysis of selling behaviour amongst subjects, a second test of the hypothesis is shown in Table 5.6. These tables compare in each treatment the average profit on shares sold during the experiment with average profit on shares that were kept to the end of the experimental session. If the disposition effect is present, subjects will sell shares which gain in value and keep shares which lose. Thus, shares kept until the end should yield less profit (or a loss) than shares that were sold during the experiment.

The £10,000 treatment clearly supports this hypothesis and confirms previous research by Weber and Camerer (1998). Subjects realised an average profit of £0.20 per share sold, while shares kept until the end resulted in a loss of £0.10 per share.

In the £8,000 condition subjects generate a much smaller profit from selling their shares, which corresponds to the results presented in Table 5.6. As subjects showed a greater propensity to selling losers than the subjects in the £10,000 treatment it is intuitive to believe that the average profit generated from these sales is likely to yield an overall loss and that is exactly what Table 5.6 illustrates. Subjects lose £0.10 per share sold compared to a gain of £0.10 per share from shares which were left to the end of the experiment.

Stock	**£8,000**		**£10,000**	
	Sold	**Kept**	**Sold**	**Kept**
A	0.1	0.1	0	-0.3
B	0.1	-0.2	0.1	-0.3
C	0	0	0.2	0.1
D	-0.2	-0.1	0.1	-0.4
E	-0.1	-0.1	-0.2	-0.2
F	0.2	0.3	0.3	0.2
G	0	0	-0.1	-0.2
H	0.1	0.1	0.3	0.2
I	0.3	0.4	0.5	0.7
J	0.5	0.6	0.7	0
K	-0.1	0	0.1	0
L	0	0	0.2	-0.1
Total	0.0	0.1	0.2	-0.1

Table 5.6: Average Profit for Shares Sold and Kept until the End £8,000 and £10,000

This table displays the average profit generated for each treatment on shares that were sold during the experiment and shares that remained in the portfolio at the end of the experiment.

Within the framework of the £10,000 treatment, results indicate the presence of a disposition effect. It is pertinent to question when subjects do realise their gains? Is it immediate, i.e. upon one price increase, or does it require sequential price increases for subjects to liquidate their assets? Table 5.7 breaks-down the selling behaviour in both treatments of assets after prices gained in price in two consecutive periods (*GG*), lost then gained (*LG),* remained constant then gained (-*G*), gained then lost (*GL),* lost twice *(LL),* remained constant then lost (-*L*), remained constant twice (--), gained then remained constant (*G-I),* lost then remained constant (*L*-). In the £10,000 condition, approximately twice as many shares were sold when the price rose in the last period (*GG, LG, -G)* as were sold when the price fell (*GL, LL, -L*). The data is consistent with the joint hypothesis that there is a disposition effect and the previous period's price serves as a reference point. The £8,000 condition demonstrates an approximately even distribution of sales across the three price (*G, L, -)* changes in the last period. This weaker effect suggests that the sunk cost shifts how subjects frame their investments: There appears a propensity for less trading and more of a desire to hold onto winning shares. Thus, the sunk cost has seemed to initiate "smarter" investment behaviour amongst the subjects.

		Conditional Treatment		Experimental Treatment	
Price Trend Period t-2	t-1	Volume of Sales	Percentage	Volume of Sales	Percentage
G	G	7660	13	1340	4
L	G	11292	19	2324	6
-	G	10866	18	3097	8
G	L	6296	11	5398	15
L	L	1880	3	7030	19
-	L	9868	17	4119	11
-	-	3834	6	6582	18
G	-	4543	8	1200	3
L	-	2816	5	5763	16
Total		59055		36853	

Table 5.7: ***Volume of Sales in Period t Depending on t-1 and t-2 Period Prices***

This table compares the volume of sales in period t prior to price movements in periods t-1 and t-2 for each treatment. There are nine permutations of possible prior price movements: Gain-Gain, Loss-Gain, "Zero Change"-Gain, Gain-Loss, Loss-Loss, "Zero Change"-Loss, "Zero Change"-"Zero Change", Gain-"Zero Change", and Loss-"Zero-Change""

5.5.4.2 Robustness Tests: Determining PGR and PLR

As stated in Section 5.4.4, the constructs proposed by Odean (1998) to calculate the disposition effect (PGR and PLR) are adopted for this data set. At the aggregate level Tables 5.8a and 5.8b illustrate the findings for each treatment. In the conditional treatment the value of the aggregate value of the disposition effect implies subjects demonstrated a propensity for this phenomenon (0.12). By segmenting the experiment into two halves (Periods 1-7 and Periods 8-14) and examining the disposition effect over these time frames one can determine if there are any differences in investment behaviour over time. The results show there is a much stronger disposition effect in Periods 1-7 (0.12) than in Periods 8-14 (0.09). This reinforces the findings from Table 5.4b; subjects engage more frequently in share selling in the early periods of the experiment than towards the end.

	Entire Experiment	**Periods 1-7**	**Periods 8-14**
Conditional Treatment			
Realised Gains	24778.5	2112.5	3666
Realised Losses	21485	14620	6761
Paper Gains	25532.5	21112.1	4583.1
Paper Losses	36717	24350	12574
PGR	0.49	0.50	0.44
PLR	0.37	0.38	0.35
PGR/PLR	1.33	1.33	1.27
Disposition Effect	0.12	0.13	0.09

Table 5.8a: ***Statistics for Disposition Effect, Conditional Treatment***

This table compares the aggregate Proportion of Gains Realised (*PG*R) to the aggregate Proportion of Losses Realised (*PLR*) of subjects in the conditional treatment (£10,000). A realised gain (loss) is recognised when a sale takes place and its selling price is higher (lower) than the reference price. A paper gain (loss) is recognised when the period of a sale takes place and the net assets value of the portfolio is higher (lower) than the reference price. In period's where no sales take place in an account, no gains or losses, realised or paper are counted. As previously described in this section the accounting principle adopted is the First-In-First-Out procedure. *PGR*, according to Odean (1998), is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and *PLR* is the number of realised losses divided by the number of realised losses plus number of paper (unrealised) losses. Realised gains, paper gains, realised losses, and paper losses are aggregated across the fifteen periods and across all subjects in the treatment. *PGR*, *PLR*, *PGR/PLR* and *PGR-PLR* are reported for the entire experiment, for Periods 1-7, and Periods 8-14.

With respect to the experimental treatment (Table 5.8b), the disposition effect is negligible (-0.03) which concurs with the earlier findings in this section, i.e. fewer "winning" shares are sold and more "losing" shares are realised. As with the conditional treatment subjects "actively" trade in periods 1-7 relative to periods 8-14. However, in this treatment subjects exhibit a larger disposition effect in Periods 8-14 than in Periods 1-7.

	Entire Experiment	**Periods 1-7**	**Periods 8-14**
Experimental Treatment			
Realised Gains	10922	7958	2964
Realised Losses	23781	16991	6790
Paper Gains	33882	20125	13757
Paper Losses	62153	42223	19930
PGR	0.24	0.28	0.18
PLR	0.28	0.29	0.25
PGR/PLR	0.88	0.99	0.70
Disposition Effect	-0.04	-0.01	-0.08

Table 5.8b: ***Statistic s for Disposition Effect: Experimental Treatment***

This table compares the aggregate Proportion of Gains Realised (*PGR*) to the aggregate Proportion of Losses Realised (*PLR*) of subjects in the experimental treatment (£8,000). A realised gain (loss) is recognised when a sale takes place and its selling price is higher (lower) than the reference price. A paper gain (loss) is recognised when the period of a sale takes place and the net assets value of the portfolio is higher (lower) than the reference price. In Period's where no sales take place in an account, no gains or losses, realised, or paper are counted. As previously described in this section the accounting principle adopted is the First-In-First-Out procedure. *PGR*, according to Odean (1998), is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and *PLR* is the number of realised losses divided by the number of realised losses plus number of paper (unrealised) losses. Realised gains, paper gains, realised losses, and paper losses are aggregated across the fifteen periods and across all subjects in the treatment. *PGR*, *PLR*, *PGR/PLR* and *PGR-PLR* are reported for the entire experiment, for Periods 1-7, and Periods 8-14.

5.5.4.3 Purchase of Shares and Mean Reversion

The disposition effect only predicts variation in the number of shares sold. The data permits an investigation into the effect of stock price movement on buying behaviour. Buying behaviour is especially important because prospect theory may not be the only possible explanation for the observed fact that subjects sold more often after shares rose in value than after they fell. A competing explanation is that subjects expected mean-reversion: a disposition effect could occur if subjects thought winner stocks would fall and losers would rise. In our design belief in mean reversion is wrong because stocks that rise are more likely to be positive trend stocks and are more likely to rise again; similarly, losers are likely to continue losing. However, subjects might have mistakenly believed in mean reversion. If they do they should buy stocks that have gained in price, more than they buy stocks, which lost.

COMPANY	GAIN	%	EVEN	%	LOSS	%
A	608	16	1103	29	2134	55
B	773	23	1332	40	1255	37
C	1203	24	1799	36	1995	39
D	508	18	977	35	1805	47
E	0	0	5779	45	6895	55
F	608	28	677	31	918	41
G	0	0	1717	19	7543	81
H	186	16	449	40	496	44
I	1108	51	668	31	400	18
J	285	22	732	58	248	20
K	633	16	628	16	2659	68
L	3753	52	1701	23	1818	25
Total	9655	17	17562	32	28126	51

Table 5.9a: ***Buying Behaviour of Subjects in £10,000 Treatment***

This table compares the number of shares for each stock that were bought after a gain in price, a loss in price and a "zero price" change relative to the original price in the £10,000 treatment (conditional treatment).

COMPANY	GAIN	%	EVEN	%	LOSS	%
A	380	18	0	0	1789	82
B	429	26	431	26	806	48
C	1433	28	1987	39	1663	33
D	388	16	870	37	1102	47
E	0	0	4257	42	5870	58
F	400	22	600	33	800	45
G	1000	8	5430	42	6489	50
H	389	37	453	44	195	19
I	450	30	644	43	398	27
J	0	0	993	67	483	33
K	308	26	300	25	598	49
L	665	16	1232	29	2319	55
Total	5860	13	17197	38	22512	51

Table 5.9b: ***Buying Behaviour of Subjects in £8,000 Treatment***

This table compares the number of shares for each stock that were bought after a gain in price, a loss in price and a "zero price" change relative to the original price in the £8,000 treatment (experimental treatment).

Table 5.9a and 5.9b give the percentage of purchased shares of stocks, which gained in price, remained constant or lost from the starting price. On average subjects bought more after losses than they bought after gains suggesting a belief in mean-reversion. The effect is weaker in the £8,000 condition, with the sunk cost, than in the £10,000 condition.

5.5.4.4 Individual Level Statistics

The disposition effect at aggregate market level for the conditional treatment was 0.12. At the individual level (table 5.10a and 5.10b) the disposition effect is significantly larger 0.25. This difference could be attributed to two reasons. Firstly, the aggregate disposition effect does not capture the idiosyncratic differences between *PGR* and *PLR* for each individual investor. Secondly, since aggregating across all investors assigns more weight to the frequent traders who are predicted to have a lower disposition bias, it reduces the magnitude of the effect.

Although, a value of 0.25 indicates the presence of the disposition effect, 5% of subjects in this treatment displayed no disposition effect and 25% of subjects displayed behaviour opposite to the prediction of the disposition effect.

In the brokerage fee treatment, the market aggregate disposition effect was -0.04. At the individual level (table 5.10b) the disposition effect was 0.08, which again is significantly larger. The breakdown of investor behaviour is more diverse in this treatment. 30% of subjects exhibit no disposition effect, 20% of subjects exhibit behaviour opposite to the behaviour of the disposition effect and 50% exhibit the phenomenon.

	Entire Experiment	Periods 1-7	Periods 8-14
Conditional Treatment			
PGR (Mean)	0.51	0.45	0.26
PLR (Mean)	0.26	0.31	0.23
PGR/*PLR*	1.73	1.85	2.01
Disposition Effect	0.25	0.14	0.03
t-statistic	2.27	2.03	1.52
Kolmogorov Smirnoff Test	0.05	0.28	0.11

Table 5.10a: ***Disposition Effect at Individual Level: Conditional Treatment***

This table offers individual level statistics for the disposition effect for the £10,000 treatment (conditional treatment). The *PGR* and *PLR* values are calculated aggregating the *PGR* and *PLR* for every individual within the data set and dividing by the sample number. The Disposition Effect is calculated as the difference between *PGR* and *PLR*. *PGR*, *PLR*, *PGR*/*PLR* and *PGR-PLR* are calculated across the 14 periods of the game as well as for periods 1-7, and periods 8-15. The t-statistics and the Kolmogorov Smirnoff Tests test the null hypothesis that the difference in proportions is equal to zero assuming that all realized gains, realized losses, and paper losses result from independent decisions.

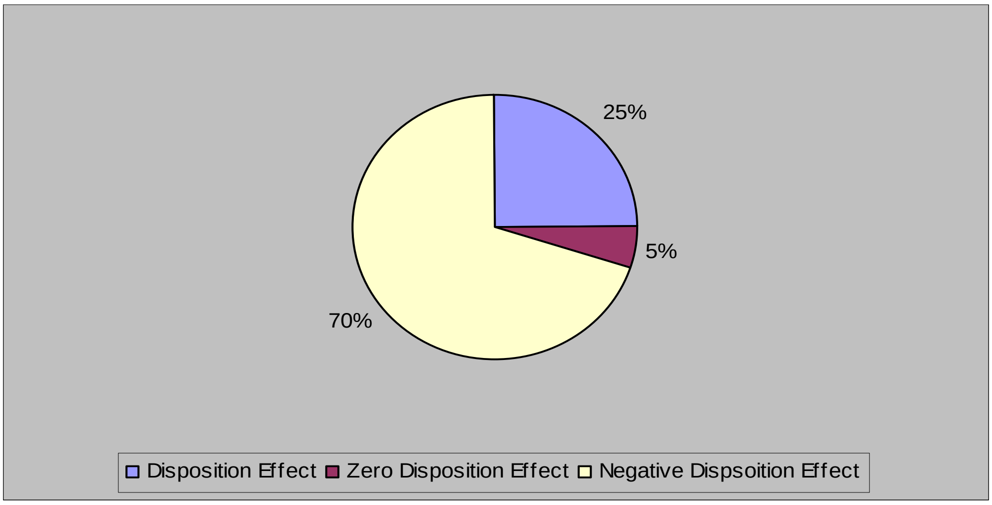


Figure 5.3a: ***Percentage Breakdown of Investment Behaviour in Conditional Treatment***

This pie chart displays categorises the subjects from the conditional treatment (£10,000) into 3 groups based upon the PGR-PLR value (disposition effect). Subjects with a value greater than 1 are assigned to the disposition effect. Subjects with a value less than 1 are assigned to the negative disposition effect and those subjects with a value equal to 0 are assigned the no disposition effect.

	Entire Experiment	Periods 1-7	Periods 8-14
Experimental Treatment			
PGR (Mean)	0.26	0.25	0.15
PLR (Mean)	0.18	0.19	0.18
Disposition Effect	0.08	0.06	-0.03
t-statistic	1.87	0.55	0.09
Kolmogorov Smirnoff Test	0.04	0.17	0.17

Table 5.10b: ***Disposition Effect at Individual Level: Experimental Treatment***

This table offers individual level statistics for the disposition effect for the £8,000 treatment (experimental treatment). The *PGR* and *PLR* values are calculated aggregating the PGR and PLR for every individual within the data set and dividing by the sample number. The Disposition Effect is calculated as the difference between *PGR* and *PLR*. *PGR*, *PLR*, *PGR/PLR* and *PGR-PLR* are calculated across the 15 periods of the game as well as for periods 1-7, and periods 8-15. The t-statistics and the Kolmogorov Smirnoff Tests test the null hypothesis that the difference in proportions is equal to zero assuming that all realized gains, realized losses, and paper losses result from independent decisions.

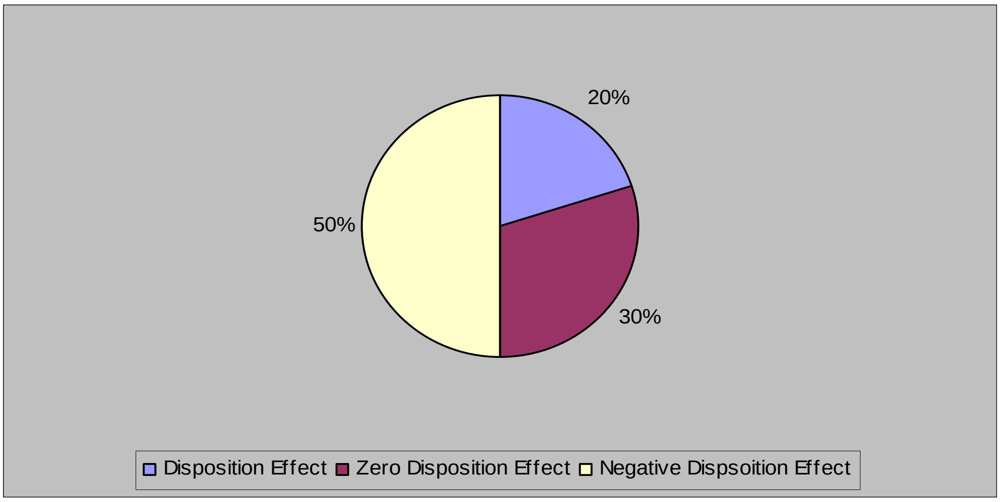


Figure 5.3b: ***Percentage Breakdown of Investment Behaviour in Experimental Treatment***

This pie chart displays categorises the subjects from the conditional treatment (£8,000) into three groups based upon the PGR-PLR value (disposition effect). Subjects with a value greater than 1 are assigned to the disposition effect. Subjects with a value less than 1 are assigned to the negative disposition effect and those subjects with a value equal to 0 are assigned the no disposition effect.

	The Disposition Effect (1)	(2)
Constant	0.38 (2.02)	0.17 (1.28)
Ln (Numtrade)	-0.12 (-1.95)	0.00 (0.01)
Treatment	-0.18 (-1.37)	-0.10 (-1.09)
Gender	0.11 (0.82)	0.11 (1.13)
Return of Realised Gains		0.00 (3.56)**
Return of Realised Losses		-0.00 (3.67)***
Adjusted R Square	0.06	0.58

Table 5.11: ***The Impact of Control Variables on the Disposition Effect***

The regression is specified as follows:

$DE = \gamma D + \beta X + \varepsilon$

The dependent variable is the disposition effect (*DE*). The independent variables include demographic dummy variables of different treatment and gender, the logarithm of the number of trades an investor has executed, the return of realised gains, and the return of realised losses

The implementation of regression analysis provides an extrapolation on the impact of investor characteristics on the disposition effect. The regression function is specified as follows and is adapted from the function utilised by Dhar and Zhu (2002):

$$DE = \gamma D + \beta X + \varepsilon \tag{5.11}$$

Where *DE* is the disposition effect. The *D* matrix contains demographic variables of each investor. Specifically contains dummy variables of "gender" and "treatment". The *X* matrix is composed of information on each investor's idiosyncratic trading pattern. In this specification it includes the logarithm of the number of trades an investor has executed and the realised returns of winning and losing trades of each investor.[45] ε is the error term.

The results are reported in Table 5.11. The result shows that the coefficient for Ln(Numtrade) is negative but insignificant which counters previous arguments to suggest trading frequency helps investors accumulate experience and become more sophisticated about selling losers. Such experience, in turn, helps reduce their disposition effect. The coefficient for control variable "gender" is positive and insignificant which reinforces previous findings suggesting that gender has no influence on the disposition effect.[46]

45 The logarithm is adopted because of its skewed distribution.
46 Surprisingly, the treatment variable has no impact on the disposition effect. Further, the adjusted R-square increases from 0.06 to 0.58, indicating that the magnitude of the realised gains and realised losses has a significantly explanatory power for investors' tendency to observe the disposition effect.

	PGR		*PLR*	
	(1)	(2)	(1)	(2)
Constant	0.14 (1.04)	0.08 (0.34)	-0.20 (-1.79)*	-0.09 (-1.13)
Ln (Numtrade)	0.09 (1.99)*	0.01 (0.34)	0.19 (5.33)***	0.05 (1.55)
Treatment	-0.18 (-1.90)*	-0.08 (-0.09)	-0.02 (-0.20)	0.05 (0.08)
Gender	0.29 (2.98)***	0.22 (2.50)**	0.12 (1.53)	0.71 (1.22)
Return of Realised Gains		0.00 (3.49)***		
Return of Realised Losses				0.00 (5.90)***
Adjusted R Square	0.27	0.45	0.43	0.71

Table 5.12: ***PGR and PLR Regressions***

The regression is specified as follows:

$\boldsymbol{Y = \gamma D + \beta X + \varepsilon}$

The dependent variables of various regressions are Proportion of Gain Realised (PGR), Proportion of Loss Realised (PLR). The independent variables include demographic dummy variables of different gender and treatment, the logarithm of the number of trades that each investor has executed , the return of realised gains, and the return of realised losses.

This dissertation seeks to examine the impact of investor characteristics in the variability of *PGR* and *PLR*, the difference of which determines the disposition effect. As previously stated a regression analysis is performed and is specified as follows:

$$Y = \gamma D + \beta X + \varepsilon \qquad (5.13)$$

Where Y is *PGR* or *PLR* and all other variables are defined as in equation (5.4). Different from the disposition effect regression that includes return of both realised gains and losses, *PGR* regression only includes the return of the realised gains and *PLR* regression only includes the return of realised losses.

The results are reported in Table 5.12. For the *PGR* regression Ln (Numtrade) is positive and significant, meaning that the more investors trade the greater the significance, which again runs counter to the argument that the disposition effect diminishes with investor sophistication. The treatment coefficient is negative and significant, implying the proportion of gains realised is influenced by investors in the conditional treatment. The coefficient for return of realised gains is positive and highly significant. This is as expected. The number of gains realised by subjects affects the *PGR*, the greater the realised gains, the greater *PGR*.

For the *PLR* regression Ln(Numtrade) is highly significant and positive which means the proportion of losses realised is heavily affected by the number of trades of an investor which again generates a finding to suggest investor sophistication does not necessarily diminish the disposition effect. The treatment and gender coefficients are insignificant implying that both subjects from both treatments showed similar patterns of investment behaviour in the context of realising losses. The coefficient return of realised losses is statistically highly significant. One possible explanation is that investors with bigger realised losses also have poorer portfolio performance. As the losses are so deep, investors do not expect further downside risk in their losing stocks and decide not to sell them. In addition the adjusted R-square increases from 0.43 to 0.7 indicating that the magnitude of the realised losses has a highly significant power for investors' tendency to sell loser stocks.

5.5.5 Discussion

5.5.5.1 Selling Behaviour

This dissertation tests firstly, the existence of the disposition effect through an experimental stock market and secondly whether a pre-trading sunk cost affects trading behaviour in this market. At the aggregate level, results indicate the presence of the disposition effect in the conditional treatment (no prior trading cost) i.e. subjects sell a higher proportion of shares that appreciate in price relative to the purchase price than compared to shares that depreciate in price relative to the purchase price. The underlying theory pertaining to the observed investor behaviour in this treatment can be explained by the following statement. According to prospect theory the disposition effects occur because subjects adopt their purchase price as a reference point and are reluctant to recognise losses; they are risk seeking in the domain of losses (by keeping stocks that have lost value) and avoid risk in the domain of gains (by selling stocks that have gained value).

Whilst these results confirm the findings of previous experimental and empirical literature in this domain (Shefrin and Statman 1985; Ferris *et al*. 1988; Oehler, 1994; Oehler, 1995; Odean, 1998; Weber and Camerer, 1998; Grinblatt and Keloharju, 2001; and Oehler *et al*. 2003) the selling behaviour of the individuals in the sunk cost treatment (subjects paid a pre-trading £2,000 brokerage cost) was in the direction against the disposition effect i.e. subjects sold a greater proportion of shares that depreciated in price relative to the purchase price than shares that appreciated in price relative to the purchase price. Not only do subjects in the brokerage fee treatment exhibit a selling behaviour that mimics the systematic behaviour postulated by rational economic theory, the volume of shares in this treatment is significantly smaller[47] than the conditional treatment. If this rationale is correct, it is pertinent to query why should the brokerage fee play such a prominent role in the future decision making of the investor? From previous documented research the answer may be embedded in the behavioural anomaly known as the status quo bias. This phenomenon perpetuates the status quo because the disadvantages of exiting appear larger than the advantages (Kahneman *et al*. 1991). In this experimental setting, promptly after being informed that they have received £10,000 to invest in the stock market they are ordered to relinquish £2,000 as a brokerage cost. The lack of uncertainty and information that this

47 Significant at the 10% level (*P*=0.068).

command could perpetuate is likely to give rise to the status quo bias and would explain the significantly lower volume of trading which occurred in this treatment throughout the experimental session. Furthermore it may explain why the trading methodology of the subjects was inconsistent with the conditional group. Even though the brokerage fee was a unique fee for the experimental group subjects might perceive the brokerage fee as a quasi tax and future transactions would be taxed accordingly to the profit accrued on a stock. A stock being sold at a loss could be perceived as a tax-free strategy for subjects in the experimental group and therefore displayed selling behaviour in the opposite direction of the disposition effect.

5.5.5.2 Mean Reversion induced Disposition Effect

The mean reversion argument claims that losers are not sold, because good performance is expected following bad performance (and vice versa for winners). An investor equipped with these beliefs would tend to sell stocks with paper losses, provided that they have been performing poorly recently. In other words, the disposition effect pattern would be reversed for stocks with such price paths.

Unlike the selling behaviour of the two treatments, the differences in buying behaviour are insignificant. Even though subjects in the experimental group have a much lower propensity to sell "winners" than losers than the conditional group both treatments display a desire to purchase shares that have depreciated in price relative to the original price (the price of the stock in Period 1). Such behaviour would suggest both groups believe in mean reversion, i.e. an autocorrelation of returns. This finding provides further evidence to suggest the experimental group have been affected by the exogenous brokerage cost and in the absence of such a cost their behaviour would draw resonance with the disposition effect.

Whilst this behaviour mimics the findings by Weber and Camerer (1998) it is still irrational to purchase stocks that have under performed as these stocks have a high probability of being the "loser" stocks and subsequently a belief in mean-reversion in this setting is certainly a sub-optimal strategy to accruing gains in this experiment.

5.5.5.3 Individual Level Disposition Effect

The findings from this experiment report that the disposition to sell "winners" and hold "losers" is widely distributed with DE values with a minimum of –1 and a maximum of 1 in both treatments. Consistent with previous research (Odean, 1998; and Dhar and Zhu, 2002) both treatments observe positive mean disposition effects.[48] However, only the conditional disposition effect is statistically significant (t=2.27, D = 0.05). In light of the previous findings in this experiment it is unsurprising to find a statistically insignificant value with regard to the disposition effect. Furthermore, in both

48 The conditional treatment has a *DE* of 0.25102, the experimental treatment has a *DE* value of 0.084956

treatments the disposition effect appears to diminish over time, which supports previous findings that the disposition effect diminishes with experience (List, 2002). The disposition effect is much smaller in the periods 8-14 than periods 1-7.

However, whilst there is a strong indication of the phenomenon present in the conditional treatment there are still 30% of subjects who did not demonstrate such an effect in their trading behaviour. As a consequence, as expected the degree of the disposition effect to a large extent is determined by investor sophistication. Especially in this experiment, subjects should lock-in to the fact that "winning" shares should be easy to spot when a probability model determines prices exogenously. In the experimental group, 50% of investors observe the disposition effect but this statistic partially masks the fact that half of the subjects displaying the disposition effect have *DE* values between 0 and 0.1, indicating a small disposition effect. At the aggregate level, brokerage fee was the driving force of the trading behaviour in this group.

5.5.5.4 Alternative Explanations

As with the previous experiments the results from this experiment are open to alternative explanations. The behaviour in the experimental treatment could reflect a belief that "winning" shares held in the portfolio could appreciate further. Thus, the regret of not maximising the return from the stock is greater than the realised gain accrued from the sale. Such a belief is a consequence of the processes that give rise to regret theory (Bell, 1982). However, such an argument fails to explain why the behaviour is not observed in the domain of "losing" shares. According to Shefrin and Statman (1985) it is the realisation of losses that brings about regret and conversely it is the realisation of gains that begets pride. Such a framework mimics the disposition effect, i.e. the expected behaviour would be for subjects to crystallise the "winners" and hold "losers".

Another explanation is naturally based that subjects in the experimental group observe the instructions more closely and adopt a more "rational" trading strategy. Thus subject "lock-in" to the notion that the underlying framework of exogenously priced probability determined stocks is to identify from previous periods the stocks that have the highest probability of price appreciation. If this is the case it is pertinent to query the buying behaviour of these subjects as both treatments display a propensity for purchasing "loser" stocks. In the conditional group who on average observe the disposition effect this is understandable and expected. In the experimental treatment if subjects were trading by speculating the "high probability" stocks, it would be expected for subjects to display a propensity for stocks with sequential price appreciations. Therefore it is unlikely that the experimental subjects are more aware of the probability distribution than the conditional group.

5.5.5.5 Challenges

The results can be challenged on the following grounds: There was not enough capacity for subjects to learn. Subjects were under time constraints and were information deficient. These challenges will be discussed in turn.

Subjects were allowed to trade in fourteen periods. They were allocated one period to acquaint themselves with the format of the experiment. They were not given enough of an opportunity to become acquainted with the experimental format through trial periods and there is little to be learnt from one period. The predominant feature of all experimental treatments irrespective of what they are testing is the same in this respect. Weber and Camerer (1996) implement three practice trading periods. However, there may be some confusion as to what extent behaviour in the experiment represents deliberate choice or just confusion. That subjects were not simply confused can be seen from all the relevant calculations, such as the calculations of gains, losses, cost of purchase of units, on their own. By checking these calculations, one can determine that subjects understood the basic procedure. All subjects performed their calculations, which is expected with highly educated individuals.

It could be argued that subjects were not allocated sufficient time between periods to calculate their portfolio value and to trade. As already discussed above subjects certainly had enough time to complete their calculations accurately and had enough time to make rational decisions. In real financial markets, professional traders have to make instant decisions if they are to realise gains. This experiment has tried to capture the verisimilitude of real financial markets so that the results are applicable and transferable to the "real world" and as a consequence subjects should behave according to a strict time constraint.

Subjects were presented with several measurements of financial performance about each company and invited to select their portfolio. There is no correlation between any one measure of financial performance given and share performance during the experiment. It could be argued that subjects were given too much information and were trading on the basis of irrelevant financial data at the start of the experiment. Whilst previous experiments in financial markets are based upon a simple and "stripped down" model, this experiment sought a higher degree of verisimilitude to simulate "real" decision making. Ambiguity is present in many facets of everyday life and there is no reason why it should be precluded from experimentation. Furthermore it allows a comparison of results between previous experiments.

5.6 Conclusion

Brokerage fees affect investment behaviour in financial markets. With a prior brokerage fee, the disposition effect is diminished as subjects on average sell more "losers" than "winners". The brokerage fee induces a cognitive predisposition coded the status quo bias. This kind of behaviour has been identified in previous studies (Odean, 1998) using market data when individuals adopt a tax-motivated strategy. In the absence of a brokerage fee subjects on average observe the disposition effect and reinforce previous findings from Weber and Camerer (1996). With respect to buying behaviour the findings report an unjustified belief in mean reversion. It is unjustified because the probability determining methodology incorporated in this experiment alludes to the fact that subjects should be purchasing stocks that display sequential price appreciations. The observed behaviour is in the opposite direction.

These findings should be pertinent to investment management firms, which dedicate themselves to assisting investors make better investments. It is in these firms' best interest to better inform their clients of the existence of the disposition bias and its implications.

Finally, trading experience seems to ameliorate the disposition effect, which supports other findings showing that experience can eliminate some market anomalies (List, 2002). However, trading frequently has also been shown to be hazardous to investors' wealth (Barber and Odean, 2001), indicating that it is rather costly to alleviate behavioural bias through trading.

Chapter 6

Conclusions, Contributions, Observations and Future Work

6.1 Conclusions

This dissertation presents an experimental analysis of the impact of sunk costs in corporate acquisitions and financial markets. The objective of this dissertation is to contribute to the understanding of individual decision making by examining sunk cost accounting in the following contexts. Firstly, when faced with a sunk cost that comprises a larger investment decision, is the sunk cost ignored? Secondly, do opponents' sunk costs affect one's own future investments? (the transmission of sunk costs across investors) and finally, do external costs affect investment behaviour in endogenously driven sunk cost environments?

6.1.1 Impact of Peripheral Sunk Costs on Investment Decision Making

In Experiment I, subjects assume the role of a CEO of an oil exploration company that is preparing a takeover bid of a competitor. In a two-round bidding process, subjects must submit a bid which is a function of the following five issues: *price per share of target company*, *research and development budget for Site A*, *research and development budget for Site B*, *the number of overseas offices that would close* and the *level of debt that would be acquired by the target company*. In each issue, subjects are presented with the range of values they can offer coupled with the value that maximises their payoff. Their payoff is negatively correlated to the value they offer. As a pre-cursor to this experiment, an attitude to risk assessment is conducted to observe subjects' risk posture and to initiate a sunk cost. The sunk cost is then transmitted across into Experiment I. The purpose of the experiment is to examine whether peripheral sunk costs influence investment decision-making.

Results from Experiment I provide evidence to suggest individuals are influenced by peripheral sunk costs. Ordinary least squares regression confirmed subjects conceded less to their opponent in the issue that had the sunk cost attached. Furthermore, across periods subjects increase their commitment in the issue. This behaviour of increased risk taking by making fewer concessions in the sunk cost issue after a loss in the attitude to risk component of the experiment, reflects escalation of commitment. The break-even group, as conjectured, displayed no escalation of commitment and were not influenced by the attitude to risk component. In general, subjects adopted a policy of offering the mid-point concession in each issue.

6.1.2 The Transmission of Sunk Costs across Bidders

Experiment II continues with a corporate acquisition context but in this case examines the transmission of sunk costs across investors in a first-price sealed-bid common-value auction. As CEO's, subjects must decide whether to purchase additional information regarding the acquisition of the target company. Subjects must acknowledge whether they wish to purchase the information. Independent of their decision, subjects are informed of whether rival bidders purchased the information. This is the sunk cost. In the sunk cost treatment, subjects are informed that all competing bidders purchased the information and in the conditional treatment, subjects are notified that none of their rival bidders purchased the information.

Findings suggest subjects assigned to the experimental condition exhibit a propensity to be influenced by the sunk costs of competing bidders. Subjects drive the bid in the direction of these sunk costs, demonstrating similar behaviour to a previous study of the transmission of sunk costs between bidders and sellers (Diekmann *et al*. 1996).
In the conditional treatment, subjects submit a bid, which is lower than the valuation, irrespective of the information they have.

The experiments suggest the phenomenon of sunk cost accounting is not exclusive to the within-person designs that have dominated the literature in this doamin. In interactive bargaining and bidding, peripheral sunk costs are just as pertinent and salient to future decision making as within-person sunk costs.

6.1.3 The Disposition Effect in Financial Markets

In financial markets there exists an analogous phenomenon to the sunk cost effect: the disposition effect. It is a descriptive theory based upon the selling behaviour of investors in stock markets. In such an environment, individuals demonstrate systematic propensity to sell recently purchased shares that have appreciated relative to the purchase price and a reluctance to sell shares that have depreciated in price since they were purchased. Such behaviour violates the efficient market hypothesis, which assumes investors are "rational traders"

Using a virtual stock market based upon Weber and Camerer's (1998) model, the experiment seeks to determine how individuals will treat an up-front brokerage fee in an experimental stock market. Two groups, one with a brokerage fee and one without are compared and their trading behaviour analysed. Subjects with the brokerage fee trade less frequently throughout the experiment and exhibit less of a propensity to sell "winning" shares rather than losers. The brokerage fee induces a cognitive predisposition coded the status quo bias. This kind of behaviour has been identified in previous studies (Odean, 1998) using market data when individuals adopt a tax-motivated strategy. Subjects without the brokerage fee observe the disposition effect i.e. selling a greater majority of "winning shares" than "losing shares." This pattern supports the findings of Weber and Camerer (1998)

With respect to buying behaviour, the findings report an unjustified belief in mean reversion. It is unjustified because subjects are informed of the probability of the stocks appreciating in price in any period. Thus, as the game progresses, subjects should be able to identify the stocks with the greater probability of appreciation. The observed behaviour is in the opposite direction i.e. subjects purchase stocks that have demonstrated sequential price decreases.

Finally, trading experience seems to ameliorate the disposition effect, which supports other findings showing that experience can eliminate some market anomalies (List, 2003). However, trading frequently has also been shown to be hazardous to investors' wealth (Barber and Odean, 2001), indicating that it is rather costly to alleviate behavioural bias through trading.

6.2 Contributions of this Work

The findings of this dissertation contribute to the greater field of experimental economics in three directions:

Firstly, this dissertation extends the sunk cost literature to a relatively unexplored area of investment decision making, i.e. sunk cost accounting beyond a "within-person" process. As detailed in Chapter 2, examining sunk costs in an interpersonal process has been confined to Diekmann *et al*. (1996) on property negotiations. This dissertation presents a novel experiment on sunk costs across bidders in a first-price sealed bid common-value auction. It is anticipated such an experiment will stimulate further interest in this area by examining the benefits of sunk costs.

Secondly, the work shows subjects are able to identify and acknowledge sunk costs in a merger and acquisition context and that use of deception in experimentation can be advantageous. Subjects displayed no suspicious effects of being deceived in the experiment. Such work indicates that deception may not be a necessary evil for experimental studies, which supports the evidence presented by Bonetti, (1998). These results merit the extension of this work and the use of deception as a measure to enhance experimental control without fear of ill effects upon future subjects.

Finally, Experiment III provides a modified experimental design of Weber and Camerer's (1998) stock market. It shows that external, unanticipated costs can diminish future irrational behaviour. This effect provides the behavioural finance literature with a novel observation and the encouragement to determine other factors that reduce behavioural biases within financial markets.

6.3 Entrapment Avoidance

The preceding chapters have demonstrated the driving forces mediating sunk cost accounting and entrapment. As a consequence, this section presents strategies that can ameliorate this phenomenon.

6.3.1 Increase Saliency

Increasing the saliency of sunk costs should enable individuals to recognise the factors that lead to entrapment and thus avoid falling blindly into decisions that harm them.

For example, if the sunk costs associated with the Taurus Project (refer to chapter 1.21 for a detailed account) had been recognised earlier, the stock exchange could have cut its losses much sooner and with it saved millions of pounds.

6.3.2 Active Decision Making

The approach to decision making should be rational and systematic: it should identify the potential challenges in attaining goals; and construct several scenarios for possible changes in economic, regulatory, or agency conditions. With this approach, it is possible to (1) identify probable costs that would be incurred if short-term goals take longer than expected to materialize, and (2) prepare cost-benefit analyses to determine if projected benefits would be worth the probable long-term commitment of resources. Entrapment can occur with passive administrative renewals, such as with the automatic billing of services that requires active decisions to stop services.

With further reference to the Taurus case, executives in 1992 refused to spend more money for additional staff as negative feedback mounted and pressure increased to channel further funds into the project. This was a symbolic move because it represented the first serious attempt to assert control over Taurus and began to shape how others viewed it. Whilst the executives were far too removed from Taurus and waited far too long to take action, when they did take control of the project, they moved effectively to cancel it and prevent further harm.

The practice of automatically renewing project budgets falls into this category as well. Zero-based budgeting,[49] which requires an active approach to continued commitment of resources, is a valuable active decision-making strategy that can reduce entrapment.

6.3.3 Consider Alternatives

If exogenous factors, such as economic shocks or natural disasters, might produce a poor outcome for a project, managers tend to increase commitment to a project. Because it can be difficult to identify the "real" reasons for failure (e.g., whether failure is due to bad luck or more to unrealistic projections), entrapment is more likely to occur. It would be advantageous to work through various scenarios for project costs and revenues (best, worst, and average cases) to differentiate the relative contribution of bad luck versus poor planning. Understanding how little of the problem may really lie in bad luck lets managers make more rational decisions about continuing commitments. The notion of bringing in an external auditor - to conduct a project assessment is a technique that can promote de-escalation by providing an independent third-party perspective. In the Taurus case, external consultants provided valuable ammunition that the executive was later able to use in persuading the board to cancel

49 The objective of Zero Based Budgeting is to "reset the clock" each year. While a traditional budgeting process allows managers to start with last year's expenditures and add a percent for inflation to come up with next year's budget, Zero Based Budgeting implies that managers need to build a budget from the ground up, building a case for their spending as if no baseline existed -to start at zero.

the project. Consultants can be a powerful way to identify and legitimise alternative courses of action, while at the same time reducing an executive's exposure to risk.

6.3.4 Limit Setting

Individuals should set a limit on the resources to be invested before embarking on a project. Once the limit is reached, it is far easier to reconsider the value and expected benefits of further investment and then if necessary, decide to discontinue the project, if necessary. The limit provides a justifiable escape route for managers if the project does not attain the desired goals. Teger (1980) found that setting limits publicly induces individuals to commit only to the designated value, as it may be brought up later in order to permit the decision maker to quit while appearing consistent and without losing face.

If Nick Leeson had adopted this strategy by implementing stop loss orders on his investments, then it could have precluded the mounting losses in his trading account. Thus, preventing Leeson from highly irrational trading strategies culminating in the bankruptcy of Barings Bank.

6.3.5 Review Decisions

Individuals need to anticipate all that might go wrong and prepare an exit strategy to get out so resources can be saved. Also, obtaining perspectives from individuals who are not responsible for the initial decision can reveal innovative strategies. Such a situation occurred in 1988 when Robert Campeau initiated a hostile takeover bid for

Federated Department Stores. A highly public bidding war ensued between Campeau and Macys, which Campeau eventually won with an irrational act, bidding over $500 million. However, shortly after Campeau declared bankruptcy. Once Robert Campeau tried to acquire Federated, he probably considered data that supported and confirmed that decision, and ignored data that contradicted it. According to Bazerman and Neale (1983), this operation is prevalent. It is easy to identify this "confirmation trap." Individuals make a tentative decision (e.g., to buy a new car, to hire a particular employee, to start research and development on a new product line). They subsequently search for data that supports their decision before making the final commitment. However, few search for data that challenges it. A manager committed to a basic strategy is likely to be biased in favour of the data consistent with it.

6.3.6 Reframe Decisions

Individuals should be aware of how to frame their decision to end a losing project. Sunk costs almost always come into play, and many managers do not know how to defend themselves against the argument of so much time and money has been committed to the investment how can we abandon it? In fact in some instances a project may be tied so integrally to the values and purposes of an organization that it becomes institutionalised. Pan American airlines exhibited characteristics of such a situation. In the late 80's Pan Am suffered major losses as the airline came to terms with deregulation of the airline industry. As losses accumulated, it sold off most of its non-airline assets. Initially the Pan Am building was sold to meet debt obligations, which was subsequently followed by the sale of the Intercontinental Hotel chain. Finally, Pan Am was forced to sell its valuable Pacific routes to United Airlines.

Withdrawing from the real estate and hotel business was probably an easier decision for the organisation than ending the more institutionalised airline operations, irrespective of the economics involved.

Individuals need to emphasize future cost savings. In self-defence, managers need to carefully frame their decisions as ultimately "saving resources" rather than as "losing resources." With this approach, a change of mind may not be held against the manager.

It is necessary to evaluate the approach to evaluations. In some organisations, managers who stick to their guns—even if doing so harms the organization—receive better evaluations than managers who experiment with different approaches. This creates a paradox: If a manager chooses not to pursue a failing project, then the organization is better off, but the manager may be perceived as being "wishy-washy."

6.4 Future Work

Given that the three experiments were designed and developed specifically to test the research questions presented in this dissertation, several areas of additional work have emerged for consideration.

1. Further examination of the effect of sunk costs in negotiation contexts. Whilst this dissertation has provided evidence to suggest sunk costs influence negotiations, there is much to be learnt in this area by investigating the role of sunk costs in various negotiation contexts. Furthermore, it may also play a

role in the analysis of the effect of complementary cognitive biases upon CEO's in merger and acquisitions. For instance, could the reason for such a large percentage of M&A's resulting in failure be a direct result of the overconfidence of the acquiring company CEO's? This dissertation conjectures initial overconfidence of CEO's in their belief of improving the corporate performance of the target company generates sunk cost accounting, once the acquisition has taken place. The rationale for this being poorly performing companies are acquired under the false belief of the CEO who overestimates the probability of "turning around" the fortunes of the target company. Once the acquisition takes place, the CEO realises the sunk cost of purchasing the company and escalates commitment to low probability events to generate a return comparable with initial expectations. Thus, is overconfidence a pre-cursor to sunk cost accounting?

2. The experiments were concerned with the sunk costs of buyers, but future work should consider the sunk costs of sellers in negotiations and supplement earlier work by Diekmann *et al*. (1996). It might also consider such contexts as how previous transfer fees affect future sell-on fees in sports, most notably in European football. The existence of players who fail to perform at a level consistent with the level of the transfer fee paid by a football club is pervasive throughout the major leagues of Europe. Take for example, Blackburn Rovers who in 1997/98 finished 6th in the English Premier League. In the 1998/99 season the club spent £38 million on purchasing new players and subsequently relegated from the league. Player performance (or a lack of it!) would appear to have been a major determinant of Blackburn's failure to compete in the

Premier League. As a result when these players were later sold, it may well be the case that the price Blackburn Rovers paid not only affected the club, but also potential buyers. Research on actual negotiations may provide further evidence of the sunk cost effects documented in this dissertation.

3. The extension of sunk costs across buyers and sellers in auctions. This dissertation provides evidence to suggest sunk cost transmit across sellers, in a private, first-price, sealed-bid auction. Further research should follow to determine whether sunk costs are pervasive across common value, first-price, sealed bid auctions and other derivatives of auctions such as English, Dutch and second price. The implications of this research would develop the understanding of the phenomenon in such an important arena of individual and corporate investments. This would provide the possibility of adopting bidding strategies that are shifted towards the optimal models posited in the literature.

4. The extension of cognitive biases and their effects in financial markets. The findings in this dissertation reinforce previous work from behavioural finance that when individual investors are able to trade "freely", i.e. without transaction costs and taxes, they on aggregate adopt a strategy that closely follows the disposition effect. Such a finding appears robust in stock markets but to the author's knowledge there exists no prior work that deals with the effect of the impact of this phenomenon in foreign exchange markets. These markets are less actively traded by the private investor but evidence from equity markets suggest professional institutional investors are not immune from the phenomenon so this dissertation hypothesises institutional investors

will succumb to a similar phenomenon in the trading of global currencies. An analogue of the experimental design used in Experiment III could be adopted, exchanging the companies for global currencies.

The experiments from this dissertation have extended the sunk cost and behavioural literature. It is hoped that these experiments will be developed further in the future and re-evaluated within a variety of other contexts.

Bibliography

- Ali, M., M. (1977) “Probability and Utility Estimates for Racetrack Bettors,” *Journal of Political Economy*, (n.85, pp. 803 –15)

- Ali, M., M. (1979) “Some Evidence on the Efficiency of a Speculative Market,” *Econometrica*, (n. 47, pp. 387-392)

- Allais, M. (1953) “Le Competent de L’homme Rationnel Devant le Risque: Critique des Postulats et Aximoes de L’ecole Americane,” *Econometrica,* (n. 21, pp. 503-546)

- Allgood, S., and Farrell, K., A. (2000) “The Effect of CEO Tenure on the Relation Between Firm Performance and Turnover,” *Journal of Financial Research*, (n. 23(3), pp. 373-390)

- Andreassen, P. (1988) “Explaining the Price-Volume Relationship: the Difference Between Price Changes and Changing Prices,” *Organizational Behavior and Human Decision Processe*s, (n.41, pp.371-389).

- Andreoni, J., and Vesterlund, L., (2001) “Which is the Fair Sex? Gender Differences in Altruism,” *Quarterly Journal of Economics*, (n. 116, pp. 293-312)

- Angner, E. (2002) “Levi’s Account of Preference Reversals,” *Economics and Philosophy,* (n. 18(2), pp.289-304)

- Ariely, D., Lowenstein, G., and Prelec, D. (2002) “Coherent Arbitrariness”: Stable Demand Curves without Stable Preferences,” *The Quarterly Journal of Economics*, (n. 118(1), pp. 73-105)

- Arkes, H., R., and Ayton, P. (1999) “The Sunk Cost and Concorde Effects: are Humans less Rational than Lower Animals?” *Psychological Bulletin*, (n. 125, pp. 591-600)

- Arkes, H.R and Blumer, C. (1985) “The Psychology of Sunk Cost,” Organizational *Behavior and Human Decision Processes*, (n. 35, pp 125-140)

- Arrow K. (1971) *Essays in the Theory of Risk-Bearing,* IL: Markham Publishing Company

- Barber, B., M., and Odean, T. (2001) “Boys will be Boys: Gender, Overconfidence and Common Stock Investment,” *Quarterly Journal of Economics*, (n. 116, pp. 261-292)

- Barberis, N., Huang, M., and Santos, T. (2001) “Prospect Theory and Asset Prices,” *Quarterly Journal of Economics,* (n.116, pp. 1-53)

- Barberis, N., Shleifer, A., and Vishny, R., A. (1998) “A Model of Investor Sentiment,” *Journal of Financial Economics,* (n. 49, pp. 307-343)

- Barberis, N., and Thaler, R., E. (2001) “A Survey of Behavioral Finance” in the *Handbook of Economics and Finance*, edited by Constantinides, G., Harris, M., and Stulz R.

- Bazerman, M., H. (1982) “Impact of Personal Control on Performance: Is Added Control Always Beneficial?” *Journal of Applied Psychology*, (n. 67, pp. 472-479)

- Bazerman, M., H. (1984) “The Relevance of Kahneman and Tversky's Concept of Framing to Organizational Behavior,” *Journal of Management*, (n.10, pp. 333-343)

- Bazerman, M. H., and Neale, M., A. (1983) “Heuristics in Negotiations: Limitations to Effective Dispute Rresolution,” in *Negotiating in Organizations*, edited by Bazerman, M. H., and Lewicki, R., J. (Beverly Hills London: Sage)

- Bazerman, M., H., and Samuelson, W., F. (1983) “I Won the Auction but Don't Want the Prize,” *Journal of Conflict Resolution*, (n. 27, pp. 618-634)

- Beins, B., C. (1993) “Perception on Computer: A Diverse Approach,” *Contemporary Psychology*, (n. 38, pp. 100-101)

- Bell, D., E. (1982) “ Regret in Decision Making Under Uncertainty,” *Operations Research,* (n. 30, pp. 961-981)

- Benartzi, S., and Thaler, R., E. (1995) “Myopic Loss Aversion and the Equity Premium Puzzle,” *Quarterly Journal of Economics,* (n. 110, pp. 73-92)

- Benartzi, S. and Thaler, R., E. (2001) “Naive Diversification Strategies in Defined Contribution Savings Plans,” *The American Economic Review*, (n. 1, pp. 79-98)

- Berg, J., E., and Rietz, T., A. (2002) “Longshots, Overconfidence and Efficiency on the Iowa Electronic Market,” *Tippie College of Business Working Paper*.

- Binmore, K., Shaked, A., and Sutton J. (1985) “Testing Noncooperative Bargaining Theory: A Preliminary Study,” *American Economic Review,* (n. 75, pp. 1178-1180)

- Binswanger H., P. (1980) “Attitudes Toward Risk: Experimental Measurement in Rural India,” *American Journal of Agricultural Economics,* (n. 62, pp. 395-407)

- Binswanger H., P. (1981) “Attitudes Toward Risk: Theoretical Implications of an Experiment in Rural India,” *Economic Journal,* (n. 91, pp. 867-890)

- Bird, R., McCrae, M. and Beggs, J. (1987) “Are Gamblers really Risk Takers?” *Australian Economic Papers*, (n. 26(49), pp. 237-253)

- Blecherman, B., and Camerer, C., F. (1998) "Is there a Winner's Curse in the Market for Baseball Players?" Mimeograph, Brooklyn Polytechnic University, Brooklyn, New York

- Bolton, G., E. and Katok, E. (1995) "An Experimental Test for Gender Differences in Beneficent Behavior," *Economic Letters*, (n. 48, pp. 287-92)

- Bonetti, S., M. (1998) "Experimental Economics and Deception," *Journal of Economic Psychology*, (n. 19, pp. 377-395)

- Bostic, R., Herrnstein, R., J, and Luce, D. (1990) "The Effect on the Preference-Reversal Phenomenon of Using Choice Indifferences." *Journal of Economic Behavior and Organizatio*n, (n.13, pp. 193-212)

- Bowen, M., G. (1987) "The Escalation Phenomenon Reconsidered. Decision Dilemmas or Decision Errors?" *Academy of Management Review,* (n. 12, pp. 52-66)

- Bowman, D., Minehart, D. and Rabin, M., (1999) "Loss Aversion in a Consumption Savings Model," *Journal of Economic Behavior and Organization*, (n. 38, pp. 155-178)

- Brandts, J., Saijot, and Schram, A. (2004) "A Four Country Comparison of Spite and Cooperation in Public Goods Games," *Public Choice* (n. 119, pp. 381-424)

- Bremer, M., and Kato, K. (1996) "Trading Volume for Winners and Losers on the Tokyo Stock Exchange," *Journal of Financial and Quantitative Analysis*, (n. 31, pp. 127-142)

- Brislin, R. (1983) "Cross Cultural Research in Psychology," *Annual Review of Psychology,* (pp. 363-400)

- Brockner, J. (1992) "The Escalation of Commitment to a Failing Course of Action: Toward Theoretical Progress," *Academy of Management Review*, (n. 17(1), pp. 39-61)

- Brockner, J., and Rubin, J., Z. (1985) *Entrapment in Escalating Conflicts: A social Psychological Analysis*. (New York: Springer-Verlag)

- Brockner, J., Rubin, J.Z., and Lang, E. (1981) "Face–saving and Entrapment," *Journal of Experimental Social Psychology*, (n. 17, pp. 68-79)

- Bromiley P., and Curley S., P. (1992) "Individual Differences in Risk Taking," in *Risk Taking Behavior*, edited by Yates, J., F. (London: John Wiley and Sons, pp. 88-132)

- Brown, P., Chappel, N., Da Silva Rosa, R., and Walter, T. (2005): "The Reach of the Disposition Effect: Large Sample Evidence Across Investor Classes" *International Review of Finance*, (n. 6, forthcoming)

- Bruce, A., C., and Johnson, J., E., V. (1999) "Toward an Explanation of the Favourite-longshot Bias: A decision-making Perspective," University of Southampton*, Discussion Papers in Accounting and Management Science* (pp. 99 – 145.)

- Busche, K. (1994) "Efficient Market Results in an Asian Setting," in *Efficiency of Racetrack Betting Markets*, edited by Hausch, D., B., Lo, V., and Ziemba, W., T. (San Diego, California: Academic Press, pp. 615-616)

- Busche, K., and Hall, C., D. (1988) "An Exception to the Risk Preference Anomaly," *Journal of Business*, (n. 61, pp. 337-346)

- Busche, K., and Walls,W., D. (2001) "Breakage and Betting Market Efficiency: Evidence from the Horse Track," *Applied Economics Letters*, (n.8, pp. 601 –4)

- Cadsby, C., B and Maynes, E. (2005) "Gender, Risk Aversion and the Drawing Power of Equilibrium in an Experimental Corporate Takeover Game," *Journal of Economic Behavior*, (n. 56(1), pp. 39-59)

- Camerer, C., F. (1998) "Social Preferences in Dictator, Ultimatum and Trust Games," *Working Paper*, California Institute of Technology.

- Camerer, C., F., and Hogarth., R., M.(1999) "The Effects of Financial Incentives and Experiments: a Review of Capital Labour-Production Framework," *Journal of Risk and Uncertainty,* (n.7, pp. 7-42)

- Cameron, L., A. (1999) " Raising the Stakes in the Ultimatum Game: Experimental Evidence from Indonesia," *Economic Inquiry*, (n. 37, pp.47-59)

- Campbell, J., Y., and Ammer, J. (1993) "What Moves Stock and Bond Markets? A Variance Decomposition for Long-Term Asset Returns," *The Journal of Financ*e, (n.48, pp.3-38)

- Cassing, J., and Douglas, R., W. (1980) "Implications of the Auction Mechanism in Baseball's Free Agent Draft," *Southern Economic Journal*, (n. 47,pp. 110-21)

- Chamberlain, E. (1948) "An Experimental Imperfect Market," *Journal of Political Economy*, (n. 56(4), pp. 95-108)

- Chapman, G. B., and Johnson, E., J. (1999) "Anchoring, activation, and the construction of values," *Organizational Behavior and Human Decision Processes,* (n. 79, pp. 115-153.)

- Chevalier, J, and Ellison, G. (1999) "Are Some Mutual Fund Managers Better than Others? Cross-Sectional Patterns in Behaviour and Performance?" *The Journal of Finance*, (n. 54, pp. 875-899)

- Chiu, S., Chen, H., Yeh, Y., and Shu, P. (2002) “Does Yearend Sweep Ameliorate the Disposition Effect of Mutual Fund Investors?” *Working Paper*

- Chow, C., Harrison, P., Lindquist, T., and Wu, A. (1997) “Escalating Commitment to Unprofitable Projects: Replication and Cross-Cultural Extension,” *Management Accounting Research* (n. 8, pp. 347-361)

- Christensen, L. (1977). “The negative Subject: Myth, Reality, or a Prior Experimental Experience Effect?” *Journal of Personality and Social Psychology*, (n. 35, pp. 392–400)

- Chu, Y., and Chu, R. (1990) “The Subsidence of Preference Reversals in Simplified and Market like Experimental Settings,” *American Economic Review*, (n. 80, pp. 902-911)

- Clotfelter, C., T. and Cook, P., J. (1993) “The Gamblers Fallacy in Lottery play,” *Management Science*, (n. 12, pp. 1521-1525)

- Coleman, L. (2004) “New Light on the Longshot Bias,” *Applied Economics*, (n. 36, pp. 315-326)

- Conlon, D.E., and Garland, H. (1993) “The role of project completion information in resource allocation decisions,” *Academy of Management Journal* (n. 36, pp. 402-413)

- Conlon, D.E., and Garland, H. (1998) “Too Close to Quit: The Role of Project Completion in Maintaining Commitment,” *Journal of Applied Psychology,* (n. 28, pp. 2025-2048)

- Conlon, E.J, and Parks, J., M. (1987) “ Information requests in the context of escalation,” *Journal of Applied Psychology,* (n. 72(3), pp. 344-350)

- Conslik J. (1989) “Three Variants on the Allais Example,” *American Economic Review,* (n. 79(3), pp. 392-407)

- Constantinides, G., M. (1984) “Optimal Stock Trading with Personal Taxes: Implications for Prices and the Abnormal January Returns,” *Journal of Financial Economics*, (n. 13, pp. 65-69)

- Cooper, D., J., Kagel, J., H., Lo, W., and Gu, Q., L. (1999) “Gamint Against Managers in Incentive Systems: Experimental Results with Chinese Students and Chinese Managers,” *American Economic Review*, (n. 89, pp. 781-804)

- Copeland, T., E. (1976) “A Model of Asset Trading Under the Assumption of Sequential Information Arrival,” *The Journal of Finance,* (n. 31, pp. 1149-1168)

- Coval, J., D., and Shumway, T. (2005) “Do Behavioral Biases Affect Prices?” *Journal of Finance*, (n. 60, pp. 1-34)

- Crafts, N. (1985) “Some Evidence of Insider Knowledge in Horse Race Betting in Britain,” *Economica*, (n. 52, pp. 295-304)

- Crafts, N. (1994) “Winning Systems? Some Further Evidence on Insiders and Outsiders in British Horse Race Betting,” In *Efficiency of Racetrack Betting Markets*, edited. by D., B., Hausch, S., Y., Lo, and W., T., Ziemba, (London Academic Press, pp. 545-549)

- Cubitt R., P., Starmer C., and Sugden R. (1998) “Dynamic Choice and the Common Ratio Effect an Empirical Investigation,” E*conomic Journal,* (n. 108, pp.1362-1380)

- Curver B. (2003) *Enron: Anatomy of Greed - The Unshredded Truth form an Insider*, Carroll and Graff

- Cutler, D., M., Poterba, J., and Summers, L., H. (1990) “Speculative Dynamics and the Role of Feedback Traders,” *American Economic Review*, (n. 80, pp. 63-68)

- Daniel, K., Hirschleifer, D., and Subrahmanyam, A. (1998) “Investor Psychology and Security Market Under-and Overreactions, *The Journal of Finance*, (n. 53(6), pp. 839-1855)

- Davis, D., and Holt, C. (1993), *Experimental Economics*, (Princeton: Princeton University Press)

- De Bondt, W., F. M., and Thaler R. (1985) “Does the Stock Market Overreact?” *The Journal of Financ*e, (n.40, pp.793-805).

- DeBondt, W., F., M., and Thaler, R., H. (1995) “Financial Decision Making in Markets and Firms: A Behavioural Perspective,” in *Financial Handbooks in Operations Research and Management Science* edited by Jarrow, R., A., Maksimovic, V., and Ziemba, W., T. (n.9, pp. 385-410, North Holland, Amsterdam)

- Dessauer, J., P. (1981) *Book Publishing*, New York: Bowker

- Dhar, R., and Zhu, N. (2002) “Up Close and Personal: An Individual analysis of the Disposition Effect,” *Yale ICF Working Paper*, (n.2 (20), pp. 1-37)

- Diekmann, K., A., Tenbrunsel, A., E., Shah, P., P., Schroth, H., A., and Bazerman, M., H. (1996) “The Descriptive and Prescriptive Use of Previous Purchase Price in Negotiation,” *Organizational Behavior and Human Decision Processes*, (n. 66, pp. 179-191)

- Dittrich, D., Güth, W., and Maciejovsky, B. (2005) “Overconfidence in Investment Decisions: An Experimental Approach,” *The European Journal of Finance*, (n.11 (6), pp. 471-491)

- Dumas, B., Fleming, J., and Whaley R., E. (1998) "Implied Volatility Functions: Empirical Tests," *The Journal of Finance*, (n. 53, pp. 2059-2106)

- Dyer, D., Kagel, J., and Levein, D. (1989) "A comparison of Naïve and Experienced Bidders in Common Value Auctions: A laboratory Analysis," *Economic Journal,* (n. 99, pp. 108-115)

- Eckel, C., C., and Grossman, P., J. (2001), "Chivalry and Solidarity in Ultimatum Games," *Economic Inquiry*, (n. 39, pp. 171-188)

- Einhorn, H., J., and Hogarth, R., M. (1978) "Confidence in Judgment: Persistence of the Illusion of Validity," *Psychological Review*, (n. 85, pp. 395-416)

- Einhorn, H., J., and Hogarth, R., M. (1986) "Decision Making Under Ambiguity," *Journal of Business*, (n. 59(4), pp. 225-250)

- Eisenhauer, J., G., and Ventura, L. (2003) "Survey Measures of Risk Aversion and Prudence," *Applied Economics*, (n.35, pp. 1477-14840)

- El-Sehity, T., Haumer, H., Helmenstein C., Kirchler, E., and Maciejovsky B. (2002) "Hindsight Bias and Individual Risk Attitude within the Context of Asset Markets," *Journal of Psychology and Financial Markets*, (n. 3(4), pp. 227-235)

- Englich, B., and Mussweiler, T. (2001) "Sentencing under uncertainty: Anchoring effects in the courtroom," *Journal of Applied Social Psychology*, (n.31, pp.1535-1551).

- Falk, A., and Fehr, E. (2003) "Why Labour Market Experiments?" *Labour Economics*, (n. 10, pp. 402)

- Fama, E., F., and French, K., R. (1996) "Multifactor Explanations of Asset Pricing Anomalies," J*ournal of Finance*, (n.51, pp. 55-84)

- Fehr, E., Fischbacher, U., and Tougavera, E. (2002) "Do High Stakes and Competition Remove Fairness? - Evidence from Russia," *Discussion Paper,* University of Zurich.

- Fehr, E., and List, J. (2004) "The Hidden Costs and Returns of Incentives-Trust and Trustworthiness among CEO's," *Journal for the European Economic Association*, (n. 2(5), pp. 743-771)

- Fehr, E., and Tougavera, E. (1995), "Do Competitive Markets with High Stakes Remove Reciprocal Fairness? Experimental Evidence from Russia," *Working paper*, Institute for Empirical Research in Economics, University of Zurich

- Fellner, G., and Maciejovsky, B, (2002) "Risk Attitude and Market Behavior: Evidence from Experimental Asset Markets," *Discussion Papers on Strategic Interaction*, Max Planck Institute of Economics, Strategic Interaction Group

- Ferris, S., P., Haugen, R., A., and Makhija, A., K. (1988) "Predicting Contemporary Volume with Historic Volume at Differential Price Levels: Evidence Supporting the Disposition Effect," *The Journal of Finance*, (n. 43, pp. 677-699)

- Festinger, L. (1957) *A Theory of Cognitive Dissonance*, (Evanston, IL: Row, Peterson)

- Figlewski, S. (1989), "What Does an Option Pricing Model Tell Us About Option Prices," *Financial Analysts Journal*, (n. 45(5), pp. 12-15)

- Flood, M., M. (1952) "Some Experimental Games," *Management Science*, (n. 5(1), pp. 5-26)

- Forsells, M., and Kenny G. (2002) "The Rationality of Consumers' Inflation Expectations: Survey-Based Evidence for the Euro Area," European Central Bank Working Paper No. 163

- Fox, F.V., and Staw, B.M. (1979) "The trapped administrator: Effects of job insecurity and policy resistance upon commitment to a course of action," *Administrative Science Quarterly*, (n. 24(3), pp. 449-471)

- Frazzini, A. (2004) "The Disposition Effect and Under-Reaction to News," *Working Paper*, Yale ICF (n. 04-24)

- French K., R., and McCormick, R., E. (1984) "Sealed Bids, Sunk Costs, and the Process of Competition," *The Journal of Business*, (n. 57, pp. 417-441)

- Friedman, M., and Savage, L., P. (1948) "The Utility Analysis of Choices Involving Risk," *Journal of Political Economy*, (n. 56, pp.279-304)

- Galinsky, A., and Mussweiler, T. (2001) "First Offers as Anchors: The Role of Perspective-taking and Negotiator Focus," *Journal of Personality and Social Psychology*, (n. 81(4), pp.657-669)

- Galinsky, A., Mussweiler, T., and Medvec, V. H. (2002) "Disconnecting Outcomes and Evaluations: The Role of Negotiator Focus," *Journal of Personality and Social Psychology*, (n.*8*3 (5), pp.1131-1140.)

- Garland. H. (1990) "Throwing Good Money After Bad: The Effect of Sunk Costs on the Decision to Escalate Commitment to an Ongoing Project," *Journal of Applied Psychology*, (n. 75, pp. 728-731)

- Gibbons, R., and Murphy, K. (1992) "Optimal Incentive Contracts in the Presence of Career Concerns: Theory and Evidence," *Journal of Political Economy*, (n.100, pp. 468-505)

- Gilovich, T., Medvec, V., H., and Savitsky, K. (2000) "The Spotlight Effect in Social Judgment: An Egocentric Bias in Estimates of the Salience of One's Own Action," *Journal of Personality and Social Psychology*, (n. 78(2), pp211-222)

- Gilovich, T., Savitsky, K., and Medvec, V., H. (1998) "The Illusion of Transparency: Biased Assessments of Others' ability to Read one's Emotional States," *Journal of Personality and Social Psychology*, (n.75 (2), pp332-346.)

- Grable, J., E., and Lytton, R., H. (1998) "Investor Risk Tolerance: Testing the Efficacy of Demographics as Differentiating and Classifying Factors," *Financial Counseling and Planning*, (n. 9(1), pp. 61-73)

- Grether, D., and Plott, C. (1979) "Economic Theory and the Preference Reversal Phenomenon," *American Economic Review*, (n. 69, pp. 623-638)

- Griffith, R., M. (1949) "Odds Adjustment by American Horse-Race Bettors," *American Journal of Psychology*, (n. 62, pp. 290-294)

- Grinblatt, M., and Keloharju, M. (2001) "What Makes Investors Trade?" *Journal of Finance*, (n. 56(2), pp. 598-616)

- Grinblatt, M. and Moskowitz, T., J (2004) "Predicting Stock Price Movements from Past Returns: the Role of Consistency and Tax-loss Selling," *Journal of Financial Economics*, (n. 71, pp. 541-579)

- Güth, W., Scmittberger, R., and Schwarze, B. (1982) "An Experimental Analysis of Ultimatum Bargaining," *Journal of Economic Behaviour and Organization*, (n. 75, pp. 367-388)

- Güth, W., and Tietz, R. (1988) "Ultimatum Bargaining for a Shrinking Cake-an Experimental Analysis," in *Bounded Rational Behaviour in Experimental Games and Markets*, edited by Tietz, R., Albers, W., and Selten R. (Springer: Berlin)

- Gutter, M., S., Saleem, T., and Gross, K. (2003) "Are there Gender Differences in Risk Tolerance or is it just a Question of Measurement?" *Consumer Interests Annual*, (n. 49, pp. 1-12)

- Harris, M., and Raviv, A. (1993) "Differences of Opinion Make a Horse Race," *Review of Financial Studie*s, (n.6, pp.473-506)

- Harrison G. (1986) "An Experimental Test for Risk Aversion," *Economic Letters*, (n. 21(1), pp. 7-11)

- Harrison, G. (1989) "Theory and Misbehavior in First-Price Auctions," *American Economic Review*, (n. 79(4), pp. 749-762)

- Harrison G., W., Johnson E., McInnes M., M., and Rustrom E., E. (2003) "Individual Choice in the Laboratory: Paradox Reloaded," working paper 03-18, Department of Economics, University of Central Florida

- Harrison G., Lau M., I., and Williams M., B. (2002) "Estimating Individual Discount Rates for Denmark: A Field Experiment," *American Economic Review*, (n. 92(5), pp. 1606-1617)

- Harrison G., W., Lau M., I., Rustrom E., E., and Sullivan M., B. (2004), "Eliciting Risk and Time Preferences using Field Data: Some Methodological Issues," in *Field Experiments in Economics*, edited by Carpenter, J., Harrison, G., W., and List J., A. *Research in Experimental Economics*, (n.10, Greenwich, CT: JAI Press)

- Harrison G., W., and List J., A. (2003) "Field Experiments," *Journal of Economic Literature*, (n.42, pp. 1009-1055)

- Hausch, D., B., Lo, V., and Ziemba, W., T. (1994) *Efficiency of Racetrack Betting Markets*, (Academic Press, San Diego)

- Heath, C. (1995) "Escalation and De-escalation of Commitment in Response to Sunk Costs: The Role of Budgeting in Mental Accounting," *Organizational Behavior and Human Decision Processes*, (n. 62(1), pp. 38-54)

- Heisler, J. (1994) "Loss Aversion in Futures Markets: An Empirical Test," *Review of Futures Markets*, (n. 13, pp. 793-822)

- Henery, R., J. (1985) "On the Average Probability of Losing Bets on Horses with Given Starting Price Odds," *Journal of Royal Statistical Society Series A* (*General*), (n. 148, pp. 342-349)

- Hey, J., D. (1991) *Experiments in Economics*, (Blackwell, Oxford)

- Hey, J., D, (1998) "Experimental Economics and Deception: Comment," *Journal of Economic Psychology*, (n. 19, pp. 397-401)

- Hill, C., W., L., and Phan, P. (1991) "CEO Tenure as a Determinant of CEO Pay," *Academy of Management Journal*, (n. 3, pg. 707-717)

- Hirscleifer, D. (2001) "Investor Psychology and Asset Prices," *The Journal of Finance*, (n. 56(4), pp. 1533-1597)

- Hirschleifer, D., K., and Subrahmanyam, A. (1998) "Investor Psychology and Security Market Under and Overreactions," *The Journal of Finance*, (n.53, pp. 1839-1855)

- Ho, D., Y., F. "On the Concept of Face," *American Journal of Sociology*, (n. 81 pp. 867-884)

- Hodges, S., D., Tompkins, R., G., and Ziemba, W., T. (2002) "The Favourite Longshot Bias in S&P 500 and FTSE Index Futures Options: The Return to Bets and the Cost of Insurance," *Working Paper*

- Hofstede, G. (1980) *Cultures Consequences: International Differences in Work-Related Values*, (Beverley Hills, CA, Sage Publishing)

- Hofstede, G. (1991) *Cultures and Organizations: Software of the Mind*, (, London, McGraw-Hill)

- Holt, C., A., and Laury, S., K. (2002) "Risk Aversion and Incentive Effects," *American Economic Review*, (n. 92(5), pp. 1644-1655)

- Hong, H., and Stein, J., C. (1999) "A Unified Theory of Underreaction, Momentum Trading and Overreaction in Asset Markets," *The Journal of Finance*, (n. 54, pp. 2143-2184)

- Jackson D. N., Hourany N., and Vidmar N., J. (1972) "A Four Dimensional Interpretation of Risk Taking," *Journal of Personality*, (n. 40, pp.433-501)

- Jegadeesh, N. (1990) "Evidence of Predictable Behavior of Security Returns," *The Journal of Financ*e, (n.45, pp. 881-898)

- Jegadeesh, N., and Titman, S. (1993) "Returns to Buying Winners and Selling Losers: Implications of Stock Market Efficiency," *The Journal of Finance*, (n.48, pp. 65-91)

- Jianakoplos, N., A., and Bernasek, A. (1998) "Are Women more Risk Averse?" *Economic Inquiry*, (n. 36(4), pp. 620-630)

- Johnstone, D. (2003) "The Reverse Sunk Cost Effect and Explanations Rational and Irrational," *Theory and Decision*, (n. 53(3), pp. 209-242)

- Joyce, E., E. and Biddle, G., C. (1981) "Anchoring and Adjustment in Probabilistic Inference in auditing," *Journal of Accounting Research*, (n. 19(1), pp. 120-145)

- Julien, B., and Salanié, B. (2000) "Estimating Preferences Under Risk: The Case of Racetrack Bettors," *Journal of Political Economy*, (n. 108, pp. 503-530)

- Julien, B., and Salanié, B. (2002) "Empirical Evidence on the Preferences of Racetrack Bettors," University of Toulouse, Working paper.

- Kachelmeier S., J., and Shehata M., (1992) "Examining Risk Preferences Under High Monetary Incentives: Experimental Evidence from the People's Republic of China," *American Economic Review*, (n. 82(5), pp. 1120-1141)

- Kagel, J., H., and Levin, D. (1986) "The Winner's Curse and Public Information in Common Value Auctions," *American Economic Review*, (n. 76(5), pp. 894-920)

- Kagel, J., H., Levin, D., Battalio, R., and Meyer, D., J. (1989) "First-Price Common Value Auctions: Bidder Behavior and the Winner's Curse," *Economic Inquiry*, (n. 27, pp. 241-58)

- Kagel, J., H., MacDonald, D., N., and Battalio, R., C. (1990) "Tests of 'Fanning Out' of Indifference Curves: Results from Animal and Human Experiments," *American Economic Review*, (n. 80, pp. 912-921)

- Kahneman, D. (1992) "Reference Points, Anchors, Norms and Mixed Feelings," *Organizational Behavior and Human Decision Processes*, (n.51, pp. 296-312)

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

- Kahneman D., Knetsch J., and Thaler R. (1991) "Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias," *Journal of Economic Perspectives*, (n. 5, pp. 193-206)

- Kahneman, D., and Lovallo (1993) "Timid Choices and Bold Forecasts. A cognitive Perspective on Risk Taking," *Management Science*, (n.39, pp.17-31)

- Kahneman, D., Slovic, P., and Tversky, (1982) (eds) *Judgement Under Uncertainty: Heuristics and Biases,* (New York: Cambridge University Press)

- Kahneman, D., and Tversky, A. (1973) "On the Psychology of Prediction," *Psychological Review*, (n.80, pp. 237-251)

- Kahneman, D., and Tversky, A. (1974) "Judgement Under Uncertainty: Heuristics and Biases," *Science*, (n. 185, pp. 1124-1131)

- Kahneman, D., and Tversky, A. (1979) "Prospect Theory: an Analysis of Decision Under Risk," *Econometrica*, (n. 47(2), pp. 263-292)

- Kahneman D., and Tversky A. (1992) "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *Journal of Risk and Uncertainty*, (n.5, pp. 297-323)

- Keil, M. (1995) "Pulling the Plug: Software Project Management and the Problem of Project Escalation," *MIS Quarterly*, (n. 19(4), pp. 421-447)

- Keil, M., and Montealegre, R. (2000) "Cutting Your Losses: Extricating Your Organization When a Big Project Goes Awry," *Sloane Management Review*, (n. 41(3), pp. 55-67)

- Kirchler, E., Maciejovsky, B., and Weber, M. (2001) "Framing effects on Asset Markets: An Experimental Analysis," Working Paper*,* National Research Center Quantification and Simulation of Economic Processes at the Humboldt-University of Berlin.

- Klein, P. (2001) "The Capital Gain Lock-In Effect and Long Horizon Return Reversal," *Journal of Financial Economics*, (n.59, pp. 33-62)

- Klemperer, P. (1999) “Auction Theory: a Guide to the Literature,” *Journal of Economic Surveys*, (n.13, pp. 227-286)

- Kray, L. J., Thompson, L., and Galinsky, A. (2001) “Battle of the sexes: Gender Stereotype Activation in Negotiations,” *Journal of Personality and Social Psychology*, (n. 80, pp. 942-958.)

- Krupat, E., and Garonzik, R. (1994). “Subjects’ Expectations and the Search for Alternatives to Deception in Social Psychology,” *British Journal of Social Psychology*, (n. 33, pp. 211–222)

- Lakonishok, J., and Smidt, S. (1986) “Volume for Winners and Losers: Taxation and Other Motives for Trading,” *The Journal of Finance,* (n. 38, pp. 1157-1179)

- Ledyard, J., (1995) “Public Goods a Survey of Experimental Research,” in *Handbook of Experimental Economics*, edited by Kagel, J., and Roth, A. (Princeton: Princeton University Press, pp.111-194)

- Leeson, N. (1996) *Rogue Trader*, Little, Brown and Company

- Lehman, B., N. (1990) “Fads, Martingales, and Market Efficiency,” *Quarterly Journal of Economic*s, (n.105, pp. 1-28)

- Lichtenstein, S., and Slovic, P. (1971) “Reversal of Preferences Between Bids and Choices in Gambling Decision,” *Journal of Experimental psychology*, (n.89, pp. 46-55)

- Lichtenstein, S., and Slovic, P. (1973) “Response-Induced Reversals of Preference in Gambling Decisions: An Extended replication in Las Vegas,” *Journal of Experimental Psychology*, (n. 101, pp. 16-20)

- List, J., A. (2003), “Does Market Experience Eliminate Market Anomalies?” *Quarterly Journal of Economics*, (n. 118, pp. 41-71)

- Lo, A., W., and MacKinlay, C., A. (1988) “Stock Market Prices do not Follow Random Walks: Evidence from a Simple Specification Test,” *Review of Financial Studie*s, (n.1, pp. 41-66).

- Locke, P., R., and Mann, S., C. (2005) “Do Professional Traders Exhibit Loss Realisation Aversion?” *The Journal of Finance*, (n. 60 (1), pp. 523-534)

- Loomes, G., and Sugden, R. (1982) “Regret Theory: An Alternative Theory of Rational Choice Under Uncertainty,” *Economic Journal*, (n. 92, pp. 805-824)

- March J., G., and Shapira Z. (1987) “Managerial Perspectives on Risk and Risk Taking,” *Management Science*, (n. 33, pp. 1404-1418)

- Markowitz, H. (1952) “Portfolio Selection,” *The Journal of Finance*, (n. 7(1), pp. 77-91)

- Maskin, E., and Riley, J. (2000) "Equilibrium in Sealed High Bid Auctions," *The Review of Economic Studies*, (n. 67(3), pp. 439-454)

- McAfee R., P., and McMillan, J. (1987) "Auctions and Bidding," *Journal of Economic Literature*, (n. 25(2), pp. 699-738)

- McCain, B., E. (1986) "Continuing Investment under Conditions of Failure: A Laboratory Study of the Limits to Escalation," *Journal of Applied Psychology*, (n. 71, pp. 280–284)

- McEnally, R., W. (1974) "A Note on the Return Behaviour of High Risk Common Stocks," *The Journal of Finance*, (n. 29(1), pp. 199-202)

- McNeill, B.J., Pauker, S., J., Sox, H., C., and Tversky, A. (1982) "On the Elicitation of Preferences for Alternative Therapies," *New England Journal of Medicine*, (n.356, pp. 1259-1262)

- Mercer Management Consulting (1997) *Report on Mergers and Acquisitions*.

- Mestelman, S., and Feeny D, H. (1988) "Does Ideology Matter?: Anecdotal Experimental Evidence on the Voluntary Provision of Public Goods," *Public Choice*, (n. 57, pp. 281-286)

- Metzger, M., A. (1985) "Biases in Betting: An Application of Laboratory Findings," *Psychological Reports*, (n. 56, pp. 883-888)

- Meyerowitz, B., E., and Chaiken, S. (1987) "The Effect of Message Framing on Breast Self-Examination Attitudes, Intentions and Behavior," *Journal of Personality and Social Psychology*, (n. 52(3), pp. 500-510)

- Milgrom, P., R., and Weber, R., J. (1982) "A Theory of Auctions and Competitive Bidding," *Econometrica*, (n.50, pp. 1089-1122)

- Milgrom, P., R., and Weber, R., J. (1985) "Distributional Strategies for Games with Incomplete Information," *Math. Operations Research*, (n. 10(4), pp. 619-632)

- Milgrom, P. (2004) *Putting Auction Theory to Work*, Cambridge University Press.

- Monk, A. (1999) "The Effects of Individual Differences and Anonymity on Commitment to Decisions: Preliminary Evidence," *The Journal of Social Psychology*, (n. 139, pp. 496-516)

- Morck, R., Shleifer, A., and Vishny, R. (1988) "Management Ownership and Market Valuation: An empirical analysis," *Journal of Financial Economics*, (n.20, pg. 293-315.)

- Morrison, R., S. and Ordeshook, P. (1975) "Rational Choice, Light Guessing and the Gambler's Fallacy," *Public Choice*, (n. 22, pp. 78-89)

- Mussweiler, T., and Strack, F. (2000a) "The "relative self": Informational and Judgmental Consequences of Comparative Self-evaluation," *Journal of Personality and Social Psychology*, (n. 79(1), pp23-38).

- Mussweiler, T., and Strack, F. (2000b) "The Use of Category and Exemplar Knowledge in the Solution of Anchoring Tasks," *Journal of Personality and Social Psychology,* (n.78, pp.1038-1052.)

- Mussweiler, T., Strack, F., and Pfeiffer, T. (2000) "Overcoming the Inevitable Anchoring Effect: Considering the Opposite Compensates for Selective Accessibility," *Personality and Social Psychology Bulletin,* (n. 26(9), pp.1142-1150).

- Neale, M., A., and Bazerman, M., H. (1985) "The Effects of Framing and Negotiation Overconfidence on Bargaining Behaviors and Outcomes," *Academy of Management Journal*, (n. 28, pp. 34-49)

- Neale, M., A., and Bazerman, M., H. (1991) *Cognition and Rationality in Negotiation*, (New York: The Free Press)

- Neuman, J., and Morgenstern, O. (1944), *Theory of Games and Economic Behaviour*, (Princeton University Press, Princeton)

- Newman, M., and Sabherwal, R. (1996) "Determinants of Commitment to Information Systems Development: A Longitudinal Investigation," *MIS Quarterly*, (n. 20(1), pp. 23-54)

- Northcraft, G., B. and Neale, M., A. (1987) "Expert, Amateurs, and Real Estate: An Anchoring-and-Adjustment Perspective on Property Pricing Decisions," *Organizational Behavior and Human Decision Processes*, (n. 39, pp. 228-241)

- Northcraft, G., and Wolf, G. (1984) "Dollars, Sense, and Sunk Costs: A Life-Cycle model of Resource Allocation Decisions," *Academy of Management Review*, (n. 9, pp. 225-234)

- Nowell, C., and Tinkler, S. (1994) "The Influence of Gender in a Non-Cooperative Game," *Journal of Economic Behavior and Organization*, (n. 25, pp. 25-36)

- Nulden, U. (1996) "Failing Projects: Harder to Abandon than Continue," in *Journees de Projectique*, (Bayonne. France: San Sebastien, pp, 63-73)

- Odean, T. (1998) "Are Investors Unable to Realize their Losses?" The *Journal of Finance*, (n. 53, pp. 1775-1798)

- Odean, T. (1999) "Do Investors Trade too Much?" *American Economic Review,* (n. 89, pp. 1279-1298)

- Oehler, A. (1994) "Behavioral Patterns of Individual Investors," *Schmalenbach Business Review*, (n. 46, pp. 939-958)

- Oehler, A. (1995) *Private Investor Behavior*, (Stuttgart)

- Oehler A., Heilmann, K., Läger V., and Oberländer M. (2003) "Coexistnce of Disposition Investors and Momentum Traders in Stock Markets: Experimental Evidence," *Journal of International Financial Markets, Institutions and Money*, (n. 13(5), pp. 503-524)

- Ochs, J., and Roth, A., (1989) "An Experimental Study of Sequential Bargaining," *American Economic Review* (n. 79, pp 355-384)

- Parrino, R. (1997) "CEO Turnover and Outside Succession: a Cross Sectional Analysis," *Journal of Financial Economics*, (n.46, pg. 165-197)

- Phillips, O., R., Battalio, R., C., and Kogut, C., A. (1991) "Sunk and Opportunity Costs in Valuation Bidding," *Southern Economic Journal*, (n. 58(1), pp. 112-128)

- Plax, T., and Rosenfeld, L. (1976) "Correlates of Risky Decision Making," *Journal of Personality Assessment*, (n. 40, pp. 413-418)

- Plous, S. (1989) "Thinking the Unthinkable: the Effects of anchoring on Likelihood Estimates of Nuclear war," *Journal of Applied Social Psychology*, (n.19 (1), pp. 67-91).

- Poterba, J., M. and Weisbenner, S., J. (2001) "Capital Gains Tax Rules, Tax-Loss Trading and Turn-of-the-Year Returns," *The Journal of Finance*, (n. 56(1), pp. 353-368)

- Pratt, J., W. (1964) "Risk Aversion in the Small and in the Large," *Econometrica*, (n. 32, pp.122-36)

- Quandt, R., E. (1986) "Betting and Equilibrium," *Quarterly Journal of Economics*, (n.49, pp. 201-207)

- Rao, V., S, and Monk, A. (1999) "The Effects of Anonymity and Individual Differences on Commitment to Decisions: Preliminary Evidence," *Journal of Social Psychology*, (n. 139(4), pp. 496-515)

- Rabin, M. (2000) "Risk Aversion and Expected Utility Theory: a Calibration Theorem," *Econometrica*, (n. 68, pp. 1281-1292)

- Raiffa, H. (1982) *Art and Science of Negotiation*, Harvard University Press.

- Raymond, D., To, H., M., and Walter, T. (2005) "Evidence Contrary to the Disposition Effect Amongst UK Managed Funds," *Working Paper*

- Reber, F. (1985) *A Dictionary of Psychology*, London: Penguin

- Rietz, T., A. (1993) “Implementing and Testing Risk-Preference-Induction Mechanisms in Experimental Sealed-Bid Auctions,” *Journal of Risk and Uncertainty*, (n. 7, pp. 199-213)
- Ritter, J., R. (1988) “The Buying and Selling Behavior of the Individual Investors at the Turn of the Year,” *The Journal of Finance*, (n. 43, pp. 701-717)
- Ritter, J., R. (2003) “Behavioral Finance,” *Pacific-Basin Finance Journal*, (n. 11(4), pp. 429-437)
- Roll, W. (1984) “Orange Juice and Weather,” *American Economic Review*, (n.74, pp. 861-880)
- Roll, W. (1986) “The Hurbis Hypothesis of Corporate Takeovers,” *Journal of Business*, (n. 2, pp. 197-216)
- Ross, J., and Staw, B.M. (1986) "Expo 86: An Escalation Prototype," *Administrative Science Quarterly*, (n. 31(2), pp. 274-297).
- Ross, J., and Staw, B.M. (1993) “Organizational Escalation and Exit: Lessons from the Shoreham Nuclear Plant,” *Academy of Management Journal*, (n. 36(4), pp. 701-732)
- Roth, A., E. (1995) “Introduction to Experimental Economics,” in *Handbook of Experimental Economics*, edited by Roth, A., E., and Kagel, J., H. (Princeton University Press, Princeton)
- Rowenhurst, G., K. (1998) “International Momentum Strategies,” *The Journal of Finance*, (n. 53, pp. 267-284)
- Rubenstein, A. (1985) “A Bargaining Model with Incomplete Information about Time Preference,” *Econometrica*, (n. 53, pp. 1151-1172)
- Rubenstein, A. (1994) “Implied Binomial Trees,” *The Journal of Finance*, (n. 49, pp. 771-818)
- Rubin, J.Z., and Brockner, J. (1975) “Factors affecting entrapment in waiting situations: The Rosencrantz and Guildenstern effect,” *Journal of Personality and Social Psychology*, (n. 31, pp. 1054-1063)
- Samuelson, P., A. (1954) “The Pure Theory of Public Expenditure,” *Review of Economics and Statistics*, (n. 36(4), pp. 387-399)
- Samuelson, W., and Zeckhauser, R. (1988) “Status Quo Bias in Decision Making,” *Journal of Risk and Uncertainty*, (n. 1, pp. 7-59)
- Schein, E. (1985) *Organizational Culture & Leadership*, (New York, Harcourt Brace Jovanovic)

- Seguino, S., Stevens, T., and Lutz, M. (1996) “Gender and Cooperative Behavior: Economic Man Rides Alone,” *Feminist Economist*, (n. 2, pp. 1-21)

- Selten, R., Sadrieh, K., and Abbink, K. (1999) “Money Does Not Induce Risk Neutral Behaviour, but Binary lotteries do Even Worse,” *Theory and Decision*, (n. 46, pp. 211-249)

- Sexton D., L., and Bowman N., B. (1985) “The Entrepreneur: a Capable Executive and More,” *Journal of Business Venturing*, (n. 1(1), pp. 129-140)

- Shapira, Z., and Venezia, I. (2001) “Patterns of Behaviour of Professionally Managed and Independent Investors,” *Journal of Banking and Finance*, (n. 25(8), pp. 1573-1587)

- Shefrin, M., and Statman, M. (1985) “The Disposition to Sell Winners Too Early and Ride Losses Too Long: Theory and Evidence,” *The Journal of Finance*, (n. 40, pp. 777-790)

- Shiller, R., J. (1981) “Do Stock Prices Move Too Much to Be Justified by Subsequent Changes in Dividends?” *American Economic Review*, (n.71, pp. 421-436)

- Shiller, R., J. (2000) “Irrational Exuberance,” Princeton University Press

- Shin, H. (1991) “Optimal Betting Odds Against Insider Traders,” *Economic Journal*, (n. 101, pp. 1179-1185)

- Shin, H. (1992) “ Prices of State-Contingent Claims with Insider Traders, and the Favourite-Longshot Bias,” *Economic Journal*, (n. 102, pp. 161-174)

- Shin, H., S. (1993) “ Measuring the Incidence of Insider Trading in a Market for State-Contingent Claims. *The Economic Journal*, (n. 103(420), pp. 1141-1153)

- Slonim, R., and Roth, A., E. (1998) “ Learning High Stakes in High Stakes: an Experiment in the Slovak Republic,” *Econometrica*, (n. 66, pp. 569-596)

- Slovic, P., Griffin, D., and Tversky A. (1990). “Compatibility Effects in Judgment and Choice,” in *Insights in Decision Making: A Tribute to Hillel J. Einhor*n, edited by Hogarth, R. (Chicago: Chicago University Press, pp. 5-27)

- Smith, V., L. (1962) “An Experimental Study of Competitive Market Behaviour,” *Journal of Political Economy*, (n. 70, pp. 111-137)

- SmithV., L., Suchanek G., L., and Williams A., W. (1988) “Bubbles, Crashes and Endogenous Expectations in Experimental Spot Asset Markets,” *Econometrica*, (n. 56, pp. 1119-1151)

- Smith, V., L., and Walker, J., M. (1993) "Rewards, Experience and Decision Costs in First Price Auctions," *Economic Inquiry*, (n. 31(2), pp. 237-244)

- Snyder, W., W. (1978) "Horse Racing: Testing the Efficient Markets Model," *Journal of Finance*, (n. 33, pp. 1109-1118)

- Solnick, S. (2001) "Gender Differences in the Ultimatum Game," *Economic Inquiry* (n. 39, pp. 189-200)

- Starmer, C., and Sugden, R. (1991) "Does the Random-Lottery Incentive System Elicit True Preferences? An Experimental Investigation," The *American Economic Review*, (n. 81, pp. 971-978)

- Staw, B., M. (1976) "Knee-Deep in the Big Muddy: A study of Escalating Commitment to a Chosen Course of Action," *Organizational Behaviour and Human Performance*, (n. 16, pp. 27-44)

- Staw, B., M., (1997), "The Escalation of Commitment: An Update and Appraisal," in *Organizational Decision Making*, edited by Shapira, Z. New York: Cambridge University Press

- Staw, B., M., and Fox, F. (1977) "Escalation: Some Determinants of Commitment to a Previously Chosen Course of Action," *Human Relations*, (n. 30, pp. 431-450)

- Staw, B.M., and Ross, J. (1978) "Commitment to a Policy Decision: A Multitheoretical Perspective," *Administrative Science Quarterly*, (n. 23, pp. 40-64)

- Staw, B., M., and Ross, J. (1987). "Behavior in Escalation Situations: Antecedents, Prototypes, and Solutions," *Research in Organizational Behavior*, (n. 9, pp. 39-78)

- Staw, B., M., and Ross, J. (1989) "Understanding Behavior in Escalation Situations," *Science*, (n. 246, pp. 216-220)

- Stevens, C., M. (1958) "On the Theory of Negotiation," *The Quarterly Journal of Economics*, (n. 72, pp. 77-97)

- Stiglitz, J. (1983) "Some Aspects of the Taxation of Capital Gains," *Journal of Public Economics*, (n. 21, pp. 257-294)

- Strack, F., and Mussweiler, T. (1997) "Explaining the Enigmatic Anchoring Effect: Mechanisms of Selective Accessibility," *Journal of Personality and Social Psychology*, (n.73 (3), pp. 437-446)

- Sutherland, N., S. (1992). *Irrationality: The Enemy Within*, (Constable)

- Tang, M. (1988) "An Economic Perspective on Escalating Commitment," *Strategic Management Journal,* (n. 9(5), pp. 79-92)

- Teger, A. (1980) "Too much invested to quit," (New York: Pergamon Press)

- Terrell, D. (1997) "Biases in Assessments of Probabilities: New Evidence from Greyhound Racing," *Working Paper*, Louisiana State University, (n. 97-28)
- Tetlock, P., E., and Boettger, R. (1994). "Accountability Amplifies the Status Quo Effect when Change Creates Victims," *Journal of Behavioral Decision Making*, (n. *7*(1), pp. 1-23)
- Thaler, R. (1985) "Mental Accounting and Consumer Choice," *Marketing Science*, (n. 4, pp. 199-214)
- Thaler, R. (1993) *Advances in Behavioral Finance*, (New York: Russell Sage Foundation)
- Thaler, R. (1986) "The Psychology and Economics Conference Handbook: Comments on Simon, on Einhorn and Hogarth and on Tversky and Kahneman," *The Journal of Business*, (n.59, pp. 279-284)
- Thaler, R., and Johnson, E., J. (1990) "Gambling with the House Money and Trying to Break Even: The Effects of Prior Outcomes on Risky Choice," M*anagement Science*, (pp. 643-660)
- Thaler, R. and Ziemba, W., T. (1988) "Parimutuel Betting Markets: Racetracks and Lotteries, *Journal of Economic Perspectives*, (n. 2, pp. 161-174)
- Thurstone L., L. (1931) "The Indifference Functions," *Journal of Social Psychology*, (n. 2, pp. 139-167)
- Triandis, H. (1984) "Toward a Psychological Theory of Economic Growth," *International Journal of Psycholog*y, (n. 19)
- Triandis, H. (1989) "The Self and Social Behaviour in Differing Cultural Contexts," *Psychological Review*, (n. 96(3), pp. 506-520)
- Tversky, A., and Kahneman, D. (1974) "Judgement under Uncertainty: Heuristics and Biases," *Science*, (n. 185, pp. 1124-1131)
- Tversky, A., and Kahneman, D. (1981) "The Framing of Decisions and the Psychology of Choice," *Science*, (n.211, pp. 453-458)
- Vaughan Williams, L., and Paton, D. (1996) "Risk, Return and Adverse Selection: a Study of Optimal Behaviour Under Asymmetric Information," *Rivista di Politica Economica*, (n.11(12), pp. 63 -82)
- Vaughan Williams, L. and Paton, D. (1997) "Why is there a Favourite-Longshot Bias in British Racetrack Betting markets?" *Economic Journal*, (n. 107, 150-158)
- Vickrey, W. (1961) "Counter-Speculation, Auctions, and Competitive Sealed Tenders," *The Journal of Finance*, (n. 16. pp. 8-37)

Von Neumann, J., and Morgenstern, O. (1944) *Theory of Games and Economic Behavior*, (Princeton University Press, Princeton NJ)

- Walster, E., Berscheid, E., Abrahams, D., and Aronson, V. (1967) "Effectiveness of Debriefing Following Deceptive Experiments," *Journal of Personality and Social Psychology*, (n.6, pp. 371-380)

- Warner, J., Watts, R., L., and Wruck, K., H. (1988) "Stock Prices and Top Management Changes," *Journal of Financial Economics*, (n. 20, pp. 461-490)

- Weber, M., and Camerer, C., F. (1998) "The Disposition Effect in Securities Trading: An Experimental Analysis," *Journal of Economic Behavior and Organization*, (n. 33, pp. 167-184)

- Wermers, R. (2003) "Is Money Really "Smart?" New Evidence on the Relation Between Mutual Fund Flows, Manager Behavior, and Performance Persistence," *Working paper*, University of Maryland.

- Weiner, B. (1995) *Aspiration Level,* Manstead, A., S., R., Hewstone, M.(Eds.), The Blackwell Encyclopedia of Social Psychology. Blackwell, Oxford, (pp. 362)

- West, S.G., and Gunn, S., P. (1978) "Some Issues of Ethics and Social Psychology," *The American Psychologist*, (n. 33(1), pp. 30-38)

- Whyte, G. (1986) "Escalating Commitment to a Course of Action: A Reinterpretation," *Academy of Management Review*, (n. 11(2), pp. 311-321)

- Wilson, R. (1977) "A Bidding Model of Perfect Competition," *Review of Economic Studies*, (n. 4, pp. 511-518)

- Wilson, R., M., S. (1997) "Entrapment and Escalating Commitment in Investment Decision Making: A Review," *British Accounting Review*, (n. 29, pp. 277-305)

- Wilson, R., M., S., (2001) "The Framing of Financial Decisions: A Financial Study," *Working Paper*, Loughborough Business School

- Wilson, T. D., Houston, C., Etling, K. M., and Brekke, N. (1996) "A New Look at Anchoring Effects: Basic Anchoring and its Antecedents," *Journal of Experimental Psychology: General*, (n.4, pp. 387-402)

- Zeelenberg, M., and Van Dijk, E. (1997) "A Reverse Sunk Cost Effect in Risky Decision Making: Sometimes we have too Much Invested to Gamble," *Journal of Economic Psychology*, (n.18, pp. 677-691)

- Zoran, I., Poterba, J., M. and Weisbenner, S. (2004) "Tax Motivated Trading by Individual Investors," NBER *Working Paper*

- Zuchel, H. (2001) "What Drives the Disposition Effect," (Manheim University)

Appendix A: Part 1 of Pre-game Instructions to Competitors for Experiment I

Dear Contestant,
Thank you for your interest in the St Andrews Bargaining Championships. This is a 3 round tournament. You must perform to a certain level to progress to the next round. Attached is a pre game test, which all participants must complete. There is no right or wrong answer to this question. Below is a description of the game you will be playing in the quarterfinals. Game 1 is an interactive test of your negotiation and bargaining skills. You will be bargaining simultaneously with other players.

There are 3 sessions available for this week if you can play?

Friday 23rd January: 12pm-1pm
Friday 23rd January: 2m-3pm
Friday 23rd January: 3pm-4pm

If these are unsuitable could you please provide dates and times of when you are?

Could you please reply and let me know either way?

Once you have a time you will be sent another message from STAB at the start of your session issuing you with a username and password to enter the game as well as further instructions.

Look forward to hearing from you.

St Andrews Bargaining Championship

Appendix B: Part 2 of Pre-game Instructions to Competitors for Experiment I

Dear Competitor

You are about to play the First Round of the St Andrews Bargaining Championships. This is played online and you will be bidding against three other individuals at the same time. The winner will progress to the next round and will face a different challenge.

We will be using AOL's instant messenger to play this game so once you have read this information please follow the link below.

The link is www.aol.co.uk click on "buddie" list. DONT TYPE THE USERNAME AND
PASSWORD UNDER SCREENNAME. Sometimes the buddylist will take a while to load
so be patient. When prompted please type in the following username and password.

username: castlecliffe321
Password: 12345

Once logged on you will receive a message from stabstandrews and you will be given further instructions. You can now start the game by going to www.aol.co.uk

If you encounter any problems, send a message to stab and we will endeavour to sort it out

Good Luck!

Appendix C: Part 1 of Instructions for Experiment I

Game1: Drilling for Oil in Argentina

Please read the following instructions and answer the following question.

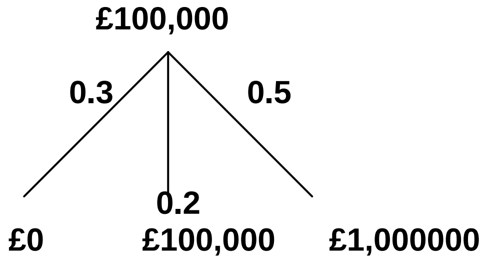
Part 1

You are the Vice President of a South American Oil company called Tripetrol Oil and Exploration Company. You are keen to invest in Argentina as you have been advised that this is an emerging area for oil.

You have been given £100,000 to invest in an oil well. There are two onshore projects in Argentina that have been alerted to you by a consultant. You may choose to invest the £100,000 in only one of them. As a guide the consultant has provided you with the possible payoffs and risk associated with investing in the particular site (shown below). Which site will you invest in?

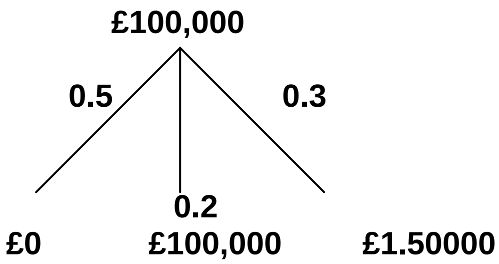
Please note. The money you gain or lose from this investment will be carried through to part 2 of the game. At the end of the game your investment account will be converted into real money at a specific exchange rate.

Site A: Drilling in Tierra del Fuego



There is a:
30% chance that you will lose £100,000
20% chance that you will break even
50% chance that you will make a profit of £900,000

Site B: Drilling in Aguada Pichana



50% chance that you will lose 100,000.
20% that you will break even
30% chance that you will make a profit of £1.4 million

Game 1, Part 2: Risk Averse, Conditional

Bridas, an Argentinian Oil Firm has oil platforms in Tierra del Fuego and Aguada Pichana (A and B from part 1) has been enjoying substantial profits in the last 8 months. The company finds itself with surplus cash and its board of directors are unwilling to utilise the money in dividend payoffs to stockholders or redeploy it with “wise acquisitions”. Bridasl as a consequence finds itself as a takeover target by rival Oil firms who wish to capture Bridas’s cash flow to make sure it isn’t frittered away on negative NPV oil exploration projects.

As the Vice President of Tripetrol Exploration and Production Company, you are keen to make an offer for Bridas as it would make you one of the largest Oil firms in South America. You have been allocated a fund of £0.5 million to negotiate the purchase of Bridas. You are in competition with 3 other firms for the acquisition of Bridas. There are 3 issues to be negotiated over (Price per

Share, Expenditure for Drilling in Tierra del Fuego and Expenditure for Drilling in Aguada Pichana). Should your offer be accepted you will receive a bonus payoff which reflects how much you paid for Bridas. The more you pay the smaller your bonus! There are 2 rounds of bidding and the less competitive bid will be eliminated after the first round.

A summary of your position so far is that you have invested £100,000 in Venture A. (Tierra Del Fuego) After 6 months you broke even. Therefore you have currently lost £0. Your remaining budget is £500,000

Experiment I, Part 2: Risk Averse, Experimental

Bridas, an Argentinian Oil Firm has oil platforms in Tierra del Fuego and Aguada Pichana (A and B from part 1) has been enjoying substantial profits in the last 8 months. The company finds itself with surplus cash and its board of directors are unwilling to utilise the money in dividend payoffs to stockholders or redeploy it with "wise acquisitions". Bridasl as a consequence finds itself as a takeover target by rival Oil firms who wish to capture Bridas's cash flow to make sure it isn't frittered away on negative NPV oil exploration projects.
As the Vice President of Tripetrol Exploration and Production Company, you are keen to make an offer for Bridas as it would make you one of the largest Oil firms in South America. You have been allocated a fund of £0.5 million to negotiate the purchase of Bridas. You are in competition with 3 other firms for

the acquisition of Bridas. There are 3 issues to be negotiated over (Price per Share, Expenditure for Drilling in Tierra del Fuego and Expenditure for Drilling in Aguada Pichana). Should your offer be accepted you will receive a bonus payoff which reflects how much you paid for Bridas. The more you pay the smaller your bonus! There are 2 rounds of bidding and the less competitive bid will be eliminated after the first round.

A summary of your position so far is that you have invested £100,000 in Venture A. (Tierra Del Fuego) After 6 months you lost your £100,000 investment. Therefore you have currently lost £100,000. Your remaining budget is £490,000

Experiment I, Part 2: "Less Risk Averse", Conditional

Bridas, an Argentinian Oil Firm has oil platforms in Tierra del Fuego and Aguada Pichana (A and B from part 1) has been enjoying substantial profits in the last 8 months. The company finds itself with surplus cash and its board of directors are unwilling to utilise the money in dividend payoffs to stockholders or redeploy it with "wise acquisitions". Bridas as a consequence finds itself as a takeover target by rival Oil firms who wish to capture Bridas's cash flow to make sure it isn't frittered away on negative NPV oil exploration projects.

As the Vice President of Tripetrol Exploration and Production Company, you are keen to make an offer for Bridas as it would make you one of the largest Oil firms in South America. You have been allocated a fund of £0.5 million to negotiate the purchase of Bridas. You are in competition with 3 other firms for the acquisition of Bridas. There are 3 issues to be negotiated over (Price per Share, Expenditure for Drilling in Tierra del Fuego and Expenditure for Drilling in Aguada Pichana). Should your offer be accepted you will receive a bonus payoff which reflects how much you paid for Bridas. The more you pay the smaller your bonus! There are 2 rounds of bidding and the less competitive bid will be eliminated after the first round.

A summary of your position so far is that you have invested £100,000 in Venture B. (Tierra Del Fuego) After 6 months broke-even on your investment. Your remaining budget is £500,000

Experiment I, Part 2: "Less Risk Averse", Experimental

Bridas, an Argentinian Oil Firm has oil platforms in Tierra del Fuego and Aguada Pichana (A and B from part 1) has been enjoying substantial profits in the last 8 months. The company finds itself with surplus cash and its board of directors are unwilling to utilise the money in dividend payoffs to stockholders or redeploy it with "wise acquisitions". Bridas as a consequence finds itself as a takeover target by rival Oil firms who wish to capture Bridas's cash flow to make sure it isn't frittered away on negative NPV oil exploration projects.

As the Vice President of Tripetrol Exploration and Production Company, you are keen to make an offer for Bridas as it would make you one of the largest

Oil firms in South America. You have been allocated a fund of £0.5 million to negotiate the purchase of Bridas. You are in competition with 3 other firms for the acquisition of Bridas. There are 3 issues to be negotiated over (Price per Share, Expenditure for Drilling in Tierra del Fuego and Expenditure for Drilling in Aguada Pichana). Should your offer be accepted you will receive a bonus payoff which reflects how much you paid for Bridas. The more you pay the smaller your bonus! There are 2 rounds of bidding and the less competitive bid will be eliminated after the first round.

A summary of your position so far is that you have invested £100,000 in Venture B. (Tierra Del Fuego) After 6 months you lost your £100,000. Your remaining budget is £490,000

Appendix D: Scenario Description for Experiment II

Tripetrol, is looking to diversify it's portfolio of companies and is paying attention to European Supermarket Chains. They have alerted you to the following information.

Due to a 10 million "blackhole" in its account, Marpetal a multinational food company has plunged into liquidation and the company's affairs are now in the hands of the receivers. They have undergone an asset stripping exercise to keep the company "afloat". A subsidiary of Marpetal is Goshopping.com, an internet based supermarket chain and has an increasing market share in the UK. You have been asked to make a bid for Goshopping.com on behalf of Tripetrol. You are aware of at least two other bidders. There is no reservation price and the bidding will take the form of a first price, English, sealed bid auction. There is only one round of bidding.

You have been allocated funds of £5 million to secure this company. Should you acquire the company you will receive a payoff which reflects how much you paid. For instance, the cheaper you acquire the company, the greater the amount your payoff will be. Your payoffs will be zero if you fail to buy the company.

In order to assist you, you have employed a management consultancy firm to provide a detailed analysis of goshopping.com and how much they think you should bid. This consultancy firm has provided information for all your rival bidders too. You now have a choice. The consultancy firm has provided you with a bidding range with what they think you should bid. This information has already been paid for by your company but for an additional £0.5 million you can receive an exact value of what they think you should bid.
Would you like to purchase the extra information at a cost of £0.5 million?

Appendix E: Part 2 for Experiment II: Range Estimation/ Rival Bidders Purchase Point Estimation

You have decided to use the range estimation provided by the consultancy firm. There is no charge for this service. I can tell you that all **your rival bidders purchased the point information.** They do not necessarily have the same budget as you so it would be unwise to assume this.

The range given to you by your consultant is in the range **£ 4.1-4.5 million**.

Please make an offer.

Remember you will be rewarded on how much acquired the company, but no company, no payoff. There is only 1 round of bidding.

Part 2 for Experiment II: Point Estimation/ Rival Bidders Purchase Point Estimation

You have decided to use the point estimation provided by the consultancy firm. There is a charge of £0.5 million which will be deducted from your budget. I can tell you that all **your rival bidders purchased the point information.** They do not necessarily have the same budget as you so it would be unwise to assume this.

The point estimation given to you by your consultant is in **£4.4 million**.

Please make an offer.

Remember you will be rewarded on how much acquired the company, but no company, no payoff. There is only 1 round of bidding.

Part 2 for Experiment II: Range Estimation/ Rival Bidders Purchase Range Estimation

You have decided to use the range estimation provided by the consultancy firm. There is no charge for this service. I can tell you that all **your rival bidders purchased the range information.** They do not necessarily have the same budget as you so it would be unwise to assume this.

The range given to you by your consultant is in the range **£ 4.1-4.5 million**.

Please make an offer.

Remember you will be rewarded on how much acquired the company, but no company, no payoff. There is only 1 round of bidding.

Part 2 for Experiment II: Point Estimation/ Rival Bidders Purchase Point Estimation

You have decided to use the point estimation provided by the consultancy firm. There is a charge of £0.5 million which will be deducted from your budget. I can tell you that all **your rival bidders purchased the range information.** They do not necessarily have the same budget as you so it would be unwise to assume this.

The point estimation given to you by your consultant is in **£4.4 million**.

Please make an offer.

Remember you will be rewarded on how much acquired the company, but no company, no payoff. There is only 1 round of bidding.

Appendix F: Stock Description's for Experiment III

Company A: Imperial Chemicals	
LEVERAGE: 4.4	PRICE VARIABILITY: 1.4
PRICE: 330.00	CUMULATIVE VOLUME 16,870,088

This may no longer be the pioneer of British industry but it still has a large amount of products ranging from food ingredients, flavourings, fragrances to paints and industrial adhesives. The company liquidated its cyclical bulk chemicals business three years ago to make it less susceptible to nasty economic surprises, but the share price halved this year as food flavourings division Strang hit trouble.

Company B: Lantro Group	
LEVERAGE: 0.4	PRICE VARIABILITY: 0.9
PRICE: 460.00	CUMULATIVE VOLUME 1,906,661

The company was originally a road haulage business, founded in 1920. It is now a leading multi-franchise car retailer distributing both new and used vehicles for leading European Car Manufacturers.

Company C: RMA	
LEVERAGE: 3.2	PRICE VARIABILITY: 0.3
PRICE: 100.00	CUMULATIVE VOLUME 4,150,034

RMA is a microchip designer that has licensed its technology to many of the world's leading electronics companies, including FG Microelectronics, SSZ Electronics, Karlstrom, Magnico Instruments and Otram. These companies use RMA's designs in devices such as mobile phones, digital cameras, games consoles and motor cars.

Company D: AH Land Consultancy	
LEVERAGE: 4.0	PRICE VARIABILITY:1.0
PRICE: 270.00	CUMULATIVE VOLUME 1,098,094
One of the UK's oldest property group's, AH Land has been dominated by chairman ever since his Union Property group reversed into it in 1970. The portfolio, predominately office and retail, has grown to £11bn in that time, but some investors have been getting restless recently with calls for Ritblat to loosen his grip and something be done about the wide gap between the share price and the value of the AH's Land's properties.	

Company E: Synergist	
LEVERAGE: 2.4	PRICE VARIABILITY: 0.8
PRICE: 150.00	CUMULATIVE VOLUME 2,567,145
The company is a leading property development and investment business whose portfolio consists of property based primarily in central London and in prime UK locations. Its investment division includes interests in early stage and mature businesses in both the UK and US.	

Company F: S. Robinson	
LEVERAGE: 0.8	PRICE VARIABILITY: 0.4
PRICE: 480.00	CUMULATIVE VOLUME 5,649,088

UK supermarket group was originally founded in Drury Lane, London, in 1869. The group began life as listed company in 1973, which at the time was the UK's largest ever flotation. The group now has interests in the US-based supermarket chain Shaw's and in 1997 moved into financial services with the establishment of Robinson's Bank. The company is now the UK's third largest supermarket chain, having lost its second place in 2003.

Company G: Easydough	
LEVERAGE: 3.6	PRICE VARIABILITY: 0.5
PRICE: 130.00	CUMULATIVE VOLUME 1,372,101
Easydough is a leading sandwich, savouries and bakery related products retailer, focusing primarily on takeaway food and catering. The group operates around 1,200 retail outlets.	

Company H: Sintra Investments	
LEVERAGE: 1.6	PRICE VARIABILITY: 1.4
PRICE: 880.00	CUMULATIVE VOLUME 3,273,009
At one time in the nineties Sintra Investmnets was the biggest bank in Europe and seemingly unstoppable after deals to take over Fundamentalist Finance and life insurer Perpetuality. Now the Perpetuality acquisition does not looks so clever and Sintrahas been overtaken and some would say left behind by its three main high street rivals. A way above average yield is indicative of the problems the market thinks SBT faces. A merger could solve a lot of them but all of the good candidates have either been snapped up or are out of reach on regulatory grounds.	

Company I: Peninsula Banking	
LEVERAGE: 2.8	PRICE VARIABILITY: 1.1
PRICE: 640.00	CUMULATIVE VOLUME 6,997,095
Anyone needing a reminder of the reach of the British Empire need only look at where Peninsula does its businesses. At one time the bank to the British India company, now it is becoming the bank to the rapidly growing Asian economies. Peninsula claims it is now the world's leading emerging markets bank employing 30,000 people in over 500 offices in more than 50 countries. Sintra Investments was interested in making a bid many moons ago but with many emerging markets showing signs of maturity Peninsula seems more than happy enough on its own.	

Company J: Interaction	
LEVERAGE: 4.8	PRICE VARIABILITY: 1.2
PRICE: 330.00	CUMULATIVE VOLUME 3,766,992
Interaction originally started out as a construction company during the industrial revolution, however the company is now an international publishing house. The group comprises of three main divisions: Education, Finance Today and Morphose. Almost two thirds of its revenues are generated from the Education arm, however it is the other two that Interaction is most famous for. The financial publishing arm has suffered heavily over the last few years both from the global advertising and stock market downturn.	

Company K: Utilium	
LEVERAGE: 2.0	PRICE VARIABILITY: 0.7
PRICE:440.00	CUMULATIVE VOLUME 19,010,886
Consisting of North West Water, Norweb and telecoms company Your Communications, Utiliumis one the leading multi-utilities in the UK though the recent emphasis has been on building up outsourcing arm Vortex. Utilium recently launched a £1bn rights issue to shore up its balance sheet ahead of a huge capital expenditure programme at North West Water.Another utility with a big dividend yield.	

Company L: Oceanic Drilling	
LEVERAGE: 1.2	PRICE VARIABILITY: 1.3
PRICE: 110.00	CUMULATIVE VOLUME 8,778,098
Britain's premier company, Oceanic Drilling moved into the big league of oil companies with the acquisitions of US concerns Amoco and Atlantas Richfel in the late nineties. More geared to oil production and exploration than its main rivals Oceanic Drilling has taken a big leap into the former soviet union to secure future production as its current key assets in the North Sea and Alaska wind down. A ruthless cost-cutting programme has boosted its performance. There may be a succession problem when current chief executive John Kelly decides to call it a day.	

Appendix G: Instructions for Experiment III: Sunk Cost Treatment

Virtual Stock Market Game

How to Play

This is a test of selecting and managing a portfolio so that it increases in value over the course of the game. There are 2 main parts of the game:

1. Selection of your original portfolio
2. Trading your shares as the game progresses.

Share Selection

The shares of 12 companies are available for buying and trading in the virtual stock market. Initially you must choose 6 companies to invest in.

You have a starting pot of £10,000 and you must invest either £1000, £2000, or £3000 in the 6 companies. All transactions are carried out by a broker, who demands a one-off-up-front payment of £2000. No other payments will be made to the broker. Therefore, with the £2000 reduction you now have £8,000 to select your shares. You don not have to spend all of the £8,000. Any unspent money will be stored in an interest free account and can be used for future purchases during the game.

Trading

There are 14 trading periods. The first period-period 1 will allow you to gauge the current price trends of the shares before you start trading. Please note you must have selected your portfolio prior to period 1. From period 2 you start trading Share prices movements in this game are different to real world share prices. All share prices will follow a probability distribution where:

There is a 0.65 probability that 2 out of 12 stocks will show an increase in any period.
There is a 0.55 probability that 2 out of 12 shares will show an increase in any period.
There is a 0.50 probability that 4 out of 12 shares will show an increase in any period
There is a 0.45 probability that 2 out of 12 shares will show an increase in any period
There is a 0.35 probability that 2out of 12 shares will show an increase in any period

At the start of each trading period you will be given the current share price of all the companies and you are free to buy or sell £1000, £2000, or £3000 in all these companies. If you want to trade in any period you will send an email to me notifying me how much you want to invest. I will calculate how much your current portfolio is worth in each period for you.

Happy Trading!.

Instructions for Experiment III: Conditional Treatment

Virtual Stock Market Game

How to Play

This is a test of selecting and managing a portfolio so that it increases in value over the course of the game. There are 2 main parts of the game:

3. Selection of your original portfolio
4. Trading your shares as the game progresses.

Share Selection

The shares of 12 companies are available for buying and trading in the virtual stock market. Initially you must choose 6 companies to invest in.

You have a starting pot of £10,000 and you must invest either £1000, £2000, or £3000 in the 6 companies. You don not have to spend all of the £10,000. Any unspent money will be stored in an interest free account and can be used for future purchases during the game.

Trading

There are 14 trading periods. The first period-period 1 will allow you to gauge the current price trends of the shares before you start trading. Please note you must have selected your portfolio prior to period 1. From period 2 you start trading Share prices movements in this game are different to real world share prices. All share prices will follow a probability distribution where:

There is a 0.65 probability that 2 out of 12 stocks will show an increase in any period.
There is a 0.55 probability that 2 out of 12 shares will show an increase in any period.
There is a 0.50 probability that 4 out of 12 shares will show an increase in any period
There is a 0.45 probability that 2 out of 12 shares will show an increase in any period
There is a 0.35 probability that 2out of 12 shares will show an increase in any period

At the start of each trading period you will be given the current share price of all the companies and you are free to buy or sell £1000, £2000, or £3000 in all these companies. If you want to trade in any period you will send an email to me notifying me how much you want to invest. I will calculate how much your current portfolio is worth in each period for you

Happy Trading!

Appendix H: Experiment 1 Data Set

Experiment 1: Linear Regression Data Set

Age	gender 0=female	Experimental 0=control	Risk 0=averse	Proj Pick 0=,A1=B	Price 1	Price 2	R&D A 1	R&D A 2	Closure 1	Closure 2	R&D B 1	R&D B 2	Debt 1	Debt 2	ownR&D1	ownR&D2	otherR&D1	otherR&D2
19	1	0	1	0.00	2.00	2.20	3.75	4.25	0.00	0.00	3.80	3.80	2.45	3.50	3.75	4.25	3.80	3.80
19	1	1	0	0.00	2.00	2.00	4.25	4.25	2.00	3.00	3.80	3.80	2.80	2.80	4.25	4.25	3.80	3.80
23	1	1	0	0.00	2.20	2.40	1.75	1.75	1.00	0.00	3.00	3.00	3.50	3.50	1.75	1.75	3.00	3.00
24	1	1	0	0.00	1.00	1.60	3.25	3.75	0.00	0.00	3.80	4.20	2.80	3.15	3.25	3.75	3.80	4.20
22	1	1	0	0.00	1.60	1.80	1.75	1.75	1.00	1.00	3.40	3.40	3.15	3.50	1.75	1.75	3.40	3.40
21	1	0	0	0.00	1.80	2.00	2.75	3.25	2.00	2.00	3.80	3.80	2.10	2.10	2.75	3.25	3.80	3.80
21	1	1	0	0.00	1.60	1.60	3.25	3.75	1.00	1.00	3.00	3.00	2.80	2.80	3.25	3.75	3.00	3.00
21	1	1	1	0.00	1.20	1.40	2.75	3.25	2.00	2.00	3.40	3.00	2.10	2.10	2.75	3.25	3.40	3.00
21	1	1	0	0.00	2.40	2.60	3.25	3.25	2.00	1.00	5.00	5.60	2.45	2.45	3.25	3.25	5.00	5.40
21	1	0	0	0.00	2.20	2.20	1.75	1.75	3.00	2.00	3.00	3.40	2.10	2.45	3.75	3.75	3.00	3.40
21	1	0	0	0.00	2.00	2.00	2.75	2.25	3.00	2.00	3.80	4.20	2.45	2.45	2.75	2.25	3.80	4.20
19	1	0	0	0.00	2.20	2.40	3.25	2.75	2.00	2.00	4.60	5.00	2.45	2.80	3.75	3.75	4.60	5.00
19	1	0	0	0.00	1.20	1.60	3.25	3.75	2.00	1.00	3.00	3.40	3.50	3.85	3.25	3.75	3.00	3.40
23	1	0	0	0.00	2.20	2.40	2.25	2.75	1.00	0.00	5.40	5.60	3.50	3.50	2.25	2.75	5.40	5.80
22	0	0	0	0.00	1.80	2.00	2.25	2.75	2.00	2.00	3.80	4.20	2.10	2.10	2.25	2.75	3.80	4.20
21	0	1	0	0.00	1.80	2.00	4.25	4.25	2.00	2.00	3.40	3.40	1.40	1.40	4.25	4.25	3.40	3.40
21	0	0	1	0.00	1.40	1.40	2.25	2.75	3.00	2.00	3.00	3.00	2.10	2.45	2.25	2.75	3.00	3.00
21	0	1	0	0.00	2.20	2.20	3.75	4.25	2.00	1.00	3.40	3.40	2.45	2.45	3.75	4.25	3.40	3.40
22	0	1	0	0.00	1.40	1.60	3.25	3.25	3.00	2.00	3.00	3.00	2.45	2.45	3.25	3.25	3.00	3.00
21	0	1	0	0.00	2.40	2.40	2.75	2.75	4.00	3.00	4.60	5.00	2.80	2.80	2.75	2.75	4.60	5.00
22	0	0	0	0.00	1.80	2.00	2.75	3.25	1.00	0.00	3.40	3.00	2.10	2.10	2.75	3.25	3.40	3.00
23	1	0	1	1.00	1.60	1.80	2.75	2.75	3.00	3.00	3.40	3.40	3.50	3.50	3.40	3.40	2.75	2.75
22	1	1	1	1.00	2.00	2.00	1.75	1.75	2.00	1.00	4.60	4.60	2.80	3.15	4.60	4.60	1.75	1.75
19	1	0	0	1.00	2.00	2.20	2.25	2.25	2.00	2.00	4.20	4.20	1.75	1.75	4.20	4.20	2.25	2.25
22	1	0	1	1.00	1.40	1.40	3.25	3.75	1.00	1.00	3.40	3.80	2.10	2.45	3.40	3.80	3.25	3.75
20	1	0	1	1.00	1.80	1.80	3.25	3.25	3.00	2.00	3.80	3.80	2.45	2.80	3.80	3.80	3.25	3.25
21	1	1	0	1.00	2.00	2.00	2.75	3.25	2.00	2.00	4.20	4.20	2.45	2.80	4.20	4.20	2.75	3.25
23	1	1	1	1.00	2.40	2.60	2.75	2.75	2.00	2.00	4.60	5.00	2.45	2.80	4.60	5.00	3.25	3.25
22	1	1	1	1.00	1.40	1.40	1.75	2.25	1.00	1.00	4.60	4.20	2.10	2.45	4.60	4.20	1.75	2.25
18	0	1	1	1.00	1.60	1.60	1.75	2.25	4.00	4.00	3.40	3.80	1.05	1.40	3.40	3.80	1.75	2.25
22	1	1	1	1.00	1.80	1.80	2.25	1.75	0.00	0.00	4.20	4.60	3.85	3.50	4.20	4.60	2.25	1.75
23	0	1	1	1.00	1.60	1.80	3.75	3.75	1.00	1.00	4.60	4.60	2.45	2.80	4.60	4.60	3.75	3.75
22	0	1	1	1.00	2.20	2.20	3.25	2.75	3.00	4.00	4.20	4.60	2.10	2.45	4.20	4.60	3.25	2.75
21	0	0	1	1.00	1.40	1.60	3.25	3.25	2.00	1.00	3.40	3.40	3.15	3.50	3.40	3.40	2.75	3.25
22	0	0	0	0.00	1.60	1.80	3.25	2.75	1.00	1.00	3.00	3.40	3.15	3.80	3.25	2.75	3.40	3.40
20	1	1	1	1.00	2.20	2.00	3.25	3.75	2.00	2.00	4.60	4.60	3.15	2.80	4.60	4.60	3.25	2.75
21	1	0	1	1.00	2.40	2.20	3.25	3.25	1.00	1.00	3.80	3.80	2.45	2.80	3.80	3.80	3.25	3.25
22	0	0	1	1.00	2.20	2.20	3.25	3.25	4.00	4.00	4.20	4.20	2.45	2.80	4.20	4.20	3.25	3.25
20	1	1	0	0.00	1.80	2.00	4.25	4.75	0.00	1.00	3.80	3.80	2.45	2.80	4.25	4.75	3.80	3.80
20	1	1	0	0.00	2.20	2.00	4.25	4.75	1.00	2.00	3.80	3.80	3.15	3.15	4.25	4.75	3.80	3.80
19	1	0	1	1.00	2.00	2.20	3.25	3.25	0.00	1.00	3.80	3.80	3.15	2.80	3.25	3.25	3.80	3.80
22	0	1	0	0.00	1.60	1.60	1.75	2.25	0.00	0.00	3.40	3.00	2.45	2.45	1.75	2.25	3.40	3.00
20	0	1	1	1.00	2.60	2.60	1.75	1.75	1.00	1.00	4.20	4.20	3.50	3.85	4.20	4.20	1.75	1.75
20	0	0	0	0.00	2.20	2.40	2.25	2.25	2.00	1.00	3.80	3.80	2.45	2.45	2.25	2.25	3.80	3.80
20	1	1	1	1.00	2.40	2.40	2.25	2.25	2.00	3.00	5.00	5.00	2.45	2.45	5.00	5.00	2.25	2.25

Experiment 2 Data Set

Experiment 2: Ordinary Least Squares Data Set							
Gender 0=Female	Risk 0=Averse 0=Averse	Condition 0=Condition 0=Conditional	Information 0=Range Estimate	Value of company	Bid	Difference	(Bid-Value)/Value
1	1	1	0	4	4.2	0.2	0.05
1	0	1	0	4	3.8	0.2	-0.05
1	1	1	0	4	4.6	0.6	0.15
1	1	1	0	4	4.3	0.3	0.08
0	1	1	0	4	4.4	0.4	0.10
0	1	1	0	4	4.1	0.1	0.02
0	1	1	0	3.9	4.2	0.3	0.08
1	1	1	0	4.3	4.7	0.4	0.09
0	1	1	0	4.4	4.7	0.3	0.07
1	1	0	0	4	4.1	1	0.02
0	1	0	0	4	3.9	0.1	-0.03
1	1	0	0	4.1	3.8	0.3	-0.07
1	0	0	0	4.3	4.1	0.2	-0.05
1	1	0	0	4	4.1	0.1	0.02
1	1	0	0	4	4	0	0.00
1	0	0	0	4.3	3.9	0.4	-0.09
1	1	0	0	4	4.1	1	0.02
1	0	0	0	4	4.2	0.2	0.05
0	1	0	0	4.4	4.3	0.1	-0.02
1	1	0	0	4.2	4.1	0.1	-0.02
1	1	0	0	4	4.2	0.2	0.05
1	1	0	0	4	4	0	0.00
1	1	0	1	4.4	4.1	0.3	-0.07
1	1	1	0	4.1	4.3	0.2	0.05
1	0	1	1	3.9	4.3	0.4	0.10
1	0	1	1	3.9	3.8	0.1	-0.03
1	0	1	1	4.1	4.3	0.2	0.05
1	0	0	1	4.1	4	0.1	-0.02
1	0	1	1	4.1	4.4	0.3	0.07
0	1	1	1	4.3	4.5	0.2	0.05
1	0	0	1	4.3	4.1	0.2	-0.05
0	1	1	1	4.3	4.4	0.1	0.02
0	0	1	1	4	3.9	0.1	-0.03
1	0	0	1	4.2	4.1	0.1	-0.02
0	1	1	1	4.2	4.5	0.3	0.07
1	1	1	1	4.3	4.5	0.2	0.05
1	0	0	1	3.8	4.3	0.5	0.13
1	1	0	1	4.1	3.8	0.3	-0.07
0	1	0	1	3.8	3.8	0	0.00
0	1	1	1	3.8	4.1	0.3	0.08
		Mean		**4.09**	**4.175**	**0.26**	**0.02**

Experiment 3 Data Set

Experiment 3: Regression Data

Disp Effect	Gender 1=Male	Treatment 1=SC	PGR	PLR	ln of Frequency of Trades	Frequency of Trades	Frequency of Trades Squared	Return of Realised Gains	Return of Realised Losses
0	1	1	0	0	0	1	1	0	0
-0.25644	1	1	0.89258	0.345901	1.945910149	7	49	1005.7	1000
0.081279	1	1	0.363415	0.281236	1.609437912	5	25	610.9	2447.7
0	0	1	0	0	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0
0.176814	1	1	0.5	0.323186	2.564949357	13	169	1081.6	1936.55
-0.24835	1	1	0.155121	0.403466	2.708050201	15	225	3063.1	5121.6
0.316049	0	1	0.415341	0.098932	2.397895273	11	121	1770.6	1144.8
0.540221	1	1	0.540221	0	2.833213344	17	289	4112	0
0	1	1	0	0	0	0	0	0	0
-0.22185	1	1	0.542857	0.764076	3.401197382	30	900	3610	2780
0	1	1	0	0	0	0	0	0	0
0.098662	0	1	0.184534	0.085873	2.197224577	9	81	1039	822
0.173429	0	1	0.173429	0	1.945910149	7	49	695	0
1	1	1	1	0	1.609437912	5	25	1589	0
-0.55652	0	1	0.134019	0.690542	2.772588722	16	256	1187	2987
-0.2847	0	1	0.0723954	0.364309	3.091042453	22	484	833	1996
0.564613	1	1	0.697694	0.13351	1.791759469	6	36	4876	1022
0.316409	1	1	0.415341	0.098932	1.386294361	4	16	1088.56	332
0.052109	0	0	0.184534	0.132346	3.044522438	21	441	987.5	655
1	1	0	1	0	0.693147181	2	4	3288	0
-0.48916	1	0	0.510843	1	2.564949357	13	169	2090.4	2166
0.164171	1	0	0.161471	0	1.945910149	7	49	1069	0
-0.1508	1	0	0.814129	1	3.737669618	42	1764	4887	5932
0.14966	0	0	0.510779	0.368813	2.63905733	14	196	7288	2881
1	1	0	1	0	1.945910149	7	49	7330	0
-0.42319	1	0	0.76809	0.5	3.044522438	21	441	3551	3668
0	0	0	0	0	0	0	0	0	0
0.784672	1	0	0.786742	0	2	2	4	1002	0
-0.11208	0	0	0.140823	0.259204	2.944438979	19	361	2331	3981
0.43056	1	0	0.43056	0	1.609437912	5	25	1773	0
0.3592	1	0	0.402985	0.043875	2.397895273	11	121	3332	881
-0.78911	1	0	0	0.78911	2.833213344	17	289	0	6511
0.188504	1	0	1	0.881584	3.295836866	27	729	4399	4285
0.743056	0	0	0.743056	0	0.693147181	2	4	1044	0
0.1173	0	0	0.161471	0.068457	2.397895273	11	121	1775	1772
0.03871	0	0	0.290284	0.252904	2.079441542	8	64	2880	990
0.046307	1	0	0.73422	0.68206	2.564949357	13	169	4128	3881
0.77636	1	0	0.77636	0	1.386294361	4	16	3359	0