INDIRECT SHORT-SELLING CONSTRAINTS

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DECLARATION

This thesis has been composed by the author. Except where specific reference is made to other sources, the work presented in this thesis is the original work of the author. The work has not been submitted, in whole or in part, for any other degree.

James Clunie

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ABSTRACT

In this thesis, I use two strategies of inquiry to further our understanding of indirect short-selling constraints. First, I interview a series of experienced market practitioners to identify their attitudes towards indirect constraints. I find little support for D'Avolio's (2002) suggestions that short-selling is inhibited by managers' fear of tracking error and by the cultural pressures of a society that can vilify short-sellers. However, I am able to introduce a new, social, indirect constraint to the literature – the perception that short-selling is a form of 'trading' as distinct from 'investment', and the consequent lack of acceptance amongst stakeholders that this engenders. This constraint reveals a divide between the attitudes of the academic community and parts of the institutional practitioner community on the subject of short-selling. However, interviewees argue that this indirect constraint is diminishing over time. This raises the prospect of markets in practice converging in behaviour towards the markets assumed in classical asset pricing models, and has implications for market efficiency. My second strategy of inquiry is to use a large, new stock lending database to explore three risk-related indirect constraints to short-selling. I examine 'crowded exits', a general class of liquidity problem, and find that these are associated with statistically and economically significant losses for short-sellers. I also examine 'manipulative short squeezes', a liquidity problem arising from predatory trading. Consistent with theory and the literature on the subject, I find that these are rare for larger, more liquid stocks. However, when they do occur, these events generate statistically significant losses for short-sellers. Finally, I build upon the work of Gamboa-Cavazos and Savor (2007) and investigate the response of short-sellers to losses. I find that short-sellers close their positions in response to accounting losses and not simply in response to rising share prices. This is consistent with short-sellers' use of risk management tools that are designed to crystallize small losses. These serve to limit the risk of potentially unlimited losses and to reduce short positions at times of heightened synchronization risk. Stocks subject to short-covering in this manner do not subsequently under-perform the market. My findings demonstrate that a sophisticated group of traders, strongly associated with price setting, does not suffer from the bias known as loss realization aversion.

1. INTRODUCTION

1.1 Research Objectives of the Thesis

Short-selling is a key component of arbitrage, a process that in neo-classical finance involves traders exploiting asset pricing anomalies and in so doing, helping to keep markets efficient. However, the literature makes a number of assumptions about short-selling and arbitrage. Implicit in Fama's (1965) description of securities markets, for example, is the existence of a myriad of arbitrageurs, each taking small positions to exploit mispricing opportunities. Asset pricing models such as the Arbitrage Theory of Capital Asset Pricing (Ross, 1976) assume no restrictions on short sales, including full use of the short sale proceeds. There are, though, important differences between markets in theory and markets in practice. For example, short-sellers in practice must find securities to borrow and effectively pay fees to borrow those securities. Furthermore, short-sellers face collateralisation and margin requirements. Short-selling is thus made difficult (in the finance literature, it is said to be 'constrained'). Such constraints serve to limit the frequency and/or scope of arbitrage, and so could have repercussions for asset pricing and market efficiency. Short-sale constraints and their impact on rational asset pricing has been a fertile area of research over many years. One key strand of the literature seeks to demonstrate that securities can become over-priced in the presence of short-sale constraints. Miller (1977) shows that securities can become over-valued and remain over-valued for some time in markets with short-selling constraints and heterogeneous expectations amongst investors. Duffie *et al.* (2002) show that in the face of short-selling constraints, a stock price can initially be higher than the greatest valuation of any investor, because the price should include the benefits obtained from being able to lend the stock in future. Furthermore, the authors show that a stock price under short-sale constraints can even be higher than that under a regime where no short-selling is permitted.

Theory thus suggests that the presence of short-sale constraints can influence asset pricing. Accordingly, any asset pricing model that assumes *unconstrained* short-selling is making use of an assumption that can, in and of itself, affect asset pricing. The role and importance of assumptions in the models of finance theory has been a controversial subject for some time. MacKenzie (2006) describes the debate that arose over the use of simplifying assumptions during the development of modern finance theory and cites Friedman's (1953) arguments on this subject. Friedman effectively provides a defence for the use of unrealistic assumptions so as to better understand the consequences of a change in circumstances: "The test of a theory was not whether its assumptions were descriptively 'realistic', for they never are, but…whether the theory works, which means whether it yields sufficiently accurate predictions." These comments were later echoed by Sharpe (1964) in his defence of the Capital Asset Pricing Model. However, Sharpe uses the considerably weakened word "acceptable", rather than "accurate", when referring to the predictions yielded by a model. This line of argument, however, is not universally accepted. In particular, both Mandelbrot (2004) and Taleb (2007) argue against the common assumption of a Gaussian distribution of returns for equities in asset pricing models. According to Taleb: "…these Gaussianizations do not have realistic assumptions and do not produce realistic results." Furthermore: "Almost everything in social life is produced by rare but consequential shocks and jumps; all the while almost everything studied about social life focuses on the "normal", particularly with "bell curve" methods of inference…" Taleb's arguments have relevance to those studying short-selling constraints - specifically, short-sellers are subject to uncommon, but consequential, events that would not be experienced by traditional, unleveraged long-only investors. Examples of such events include 'crowded exits' and 'manipulative short squeezes'. These topics are addressed in Chapters 6 and 7 of this thesis.

D'Avolio (2002) studies a sample of US stock lending data and observes that short-selling is 'relatively uncommon' – short interest is typically only 1.5% of market value, while only 7% of loan supply (by value) is borrowed. The author introduces the 'short sale reluctance puzzle' and attributes it to short-sale constraints. He suggests three types of constraint: borrowing costs, cultural barriers and a fear of

tracking error, and argues that further research needs to be conducted into the barriers to short-selling. It should be noted, though, that short-selling activity has generally been increasing in developed equity markets over recent years. Dechow *et al.* (2001) observe a trend of increasing short-selling in the USA over the period 1973-1993. Boehmer *et al.* (2008) find that 1 in 8 trades in their US stock sample is a short-sale, and suggest that short selling is 'relatively common' - in contradistinction to D'Avolio's assertion that it is 'uncommon'. Further, growth in the number of hedge funds and in their assets under management[1] suggests an increasing appetite for short-selling. Nevertheless, globally, short-selling remains a limited activity (see Bris *et al.*, 2007) and is certainly not the broadly and frequently practised activity assumed in Fama's 1965 discussion of security markets.

Nagel (2005) shows that short-sale constraints help explain cross-sectional returns. He argues that there are two types of constraint on short-selling: 'direct' constraints – associated with costs of borrowing and access to stock loans - and 'indirect' constraints – associated with institutional and cultural barriers. He further argues that stocks owned by major stock lenders are less likely to be subject to direct short-selling constraints. Using institutional ownership as a proxy for direct short-sale constraints, he finds that these help explain a number of cross-sectional return anomalies, but do not *fully* account for the cross-sectional return differences. He calls for further research into indirect short-sale constraints. The literature thus provides evidence that direct short-selling constraints can influence cross-sectional returns, but also identifies weaknesses in our understanding of indirect short-selling constraints. D'Avolio's 'short-sale reluctance puzzle' and Nagel's call for further research into indirect short-sale constraints together inspire the research conducted for this thesis.

I interview a series of practitioners to explore the barriers that exist to short-selling. The interviewees include a variety of experienced financial market practitioners, only some of whom are involved in short-selling. These interviews are designed to improve our understanding of indirect short-sale constraints, to query their relevance

[1] Industry data is available at www.ifsl.org.uk - International Financial Services London, for example.

in light of the Boehmer *et al.* (2008) study that suggests that short-selling on the New York Stock Exchange has become common, and to identify changing attitudes amongst stock market participants. Although I address research questions posed in the finance literature, this part of the thesis arguably belongs in the "Social Studies of Finance" field. Social Studies of Finance is the application to financial markets of social science disciplines, including sociology and anthropology.

The finance literature highlights a number of indirect short-sale constraints, including short time horizons (De Long *et al.*, 1990), agency relationships between short-sellers and owners of capital (Shleifer and Vishny, 1997) and a lack of co-ordination amongst short-sellers (Abreu and Brunnermeier, 2002). Interviewees refer to each of these indirect short-sale constraints, and to a number of well-understood direct constraints such as legal restrictions and the costs associated with borrowing stock to facilitate short-selling. However, interviewees reject the two suggestions put forward by D'Avolio (2002) – namely, fear of tracking error and the cultural pressures of a society that can vilify short-sellers. This allows me to reject the hypothesis that the fear of tracking error and vilification are *universal* constraints to short-selling. Furthermore, interviewees make suggestions that allow me to introduce a new, social, indirect constraint to the literature – the notion that short-selling is associated with speculation or trading, as opposed to 'investing'. Whereas 'investing' is perceived as a long-term social 'good' that receives acceptance amongst stakeholders such as clients, trustees and investment consultants, short-selling is perceived to be speculative or trading–oriented and so does not meet with the same level of acceptance. This 'lack of acceptance' is an indirect constraint that limits the capital allocated to short-selling. It also reveals a divide between the academic community and parts of the institutional practitioner community on the subject of short-selling. However, interviewees suggest that this indirect constraint has been diminishing over time. This raises the possibility of convergence between practice and theory and has potentially positive implications for market efficiency.

Interviewees also highlight a number of risks and practices specific to short-selling, including 'crowded exits', 'manipulative short squeezes' and the potential for

theoretically unlimited losses. I investigate these phenomena further, and make use of a large, new commercial stock lending database to undertake econometric analysis, with the aim of better understanding the nature and impact of these three risk-related indirect short-selling constraints. The database comprises publicly available stock lending data for the London Stock Exchange (the world's second largest equity market by market capitalization throughout this study). My data runs for 45 months, from the inception of the dataset on September 1st 2003 through until May 31st 2007. The institutional framework on disclosure and transparency with respect to short-selling differs by country. In particular, there are important differences in disclosure between the UK and USA. Whereas monthly short-sale information is publicly available in the USA, aggregate daily stock lending data for the largest companies is provided in the UK. Stock lending data can be obfuscating compared to short-selling data, as one might borrow stock for more reasons than simply facilitating a short-sale. However, the availability of *daily* data provides for a greater degree of granularity than does monthly data. Given the short-term nature of much short-selling activity (see, for example, Boehmer *et al.*, 2008 and Cohen *et al.*, 2007), this enhanced granularity allows for a much richer analysis of the activities of short-sellers and of the risks that they face.

Short squeezes are described in a series of studies into short-selling constraints (see, for example, Dechow *et al.*, 2001, D'Avolio, 2002, Geczy *et al.*, 2002) but are not examined in detail in any of these studies, perhaps because of the practical difficulties in identifying them. Dechow *et al.* (2001) describe a short squeeze as a situation where a stock loan is recalled and the stock borrower is unable to find an alternative lender. The stock lender must then purchase shares in the open market to repay the stock loan and close the position. Given this definition, a short squeeze could occur naturally where a stock lender recalls his stock to settle a sale and the short-seller is unable to replace his stock loan due to limited supply. However, short squeezes can also be associated with manipulation and market abuse: the stock lender buys additional shares in the company to 'pump' the share price and simultaneously recalls stock on loan. If the short-seller is unable to locate new stock to borrow, he must cover his position by buying stock in the open market. The

market impact of his stock purchases places further upwards pressure on the stock price. The manipulator completes the process by 'dumping' his shares at a profit. Note, though, that the affirmative identification of a manipulative short squeeze requires knowledge of the motivation for an actor's behaviour. As a manipulative short squeeze would be considered market abuse by a regulator, it is likely to be covert in nature. Consequently, a manipulative short squeeze will generally be unobservable to the researcher. Nevertheless, Gamboa-Cavazos and Savor (2007) argue that: "short squeezes are not just a theoretical concept or a Wall Street myth, but rather a market reality." My research strategy is to study patterns in market behaviour that are *consistent* with a manipulative short squeeze, whilst being aware of the possibility that each apparent manipulative short squeeze could simply reflect noise. I define a pattern of market behaviour that one would expect to find around the time of a manipulative short squeeze. I study the dataset for patterns consistent with manipulative short squeezes and find that they are infrequent in nature. Theory suggests that manipulative short squeezes are most likely to occur in smaller, less liquid stocks. Consistent with theory, I find few apparent manipulative short squeezes in larger stocks. It also follows from theory that to attract a short-seller to a less liquid stock, the mispricing would need to be greater, so as to compensate the short-seller for the risk of becoming the victim of a manipulative short squeeze. This risk/ liquidity problem could contribute to the cross-sectional return differences observed by Nagel.

I also define and study 'crowded exits' – liquidity problems that arise in stocks where short-sellers hold large positions relative to normal trading volume, and when a catalyst prompts short-sellers to cover their positions rapidly and simultaneously. Catalysts include, but are not limited to, public news releases by companies. The temporary excess of demand for stock relative to normal trading volume leads to upward pressure on the stock price. I measure the abnormal returns around these periods and observe that 'crowded exits' are associated with statistically and economically significant positive abnormal returns (i.e. losses to short-sellers). Crowded exits pose a risk to short-sellers and thus deter short-selling.

Limits to arbitrage can explain a variety of market anomalies found in the literature. The easing of short-sale constraints leads to reduced limits to arbitrage and consequently should have an impact on price discovery, pricing efficiency and market liquidity. As an illustration, Danielsen & Sorescu (2001) find that option introductions, as examples of diminishing short-sale constraints, lead to price falls. As short-selling becomes more common, market practice converges towards a key assumption in finance theory: namely, that short-selling is 'plentiful' and widely practised. This could have important effects on a number of the market 'anomalies' identified in the empirical finance literature. In an environment of diminishing short-sale constraints, existing trading strategies that exploit the inability of some actors to short-sell should not be relied upon to continue generating positive abnormal returns.

The more widespread use of short-selling could be regarded as an example of what MacKenzie (2006) describes as 'Barnesian performativity'. Economists might assume the broad and frequent use of short-selling in asset pricing models. As market participants begin to regard this assumption as a natural state of affairs, they engage and make greater use of short-selling. Ultimately, markets become more like the efficient markets envisaged by the economists' models. However, not all changes in stock market behaviour related to the growth in short-selling need be as benign as the gradual erosion of market anomalies. MacKenzie (2006) also describes 'counter-performativity', where the practical use of some aspect of theory makes economic processes less like their depiction in economics. In my investigation of crowded exits, I explore a possible example of 'counter-performativity' in markets. Starting from the Diamond and Verrecchia (1987) theory that short-sellers are, on average, well-informed, and noting that a series of empirical studies (e.g. Ackert and Athanassakos, 2005, and Boehmer *et al*., 2008) show that heavily shorted stocks perform poorly, there is an incentive for rational market actors to use short-sale/stock loan data to form trading strategies. In particular, an otherwise uninformed trader could simply short stock in a company that is observed to be heavily shorted. This is effectively a form of 'imitation' – short-sellers copy the trades of earlier short-sellers. As this technique becomes more common, the prices of heavily shorted stocks will begin to reflect more 'imitation' and less 'information'. It could also lead to

increased short positions relative to the normal liquidity offered by a stock. This approach bears the seeds of its own destruction and should eventually break down. As a result of widespread and repeated imitation, popular short positions become very crowded relative to the stock's normal liquidity. A liquidity problem could arise if short-sellers attempt to cover their positions simultaneously. When such crowded exits occur, stock returns would be driven not by changes in the fair value of the company, but by the herd-like behaviour of traders covering their short positions. Markets would (temporarily) exhibit behaviour that is inconsistent with market efficiency. Given the importance of the *path of stock returns* to investors employing leverage (who are liable to margin calls or subject to loan covenants) or to investment agents using open-ended fund structures (who are subject to the risk of redemption by clients), even temporary market imbalances can have important practical implications. This process of imitation, crowded exits and path dependency problems arguably constitutes an example of counter-performativity in securities markets.

I conclude by considering the risk of potentially unlimited losses to short-sellers. I follow the line of enquiry of Gamboa-Cavazos and Savor (2007) and test for systematic behaviour by short-sellers in response to negative returns. I extend their analysis and study the behaviour of short-sellers as share prices rise above the estimated average costs basis for short positions. I find that short-sellers cover their positions in response to accounting losses. Accordingly, short-sellers do not suffer from loss realization aversion, a well-documented bias found amongst many other types of investor. Short-sellers' behaviour is consistent with the use of stop losses as a risk control mechanism, a technique described by a series of interviewees. Stop losses are designed to prevent large losses by 'stopping out' (i.e. closing) positions once they produce a small loss. Short-sellers form a subset of the investment community that is generally considered to be 'sophisticated' or 'well-informed' (see Diamond and Verrecchia, 1987 and Boehmer *et al.*, 2008) and it is noteworthy that they do not in aggregate suffer from loss realization aversion. My findings contribute to the discussion initiated by Gamboa-Cavazos and Savor (2007) on why short-sellers retreat from their positions.

A better understanding of indirect short-selling constraints and of changes to these constraints should be of interest to financial regulators and academics alike. It is also highly relevant to those market practitioners, including analysts, active investment managers and traders who compete incessantly in stock markets to identify opportunities for out-performance. Accordingly, this research into indirect short-selling constraints has a potentially wide audience.

1.2 Structure of the Thesis

Section 2 describes the institutional framework governing short-selling and stock lending. I provide definitions for short-selling and stock lending, and discuss motivations for these practices. I explain the process of borrowing stock, and describe the risks associated with lending stock and short-selling. I also discuss regulatory and disclosure regimes with respect to short-selling and stock lending.

Section 3 is the literature review. I describe the various theoretical perspectives on short-selling constraints and the main hypotheses posited. I also describe the empirical evidence in support of these hypotheses. I review the literature on indirect short-sale constraints and identify gaps in the literature.

Section 4 investigates indirect short sale constraints. I use the results from a series of interviews with experienced investment professionals to identify the key direct and indirect short-selling constraints that they experience. I compare these results to those constraints discussed in the literature. I explore the nature of the cultural and institutional constraints on short selling, and seek to understand why short-selling has been generally increasing over the past thirty years, by referring to the changing nature of these constraints.

Section 5 describes the data that I use for my quantitative studies. I use a new dataset of daily stock lending data for 45 months of London Stock Exchange activity. I

merge this dataset with data on stock returns and other stock characteristics from Datastream to produce my final dataset. I discuss the strengths and limitations of this dataset and make adjustments to minimize the obfuscating impact of dividend tax arbitrage on the stock lending data.

Section 6 deals with the first of my quantitative studies into indirect short-sale constraints. I define and investigate ‘crowded exits’. I study the abnormal returns of stocks involved in crowded exits, and describe how crowded exits can constitute a form of ‘counter-performativity’ in markets. I also suggest how short-sellers should incorporate an understanding of ‘crowded exit risk’ into the portfolio risk management process.

In Section 7, I explore the frequency and nature of ‘manipulative short squeezes’. I test theories on the types of stocks most likely to be subject to manipulative short squeezes and study the abnormal returns of stocks around apparent short squeezes, to understand more fully the risks facing short-sellers.

In Section 8, I build on research by Gamboa-Cavazos and Savor (2007) and analyse the response of short-sellers to accounting losses. I then relate my findings to the literature on loss realization aversion.

Section 9 concludes. I summarise the main findings, discuss their implications and consider ideas and paths for future research.

2. INSTITUTIONAL BACKGROUND

2.1 Short-Selling

2.1.1 Definition

Short-selling is a financial market practice that allows an investor to act on his/ her belief that a security is over-priced in some manner, or that it is expected to under-perform. This perceived over-pricing or expected under-performance can be in absolute terms (i.e. the security is trading above its perceived fair value or is expected to fall in price), or can be relative to the price of some other security.

It may be defined as the sale of securities that the seller does not own, or that the seller owns but chooses not to deliver. The short-seller borrows securities in order to fulfil delivery obligations to the purchaser. At some later time, the short-seller purchases the same security, effectively closing out his/ her position.

2.1.2 Motivation for Short-Selling

Traditionally, short-selling has been perceived as a speculative activity. McDonald and Baron (1973) cite a New York Stock Exchange survey from 1947 suggesting that approximately two thirds of short trades are speculative in motive. The remainder is likely to comprise hedging, 'risk arbitrage' or tax related trades (such as 'selling against the box' i.e. short-selling against existing long positions). McDonald and Baron suggest that the proportion of hedging and arbitrage trades is likely to have increased since this report was published. More recent studies suggest a dramatic change in motivations. According to Brent *et al.* (1990), a short-sale is rarely a straight-forward speculative bet on a decline in the value of a security. Instead, short positions are generally entered as part of a broader trading strategy, designed to

benefit from perceived pricing anomalies between two or more securities. These trading strategies, often referred to as ‘arbitrage’ or ‘risk arbitrage’ strategies, involve the simultaneous positioning of the trader in one or more long positions and one or more short positions. The price of each security will be related in some manner. The positions are subsequently reversed or unwound, with any profit being earned by the relative price movements of the positions, and any transactions costs associated with the trades. A number of examples of such strategies are shown below:

Convertible Bond Arbitrage

In practical terms, convertible bond arbitrage generally entails the purchase of convertible bonds and the hedging out of equity risk by short-selling the underlying stock. Other risks involved in purchasing convertible bonds (such as credit risk, interest rate risk or volatility risk) may also be hedged out by the risk arbitrageur. At a later time, either the positions will be unwound; or the convertible bond will be converted into equity and this will provide the stock to cover the short position. In both cases, the risk arbitrageur aims to benefit from relative price movements in the two securities (less transaction costs) during the holding period. Agarwal *et al.* (2004) study the risks and return characteristics of convertible bond arbitrage and argue that it is associated with three “primitive trading strategies”: positive carry, volatility arbitrage and credit arbitrage.

Merger Arbitrage

When a company is offering shares in itself in a bid to acquire another company, a typical merger arbitrage strategy is to sell short shares in the bidding company, and to buy shares in the target company. If the bid is successfully completed, the target company shares are exchanged for shares in the bidding company, and these are used to cover the short position. The profit from this position is the uplift in value of the target company shares as the bid moves to completion, less all relevant transaction costs. The risks include the possibility of non-completion of the bid. The distribution

of returns and the risks associated with this strategy are described in Mitchell and Pulvino (2001).

Index Arbitrage

This entails either buying or selling short the shares in constituent companies of an equity index (e.g. FTSE 100 index) and taking an offsetting position in the index future, to benefit from an arbitrage opportunity. The positions are unwound after price convergence at some point during the life of the futures contract.

Pairs Trading

This is generally undertaken when the share price relation between two companies is inconsistent with its historical relationship, or expected to change in future. It entails buying shares in one company, believed to be undervalued relative to the other, and selling short shares in the second company. The two companies may have similar characteristics, providing a natural hedge against market movements. The positions are later unwound, and any profit would be based on relative share price changes less transaction costs (see for example, Vidyamurthy, 2004).

Capital Structure Arbitrage

This strategy involves exploiting perceived mispricing between the different classes of capital within a firm's capital structure. In particular, some combination of long and short positions are taken in the bonds, credit default swaps and equity of the same company. Yu (2006) argues that capital structure arbitrage "is full of risk, and can lead to large losses with alarming frequency."

In addition to profit-seeking strategies such as those above, the literature identifies a number of other purposes for short-selling:

Improving the Risk-Adjusted Return of a Portfolio

Adding a lowly correlated asset or portfolio to an existing portfolio can lead to improved risk-adjusted returns (see Elton *et al.*, 1976). One type of portfolio that can have a low correlation of returns with traditional asset classes such as equities and bonds is a hedge fund. These, according to Ackermann *et al.* (1999), can be characterised by a number of features, including "largely unregulated organisational structures, flexible investment strategies [including short-selling], relatively sophisticated investors, substantial managerial investment, and strong managerial incentives." The authors study hedge fund returns in the eight years ending in 1995 and show that adding such funds to an existing portfolio of assets can enhance risk-adjusted returns.

Hedging

Alexander (1993) argues that, as most stocks have a positive covariance with one another, "short-selling creates a set of negative covariances" and can thus be used to reduce risk when constructing a portfolio. He suggests that in the context of total portfolio risk, short–selling might not be as risky as it seems when merely looking at the variance of a short position. The ability to undertake short-selling also allows the investor a further means of protecting the value of a portfolio against an anticipated market fall. Brent *et al.* (1990) find evidence supporting a hedging motivation for entering into short positions.

Market Spanning

Bey and Johnson (2006) show that emerging market equity investments can be 'spanned' (i.e. their behaviour can be replicated) using traded U.S. securities, provided investors can undertake short-selling and margin trading. U.S. investors wishing to invest in emerging market equities, but unable to do so for, say, regulatory

reasons, can thus achieve similar results in the domestic market, so long as short-selling and margin trading is permitted.

Improving the 'Informational Efficiency' of a Portfolio

Short-selling allows for more 'informationally efficient' portfolios to be created (see Clarke *et al.*, 2002, 2004). In a traditional long-only portfolio, securities deemed to be over-priced can, at the lower limit, be zero-weighted in a portfolio. By lifting the restriction on short-selling, over-priced securities can be short-sold and information gained from investment analysis, including negative opinions on stocks, can be more fully utilised. This is particularly helpful when a negative opinion is obtained on a smaller company, as merely holding a zero weighting in a smaller company will have little benchmark-relative impact on performance. This insight has led to the development of so-called 'short extension portfolios' in recent years – portfolios that permit some degree of short-selling, but that re-invest the proceeds of short-selling so as to have a net 100% long position in stocks (see, for example, Jacobs and Levy, 2007, and Clarke *et al*., 2008).

2.1.3 Constraints and Risks associated with Short-Selling

A number of constraints are identified with short-selling. These include 'direct constraints', such as legal and regulatory restrictions on short-selling (see Almazan, 2004) or costs associated with the borrowing of stock so as to facilitate the settlement of a short-sale. There also exist a series of 'indirect constraints', including cultural and institutional constraints (see, for example, D'Avolio, 2002; Jones and Lamont, 2002; and Nagel, 2005). The literature also describes a series of risks that act as indirect constraints on short-selling. These include:

Fundamental risk

A typical risk arbitrage strategy, such as pairs trading, might involve a short position in an apparently over-valued security and a long-position of equal size in a similar, but apparently under-valued security. This partially hedged arbitrage position is risky, because the fundamental value of the combined position might change adversely due to the emergence of new information about the fundamentals of each company. Furthermore, the valuation models used by the arbitrageur might be faulty. Shleifer and Vishny (1997) suggest that such risk arbitrage is concentrated in markets where the value of securities can be ascertained with some confidence. For example, for high quality bonds, where future cash flows are almost known with certainty, arbitrageurs can identify deviations in price from fundamental value, and fundamental risk is low. In foreign exchange markets, where central banks may intervene in an attempt to maintain non-market exchange rates, arbitrageurs can again identify potential mispricing. In equity markets, though, the absolute and relative values of shares are more difficult to estimate, and hence arbitrage opportunities are harder to identify. This suggests a rationale for why short-selling is so rare in equity markets: the fundamental risk associated with arbitrage between different equities is often high enough to deter the arbitrageur from taking a position. Shleifer and Vishny (1997) also suggest that risk-averse arbitrageurs might avoid extremely volatile markets, if expected 'alpha' does not increase in proportion to volatility. This would be the case where fundamental risk was the cause of much of the volatility, and they cite the example of an industry that is perceived to be under-priced as one bearing high fundamental risk.

Noise Trader Risk

Noise trader risk, described by Black (1986) and De long *et al.* (1990), concerns the risk that prices can move further away from fundamental value, due to the correlated actions of 'uninformed' investors. If the arbitrageur can hold on to the security position long enough, a reversion to fair value will ensue and noise trader risk merely presents opportunities to take additional arbitrage positions. But in practice, the investor might be unable to hold the position long enough to profit from reversion. Reasons for this might include an inability to meet margin calls for collateral on the

short position (due to limited capital) if noise traders move prices further away from perceived fair value; or redemption by clients disaffected with short-term fund performance. Shleifer and Vishny (1997) name this latter problem 'performance based arbitrage'. Contractual restrictions on the withdrawal of funds by investors (known as 'lock-in periods') are attempts by risk arbitrageurs to mitigate this problem. Closed-end funds, such as investment trusts, naturally mitigate 'performance based arbitrage' by their 'closed-ended' nature. For investment managers, this serves to reduce the risk of withdrawal of funds following poor returns. It might at the same time protect fund investors (in aggregate) from mistiming the market.

Synchronization Risk

Synchronization risk, as identified by Abreu and Brunermeier (2002) is concerned with uncertainty about the market timing decisions of other rational arbitrageurs, and thus the timing of the price correction. They show that rational arbitrageurs do not act immediately on knowledge of stock over-valuation, but instead wait for other rational arbitrageurs to learn about the over-valuation. Acting immediately might lead to losses, if enough other rational arbitrageurs do not know of the over-valuation and fail to act at the same time. Chanos (2003) states "It is very costly and full of risk for the short seller to execute and maintain a position, waiting for the rest of the market to realise the stock is overvalued." Shleifer and Vishny (1997) suggest that risk arbitrageurs might tend to avoid positions where the long-term ratio of alpha to volatility is high but the short-term ratio is low, perhaps due to the slow resolution of uncertainty, noise trader risk and the lack of a catalyst for convergence. However, Hardie and MacKenzie (2007) observe that, in practice, arbitrageurs can enter immediately into seemingly attractive positions and then proceed to advise their known contacts, such as brokers and peers, of the attractiveness of that position. For example, in their observational study of a hedge fund, the following situation arose:

"The trader asked his assistant to construct a spreadsheet of recent prices of the two bonds, which supported the view that it was indeed an anomaly and thus a trading

opportunity. Having first made the necessary purchases and short sales to take advantage of it, the trader then phoned a contact in an investment bank to direct his attention to the anomaly – 'There is at least half a point in that trade, and there is zero market risk' – and sent him the spreadsheet."

The purpose of this activity is to encourage dissemination of the idea and to alert other arbitrageurs to the opportunity. This has two effects: first, it lowers the risk of greater divergence of the position from fair value, so limiting margin calls and the risk of 'performance-based arbitrage'. Secondly, it might bring the trades of other actors forward in time, thus reducing synchronization risk.

Recall Risk

Short-sellers borrow securities to settle short positions. For a security borrowed 'on call' rather than for a fixed term, the short-seller risks having the borrowed security recalled by the lender. If the short-seller is unable to replace the borrowed stock, he must buy the stock in the market to cover his position. In the case of a simple short-sale, if the stock is re-purchased at a higher price than the original short-sale price, a loss results. Where the recall occurs within a risk arbitrage position, losses can arise depending on the relative movements of the components of the strategy prior to position closure. When a large trader is an immediate, forced buyer of an illiquid security, there could be considerable market impact. Additionally, if other traders were aware that a forced buyer was about to enter the market, they could choose to trade in a predatory manner, ahead of the forced purchase (see Brunnermeier and Pederson, 2005). This can affect liquidity and stock returns, and is explored further in Section 6.

D'Avolio highlights that when a 'special' (a security that is expensive to borrow) is recalled, short-sellers on average are unable to renew a similar loan for a mean of 23 days (median of 9 days).

Unattractive Distribution of Returns from Short-Selling and Risk Arbitrage

A positive return is expected for owning a risky asset. Consequently, a short-seller should expect a negative return from a short position in a risky asset. No income is received from stocks that are sold short – in fact, dividends must be manufactured for the stock lender. Short-sale profits are limited to 100% of the proceeds on the date of sale. Losses are theoretically unlimited however, as share prices are not 'capped'. In practice, though, the limited capital of the short-seller places a constraint on losses - at the point at which the short-seller runs out of capital and is unable to meet variation margin, his/ her short-position will be covered by the broker and the short-seller's loss will be 'locked-in.' Viewed in isolation, a negative expected return is likely to be unattractive to many market participants.

Short-selling is understood to be practised by hedge fund managers and risk arbitrageurs as a routine part of their strategies. However, Ackermann *et al.* (1999) state that a "standard deviation of return measure of total risk may not fully capture the complex risk taking from hedge funds' dynamic, highly leveraged strategies." The distribution of returns from a hedge fund is believed by the authors to exhibit 'fat tails' relative to a Normal or log-normal distribution. Mitchell and Pulvino (2001) state that: "Risk arbitrage is appropriate only for those investors that are willing to incur negative returns in severely depreciating markets and limited positive returns in flat and appreciating markets." In other words, the distribution of returns in risk arbitrage is skewed or asymmetrical. Such distributions could prove unattractive to some market participants.

In summary, there exists a variety of direct and indirect constraints on short-selling. Several of these indirect constraints are related to risk. Whereas some of these risks, including fundamental risk and noise trader risk, are also associated with 'long-only' investing, others, such as recall risk, are unique to short-selling.

2.2 Securities Lending

2.2.1 Definition

Securities lending is the market practice whereby securities are transferred temporarily from one party (the lender) to another (the borrower) for a fee. The borrower must return the securities to the lender either at the end of an agreed term, or on demand. In law, the transaction is an absolute transfer of title (or sale) against an undertaking to return equivalent securities. Most securities loans are 'collateralised' either with cash or other securities. The process is facilitated by agent intermediaries, such as custodian banks and investment managers, and by principal intermediaries, such as prime brokers and broker dealers - these latter often being divisions of investment banks.

2.2.2 The Stock Lending Process

A typical stock lending transaction starts with a trader, who intends to short-sell, requesting from his broker a 'locate' on a given quantity of a stock. In the USA for example, Regulation SHO (2004) requires that short-sellers 'locate' stock to borrow prior to selling the stock. Formal securities lending exchanges do not currently exist, although Jones and Lamont (2002) describe a formal market that existed on the New York Stock Exchange from 1926 to 1933. Brokers may locate stock from their own inventory, from an institutional investor with whom they have either a relationship or a stock lending agreement, or via the use of an intermediary such as a custodian or investment bank. Electronic platforms such as EquiLend and SecFinex allow firms to share information on stock available for lending and to negotiate stock loans, thus facilitating the process of locating or lending stock. Some stock lending agents enter into agreements known as 'exclusives' with investment managers, whereby they obtain access to all stocks in a portfolio over some defined term, for the purpose of lending to third parties.

The difficulty of locating stocks depends on a series of factors. Duffie *et al.* (2002) suggest that the difficulty depends on company size (market capitalisation), the proportion of a company's shares available for trading (free-float), whether or not the stock is included in a major index, the degree of concentration of ownership, liquidity of the stock, and 'special' factors, such as whether or not the stock is or has recently experienced an IPO, merger, acquisition or spin-off. Other influential factors are likely to include the proximity of a dividend record date or a cut-off date for voting at an AGM or EGM (see Section 2.2.3 and 2.2.4 for a description of the motivation for borrowing and lending securities).

Stock borrowing generally takes place on a quicker cycle (typically same day) than stock settlement (typically T+3 settlement). Collateral is transferred from the stock borrower to the lender, to protect against the effects of default. If in the form of cash, collateral of 102% of the market value of the loaned stock is typical. If securities such as Treasury bills or other stock are used, collateral is likely to be higher because of the greater risk to the lender in terms of the need to liquidate the securities in the case of default (see Section 2.1.3 on risks). Cash collateral earns a 'rebate': the lender, who receives the collateral, effectively pays interest to the stock borrower who provided the cash collateral. The rebate rate incorporates an effective stock lending fee, and so is lower than the rate of interest that the cash might otherwise have earned. In the case of hard to borrow stocks ('specials') the rebate rate can be zero or even negative. The effective securities lending fee is negotiated between the parties involved, and is determined by supply and demand for the securities to be lent, collateral flexibility (the borrower might be willing to pay a higher fee if the lender is willing to be flexible on the type of collateral accepted), the term associated with the transaction, the marginal tax rates of the respective parties and the size of any forthcoming dividends. According to Faulkner (2006), typical fees to borrow FTSE 100 stocks are 6-200 basis points per annum. For FTSE250 mid-capitalisation stocks, fees are generally somewhat higher, at 10-400 b.p. per annum. D'Avolio (2002) finds that the value-weighted mean fees for 'general collateral' US stocks (i.e. stocks that are not 'specials') is 17b.p. per annum. Under Regulation T, US *retail*

clients must post 50% of the market value of the stock in additional collateral. Furthermore, they typically do not receive interest on their collateral.

Stock loans are normally made on a 'call' basis: that is, they are open-ended in nature, renewed daily and with collateral adjusted according to daily market moves in the underlying stock. For call loans, stocks may at any time be 'recalled' (i.e. return of the stock may be demanded by the lender). A small proportion of loans are 'term loans', where recall is not permitted without penalty during the term of the loan. Common reasons for recalling include a desire to sell the underlying stock, or the desire to vote on a corporate issue. In fact, voting of proxies is considered best practice for institutional voters, and Myners (2005) argues that for contentious resolutions, "the lender should automatically recall the related stock, unless there are good economic reasons for not doing so." When a stock is recalled and the original borrower is unable to locate new stock to replace the recalled stock, he becomes a forced buyer of the stock, due to his need to close out the position. This situation is referred to as a 'short squeeze.'

During a stock loan, the lender is 'made whole' by the borrower in all respects possible. For example, dividends are manufactured by the borrower and paid to the lender. Additionally, during a rights issue, rights are manufactured by the borrower for the benefit of the lender. However, voting rights are transferred to the borrower, as by law the transaction is an absolute transfer of title and the lender no longer legally owns the stock, Raajimakers (2005) argues that institutional investors "must as far as possible prevent their shares being used by others to influence voting relationships" and that regulators will need to take additional measures, including an explicit ban on the borrowing of shares with the aim of voting on them, in order to make clear that the practice is not permitted.

Potential borrowers can reserve or pre-borrow via a process known as 'icing' or putting securities 'on hold'. 'Icing' applies for one business day but can be rolled over. No fee is paid to the lender and if a new prospective borrower emerges, the original borrower is typically given thirty minutes to commit to the loan.

Alternatively, one can ‘pay to hold’, whereby the prospective borrower pays the lender a fee to secure the future stock loan and a contract is formed. ‘Icing’, ‘paying to hold’ or borrowing more stock than required fulfils the locate requirement for future short-selling and protects against the risk of loan recall for existing short positions.

2.2.3 Motivation for Borrowing Securities

There are several motivations for borrowing securities (see, for example, Moore and Rich, 2002). As described in Section 2.1.2, a common reason for borrowing securities is to settle an outright sale of securities, known as ‘short covering’. Short covering would be required, for example, after a short sale - the sale of a security that the seller does not own. Furthermore, a broker may borrow securities to cover a short position after failed settlement. A market maker or exchange specialist might borrow securities to fill a customer buy order or to maintain price stability.

Securities lending can also be related to a derivative contract, such as a swap, a ‘contract for differences’ (‘CFD’) or a spread bet. Derivatives can be used to speculate on price movements in securities without the need to purchase or short-sell those securities. In the UK, derivatives have some tax advantages over transactions in the underlying security: swaps and CFDs are not subject to stamp duty; spread bets are subject to neither stamp duty nor capital gains tax. Where an investor or speculator enters a derivative contract, the counterparty to the contract may choose to hedge his/ her exposure to the underlying security. Where an investor or speculator believes that a stock will perform poorly, he might initiate a ‘bear’ CFD or spread bet. The counterparty to this transaction could hedge his position if desired by borrowing and then short-selling the underlying stock. In the UK, purchases of stock by market makers are free from stamp duty (normally set at 0.5% of the value of all purchases in listed UK equities). This provides for tax-efficiency in derivative trading when the ultimate counterparty is a market maker.

Where a voting decision is pending on some corporate decision (e.g. a restructuring or acceptance of a take-over bid), securities may be borrowed and voted, providing an inexpensive mans of influencing the vote. Borrowing stock to influence a vote is legally permitted, but generally considered to be unacceptable practice amongst practitioners. Christoffersen *et al.* (2007) find evidence that stock lending markets host markets for the trading of votes.

2.2.4 Motivation for Lending Securities

A primary motivation for stock lending is that lenders typically receive fees from the borrowers. The mechanism for this is discussed in Section 2.2.2.

A further motivation for lending securities is to obtain cash collateral for financing purposes. Transactions other than cash-collateralised securities lending, such as repurchase agreements and buy/sell back agreements, can also be used to obtain cash in exchange for lent securities.

Index funds make natural lenders of stock: they generally have large scale and long duration holdings in stocks. Their aim is to track an index; the performance of specific stocks within that index is of lesser importance. Actively managed pension funds, endowments and other institutional investors are also potential stock lenders, although each of these parties might be concerned with the impact on their investment returns if the securities lent are short-sold.

Intermediaries, aware of demand to borrow stock, are able to provide ‘guaranteed fee’ deals to institutional investors. This provides a marketing-led, fee-seeking incentive for stock lending, and was mentioned by several of my interviewees as a common practice. Institutions holding stock are offered guaranteed fees or ‘out-performance certificates’ for some defined term, in exchange for lending their stock. The intermediary uses the borrowed stock to arrange swaps with other institutions that wish to gain short exposure to these same stocks. The swaps could include a

‘break fee’ if the institution obtaining a short position wishes to terminate the contract early, thus allowing the intermediary to offer the guaranteed term fee to the lender.

The temporary transfer of ownership may also inspire securities lending. For example: where the holder of securities is subject to withholding tax on interest or dividends, but some other body would be free of withholding tax, the latter could borrow securities, receive the interest or dividend free of withholding tax and share some of the benefits with the lender, via a fee or larger manufactured dividend. As another example, where a company offers shareholders a choice of receiving a dividend as cash or as further shares in the company, a shareholder may be constrained from acquiring more shares. For example, the shareholder might be a full replication index fund unable to take an over-weighted position in a company, or may have reached its maximum holding size in the dividend paying company. The stock dividend might be more attractive than the cash dividend, due to movements in market price of the company’s shares, subsequent to the declaration of the dividend. In these circumstances, it may be beneficial to lend the shares to an unconstrained investor, who will accept the dividend in the form of shares and then sell these shares in the market, sharing some of the benefits with the lender. Such practices are typically known as ‘dividend arbitrage’ and are not uncommon. Quoted in Bollen (2005), Paul Wilson, Head of Securities Lending and Investment Products at JPMorgan Investor Services EMEA, commented: “On average, our estimates suggest that dividend arbitrage accounts for about 10 percent of overall volume and 35 percent of equity volume. It would have a slightly higher proportion of overall [intermediary] earnings.”

2.2.5 Risks associated with Securities Lending

There are two main risks associated with securities lending: risk of default by the borrower and risk associated with the investment of cash collateral.

As described in Section 2.2.2 above, when a lender receives cash collateral, he must pay a rebate rate to the provider of that collateral. This rate incorporates a market return on invested cash, less a stock lending fee. If the lender aims to further enhance returns on the transaction, the lender may re-invest the cash collateral into securities with a greater credit risk or longer duration than the likely term of the loan. Losses may occur if the credit quality of the securities deteriorates, or if interest rates rise. According to Faulkner (2006), a number of large securities lending losses have been associated with the unsuccessful reinvestment of cash collateral.

If the stock borrower defaults (i.e. is unable to deliver stock following recall by the lender) cash collateral is used to 'buy-in' the borrower. The borrower must compensate the lender for any additional costs associated with a buy-in. If collateral had been offered in the form of securities, the lender can sell the collateral in the market to raise funds to replace the lent securities. However, losses can occur if the sale proceeds are lower then the value of the lent securities. Risk of loss increases if the securities used as collateral were originally over-valued, do not move in line with the loaned securities, or suffer from poor liquidity.

Further risks include fraud, risk of error and system failure – risks that can be observed in any financial transaction. Also, securities loans are sometimes settled as 'free of payment' transactions, whereby collateral is taken separately and possibly at a different time. There is thus the possibility of 'daylight exposure risk' – when securities have been delivered but not yet covered by collateral. Sackville *et al.* (2005) outline a framework for quantifying the risks in securities lending, so that the securities lender can compare the anticipated returns from securities lending to the risks involved.

2.3 The Regulatory and Disclosure Environment

Robotti (2005) explores short-selling and arbitrage in a regulatory context. Some classes of investor, involved in collecting money from the public in certain countries,

are legally prevented from short-selling securities. Such laws are designed to protect (unsophisticated) investors from unlimited losses. However, increasingly available alternatives, such as single stock futures, spread betting and contracts for differences, allow smaller (or 'retail') investors to short-sell securities. At the same time, regulators might be interested in achieving and maintaining efficiency in markets. Fama's (1965) description of arbitrage regards short-selling as an essential mechanism for correcting over-pricing in securities and hence short-selling can assist in making markets more efficient. Thus, regulators face a dilemma: permitting short-selling might help make markets more efficient, in the sense that there exists a mechanism for driving prices towards fair value, but it could also result in unlimited losses for some investors (effectively, bankruptcy sets in at some point due to limited capital). If confined to sophisticated investors, large losses and bankruptcy might be tolerable. However, amongst retail investors, especially those invested via collective investment funds, this might become politically unacceptable. Robotti argues: "The puzzle for regulators lies in this tension between the need to protect investors and the need to promote efficiency, which regulators find equally constraining." The author argues that the efficiency argument has had an important influence on the way regulators allow short-selling to operate in a market.

Chanos (2003) describes short-selling as being a "heavily regulated strategy with significant legal and economic constraints." At a minimum, short-sales are subject to the same anti-manipulation rules as long-only investing. In the main, these rules were developed following a series of high profile stock manipulation cases in the USA in the 1930s. A number of these incidents involved short-selling, and this cast suspicion over the practice. Case law in stock manipulation (e.g. Harris V United States 1931, United States v. Brown 1934) developed rapidly during this period, and following a backlash from politicians, a series of securities laws including the National Securities Act of 1933 and the Securities Exchange Act of 1934 were passed. Sections 9 and 10 of the 1934 Act specifically deal with the manipulation of security prices. Some of these laws are contentious. For example, Berle (1938) argues that the stabilisation of stock prices after an Initial Public Offering could be perceived either as stock price manipulation, or as a technique for the protection of investors during the distribution

phase of the IPO. The author argues that "the intent should govern" when determining whether or not a particular course of action constitutes stock price manipulation and this is reflected in current industry standards. For example, the CFA Institute's (2005) 'Standards of Practice Handbook: Standard II, Integrity of Capital Markets (B), Market Manipulation' argues that "market manipulation damages the interests of all investors by disrupting the smooth functioning of financial markets and damaging investor confidence" but states that "the intent of the action is critical to determining whether it is a violation of this standard."

There also exists anti-manipulation regulation specific to short-selling. The introduction of Regulation SHO in the United States of America in 2004 provides one such example. Primarily, it requires a 'locate' requirement. That is, short sellers must first find securities to borrow and make an arrangement to borrow them in future, ahead of entering a short position in that security. Finnerty (2005), however, explains where loopholes to Regulation SHO exist, such that 'naked' short selling might continue to be practiced[2]. In particular, the use of certain alternative markets to the cash market allows for naked short selling. There remains the suspicion that short-selling can be used as a tool for the manipulation of stock prices. Rhee (2003) expresses this notion when he states that "securities traded in the OTC [over the counter] markets including NASDAQ Small Cap, OTCBB, and OTC Pink Sheets are not subject to short sale restrictions, even though most of these securities are illiquid and vulnerable to price manipulations related to short-selling."

A further noteworthy piece of legislation relating to short selling is the so-called 'uptick rule', currently practiced in Japan and until 2007 practiced in the USA on the NYSE and NASDAQ markets. This requires all short-sales to be disclosed as short-sales, and for all short-sales to be made only at or above the last transaction price (referred to as zero plus tick if the same price as the last transaction, or plus tick if at a higher price than the last transaction). Exchange traded funds are generally exempted from this rule, so as to facilitate their use in hedging. Such a rule could be

[2] A 'naked' short-sale arises when the seller does not own the shares and has no plans to borrow stock by the settlement date. See Culp and Heaton (2007) for a fuller description of naked short-selling.

interpreted as an attempt to prevent short-selling from driving down the price of a security, and to provide re-assurance to market participants concerned at this risk.

Regulation on short selling and securities lending varies across different countries. At one extreme, China currently prohibits both practices, but short-selling is becoming effectively possible as alternative instruments such as options and index futures become available (see Clunie and Ying, 2008). In September 2008, the China Securities Regulatory Commission announced that it plans to liberalize rules to allow limited short-selling of stocks. Following an anti-deflation package announced by the Japanese government in February 2002, the Japanese Financial Services Agency introduced an "up-tick rule" from March 2002. Although similar to US rules, these changes caused some controversy amongst practitioners at the time of announcement. In the United Kingdom, there is no "up-tick rule." The Financial Services Authority has stated that it regards short-selling as a legitimate investment activity that promotes market efficiency. It generally regards regulatory constraints as unnecessary in light of existing market and regulatory arrangements. Bris *et al.* (2007) show that stock prices in countries with short-sale constraints in place are less efficient that those where short-selling is permitted. Nevertheless, during 2008, extraordinary changes were made to short-selling rules by many national financial regulators. These changes were ostensibly in response to events in the banking industry that had led to the so-called 'credit crunch' that began in 2007 and continued into 2009. In June 2008, the Financial Services Authority of the United Kingdom (FSA) introduced greater disclosure rules on short-selling during rights issues, addressing fears over manipulation by short-sellers. In July 2008 the Securities and Exchange Commission of Pakistan became the first of a series of regulators to suspend short-selling. In September 2008, the FSA suspended short-selling of shares belonging to a list of financial companies, arguing that this was required to maintain confidence in the markets. Other countries soon followed suit, including the USA. Regulators in other countries went further: in Australia, for example, all new short-sales were suspended. At the time of writing (January 2009), some, but not all, of these suspensions have been repealed.

Robotti (2005) analyses responses to the SEC's consultation process ahead of implementation of regulation SHO 2004, and shows that different institutions are affected by short selling regulation in different manners. For example, broker/ dealers favoured less regulation, perhaps due to the fact that they derived income from the process of short-selling and wished to see it unconstrained. Stock exchanges, representing indirectly the corporate sector, favoured no change in regulation. Smaller capitalization companies favoured tighter regulation, perhaps fearing that short-selling could drive down their share prices and raise their cost of capital. Some smaller capitalization companies, and their shareholders, criticised short-sale abuses and alleged share price manipulation. Robotti (2005) argues that any initiative on short selling can affect the balance between the interests of long-shareholders (investors) and hedge funds/ market makers. The author concludes;" The efficiency justification of short selling produces a divide [between corporate and financial interests, and also between long and short holders of capital]." Furthermore: "Contrary to the dominant view on short selling, no financial practice is positive or negative in absolute terms but only in relative terms. There are always social conflicts surrounding market practices."

In the USA, the Investment Companies Act of 1940 allows mutual funds to short-sell only if this is incorporated into the fund prospectus. Most hedge funds are exempt from the 1940 Act, by virtue of being domiciled offshore, or by being limited partnerships with fewer than 100 investors. Ackermann and Ravenscraft (1998) show that regulatory differences between mutual funds and hedge funds lead to large differences in their uses of short-selling, as well as uses of leverage, concentration, derivatives, illiquid securities and lock-up periods. Such differences appear to hinder mutual fund performance relative to hedge fund performance. According to Almazan *et al.* (2004), only about 30% of US mutual funds are allowed to sell short, and only about 3% actually do sell short.

Disclosure

Disclosure of information on short selling also presents a dilemma to regulators. Publishing information on outstanding short positions improves transparency in markets, and should assist in making market more efficient, in the sense that information is readily available, disseminated widely and can be imputed into security prices. However, by disclosing such information, the risks associated with short selling can increase. One risk associated with short selling is that of a 'short squeeze' (see Section 2.1.3 above). If detailed information about short positions was made public, predatory traders could seek to exploit it. By aggressively purchasing stock in companies known to be shorted by traders with limited capital, it might be possible to impose losses on the short-seller and induce closure of the position. If this is accompanied by a loan recall, and the stock loan cannot be readily replaced, the borrower becomes a forced buyer of the stock and could suffer losses. Fear of a manipulative short squeeze might deter short-selling amongst traders, and thus curtail the process of risk arbitrage. If short-sellers stop driving prices towards fair value, the market becomes less efficient. This is a particularly difficult dilemma to resolve and regulators generally arrive at a compromise. For example, in the USA, aggregate short positions are disclosed to the market once a month for major stocks. In the UK, the aggregate number of securities on loan for the largest companies is disclosed daily, three days in arrears, to the market. These disclosures provide a degree of transparency, but by delaying publication and using aggregated data, investors are protected somewhat from predatory traders.

Tax

In the USA, profits from a short sale are taxed at the short-term capital gains rate, regardless of the length of time for which the short position was open. By contrast, lower capital gains tax rates apply to those long-positions that are held for longer durations. Short-selling is thus disadvantaged relative to long-only investing, for taxable investors.

Recall that a securities lending transaction is, in law, an absolute transfer of title, suggesting that it should be a taxable event. Such tax treatment, though, could render

securities lending unattractive and provide a barrier to a process that is believed to improve market efficiency. Accordingly, most countries do not regard securities lending as a taxable event. For example, in the UK, appropriately documented securities lending transactions are not subject to two taxes that a typical sale and purchase would face: Stamp Duty Reserve Tax (currently payable by the stock purchaser at the rate of 0.5% of the value of the transaction) and Capital Gains Tax (payable by the seller when the proceeds of the sale exceed the costs basis of the security, and subject to a complex system of tax rates, indexation allowances and taper relief).

2.4 Alternatives to Short-Selling and Securities Lending

2.4.1 Introduction

Lamont and Thaler (2003), Geczy *et al.* (2002), and Ofek *et al.* (2004) all note that there are alternative means of obtaining short-exposure to an equity, other than short-selling. A series of derivative instruments exist that can be used to construct positions economically equivalent to short sales. These include:

Single Stock Options

Single stock put options give investors the ability to gain from falling share prices, and can thus provide an alternative to short-selling. According to Sorescu (2000) and Danielsen and Sorescu (2001), single stock put options are associated with potentially lower transaction costs than short-selling stock. The introduction of such derivatives reduces the constraints on short-selling and is associated with price drops in the underlying securities.

Single Stock Futures

Markets for futures contracts on single equity stocks were first offered to U.S. investors in 2002. Single stock futures can provide an alternative to trading in the shares of a company on the stock exchange. Selling a single stock future is equivalent to taking a short position in a company. Margin for single stock futures is set at 20 percent of the contract's value, well above the 5 percent margin typical for other futures contracts. Johnson (2005) surmises that the Securities and Exchange Commission, co-regulator of the single stock futures market along with the Commodity Futures Trading Commission, wanted to ensure that stock futures did not have a "margin advantage" (i.e. lower margin levels) than exchange traded stock options. In turn, the 20 percent margin on Chicago Board Options Exchange stock options might have been set - according to Johnson - out of fear that "lower option margins could draw investors away from the regular stock market." Johnson is thus suggesting that margin levels have been set by regulators in such a way as to balance the attractiveness of the three markets. This in turn suggests an understanding by regulators that investors can treat each market as an alternative for the others.

In addition to discussing the regulatory environment surrounding US stock futures, Johnson examines whether or not the market has been successful since launch. The market had, by 2005, disappointed some observers. Figures from the Futures Industry Association suggest that stock futures accounted for less than one percent of industry volume in 2004. Johnson argues that the US regulatory environment for stock futures is "unnecessarily harsh" but admits that: "even in the institutional world, where the regulatory hurdles and costs are easily avoided, business in stock futures has failed to bloom." He considers the reasons for the lack of interest in the US stock futures market: "Does it have anything to do with the bias shown by investors for the long side of the market, a proclivity to view hedging as a drag on potential investment profits, a preference for the limited-liability features of stock options, or other considerations that are endemic to securities markets but do not exist or are more neutralised in futures trading?"

Index Futures

Raab and Schwager (1993) state that the degree of market incompleteness is "expressed by the difference between the number of states of nature and the number of linearly independent states." They take a market with a set of assets and assume a short-selling restriction on those assets. They then introduce a new asset, which is a positively weighted sum of the original assets, and assume no short selling restriction for this new asset. They show that this new asset is a substitute for short positions in the original assets. As a practical example, by taking a short position in a stock index future, and long positions in each of the stocks covered by the index future except for one, a short-position in a single stock is effectively created. Thus, when a stock index future exists, it is possible to synthetically short-sell any stock contained in the index to which the index future relates.

Contracts for Differences

A contract for differences (CFD) is a cash-settled agreement or contract between two parties. It allows a trader to speculate on price movements in securities without the need to purchase or sell-short those securities. A typical CFD requires the counterparty to pay the CFD position taker the difference between a security's current price and its price on initiation of the CFD. CFDs are marked to market daily, with initial margin and variation margin. They are open-ended (i.e. there is no pre-defined maturity of the contract) and the position is generally closed at the discretion of the position taker. Where an investor or speculator enters a contract for difference or places a spread bet, the counterparty may choose to hedge his/ her exposure to the underlying security.

Swaps

Swaps, agreements between two parties to exchange cash flows at future dates according to some defined formula, can be functionally equivalent to the establishment of short (or long) positions in securities. Such swaps are known as 'total return swaps.' Investment banks or prime brokers that offer swaps to investors/ traders who have a negative opinion on the outlook for a security "usually take a

risk-neutral position by hedging the client's position with the underlying asset", according to a 2007 investment bank report[3].

2.4.2 Tax Treatment of Alternatives

"The tax treatment of derivatives is more critical to their success than in most technologies" argues MacKenzie (2007). He cites the example of UK tax law treating options, up until September 1980, as 'wasting assets', such that capital gains could be incurred on loss-making as well as on profitable trades. This initially curtailed the appeal of the London Traded Options Market. Additionally, "a large part of the appeal of financial spread betting is that in the U.K. customers' winnings are free from tax."

Gordon (2005) argues that, for US investors, the time horizon of a trade or investment will influence the choice of whether to trade in the underlying security, or to trade via derivatives. This is because of differing capital gains treatment over different time horizons for different types of security or contract. Another influence will be the issuer of the contract. The author states: "If an investor makes a short-sale, no matter how long the holding period until a gain is realized, it will always be taxed as a short-term gain [and thus subject to the highest possible marginal tax rate]. When the investor owns a listed put [option] from an exchange, the capital gains will be taxed at [a] blended rate of 23 percent. But if the investor had bought a put from a dealer, then any short-term gains would have been taxed at 15 percent, the only difference being the issuer of the contract."

One can thus conclude that the choice of instrument for expressing a negative opinion on a security will depend on several factors, including cost of access to different markets, scale of trade, perceived pricing anomalies across markets, tax effects, time horizon for the trade and the issuer of the contract. For any given level

[3] "130/30 solutions for UCITS Funds", JP Morgan, June 2007, London, United Kingdom.

of risk, rational tax-paying traders will choose the instrument with the greatest net-of-tax expected return (although in practice, there is likely to be some market segmentation).

3. LITERATURE REVIEW

3.1 Introduction

The financial literature has traditionally depicted short-sellers as 'well informed' market participants who have the ability to identify overvalued stocks, and who act on this knowledge. This depiction arises, for example, in Fama's (1965) description of securities markets and in the Arbitrage Theory of Capital Asset Pricing (Ross, 1976), where arbitrageurs are able to identify mispricing of securities and act on this knowledge for profit. A growing number of studies, including most recently Ackert and Athanassakos, 2005, and Boehmer *et al.*, 2008, provide empirical support for the notion that short-sellers are, in aggregate, well-informed. However, short-selling costs and constraints can make it difficult for short-sellers to exploit over-pricing in assets. A picture thus emerges in the literature of well informed market participants who exploit (and thus correct) pricing anomalies in markets, but who are limited in their activities by a number of direct and indirect constraints. A series of researchers (D'Avolio, 2002, Ofek *et al.*, 2004, and Nagel, 2005) argue that our understanding of indirect constraints is incomplete, thus highlighting gaps in the literature.

Despite the generally benign depiction of short-sellers in the literature, a number of recent theoretical and empirical papers, including Cai (2003), Brunnermeier and Pederson (2005), Attari *et al.* (2005) and Coval and Stafford (2007) reveal that short-sellers can also act in a manner that not only fails to promote market efficiency, but instead actively seeks to drive asset prices *away* from fair value. These papers provide illumination on a 'darker' side of short-selling, and create a richer picture of how short-sellers act in practice, and of how asset prices can be set.

3.2 Asset Pricing Models and Constraints on Short-Selling

Asset pricing models such as the Arbitrage Theory of Capital Asset Pricing (Ross, 1976) assume that there are no restrictions on short-sales, including full use of the short-sale proceeds. However, in practice, short-sellers must find securities to borrow, effectively pay securities lending fees and face collateralisation and margin requirements (see Section 2.1.3). In the finance literature, practical and/ or cultural barriers to short-selling are referred to as 'short-sale constraints' and the impact of these constraints on the rational pricing of assets has been a fertile area of research over recent years. A further key assumption in some asset pricing models, such as the Capital Asset Pricing Model (Sharpe, 1964), is that investors have 'homothetic expectations'. That is, all investors have identical estimates of the expected return and probability distribution of returns from all securities. Shleifer and Vishny (1997) point out that uncertainty over future cash flows and the appropriate discount rate for an asset can make it extremely difficult to ascertain its fair value. As a result of this difficulty, investors in practice are generally understood to have 'heterogeneous expectations'. Lintner (1969) creates a model with heterogeneous expectations, but with unrestricted short-selling, and obtains results similar to the Capital Asset Pricing Model. This might suggest that relaxation of the homothetic expectations assumption has little impact on asset pricing. However, in a canonical paper on short-selling constraints, Miller (1977) considers heterogeneous investor expectations in conjunction with short-sale constraints. He argues that with short-sales constraints and divergence of opinion amongst investors, the price of a security is set by the beliefs of the most optimistic investors, not by those of the average investor. He observes that the entire issue of shares in any company is held by a limited number of investors relative to the total universe of investors. It will be those investors with the most optimistic estimates of returns that own the securities. In his model, overpricing develops because pessimists are prevented from short-selling overpriced stocks. Miller concludes that "the presence of a substantial number of well informed investors will prevent there from being substantially undervalued securities, but [given short-selling constraints] there may be securities whose price has been bid up to excessive levels by an uninformed minority, thus contradicting the efficient market hypothesis."

A series of subsequent articles consider Miller's hypothesis. Harrison and Kreps (1978) state that if the markets for stocks were perfect, the amount of stock available to be held long would not be fixed, but would "increase as members of less optimistic classes sold the stock short". However, with short sale constraints, the price of a stock can rise above even the valuation of the most optimistic investors, based on their expectations for future payoffs. They conclude that: "Equilibrium will be reached only when investors take positions sufficiently disparate that their aversion to risk gives them identical marginal beliefs". Jarrow (1980) argues that under "homogeneity of beliefs" for the covariance matrix of future prices, short-sale constraints will only increase prices of risky assets. He points out that according to Miller (1977), market-wide short-sale constraints would lead to pervasive overpricing of the entire market. Diamond and Verrecchia (1987) explicitly dismiss the possibility of price bias as a result of short-sale constraints, observing that "rational expectations formation…removes any upward bias to prices." The Diamond and Verrecchia (1987) model examines the effect of short-sale constraints within a rational expectations framework. Their model incorporates three types of market participant: perfectly informed traders, uninformed traders and a competitive market-maker. Not all traders face the same short-selling costs: some face none, some face short-sale prohibitions and others face short-sale restrictions or costs (e.g. stock borrowing costs). The authors argue that imposing a cost on short-selling makes it less attractive, and so leads to fewer short-sales. Furthermore, as those willing to bear the cost are most likely to be those anticipating the greatest benefit from short-selling, the imposition of costs on short-selling will increase the proportion of informed traders relative to uninformed traders within the pool of short-sellers. Conditional on some traders experiencing costs to short-selling, their model predicts that the announcement of an unexpected increase in short-interest in a security is bad news, as the announcement reveals a greater than expected proportion of short-sales amongst all sell orders placed in the market. An empirical implication is that short-interest announcements produce a price-adjustment where they contain information that is not yet public knowledge. This in turn suggests a possible test for information efficiency across markets, by comparing abnormal returns after short-interest announcements. Note though that this is not a simple research exercise in

practice, because of differing disclosure rules across markets (see Section 2.3). Diamond and Verrecchia (1987) argue that short-sale constraints are likely to reduce informational efficiency. Short-sale constraints imply asymmetry in the speed of price adjustments to negative versus positive information, and skewness in the distribution of returns. Periods of no trading are bad news, as they may reflect informed traders holding bad news but facing short-sale constraints.

Morris (1996) considers short-sale constraints and argues that the price of a stock can be higher than the valuation of all investors due to the opportunity to speculate that arises when shorting is prohibited. Securities lending fees are studied in static models by Duffie (1996), Krishnamurthy (2002) and by D'Avolio (2002). However, Duffie *et al.* (2002) create a dynamic model of equity prices, stock lending fees and short-interest. Trading is motivated by differences of opinion between agents. The authors claim that strong lender bargaining power, or a large discrepancy between the beliefs of optimists and pessimists, can produce share prices above even the most optimistic shareholders' valuation. This is due to the opportunity to earn fees from lending the stock in future. This suggests that a stock price, when limited shorting is permitted, is initially higher than the price with no shorting permitted. This provides a rebuttal against the common perception that easier access to short-selling results in lower security prices. The authors further argue that this can explain the 'negative stub value' effect associated with spin-offs (i.e. a negative implied market value for the portion of a parent company not spun off, even though equity is associated with limited liability). This effect has been identified by Lamont and Thaler (2003), who study the case of 3Com/ Palm, and by Ofek and Richardson (2003). In the Duffie *et al.* (2002) model, as lending fees decrease, so too does the valuation associated with the marginal investor and this leads to a decline in stock price. The model thus predicts a relationship between expected returns and lending fees. This is consistent with Jones and Lamont (2002), who, for their sample of NYSE stocks from 1926 to 1933, find that stocks with high lending fees deliver inferior average returns. Duffie *et al.* argue: "Since the lending fees reflect the expectation of future shorting demand, our model suggests that price declines can be more directly related to expected changes in the short interest over time." The Duffie *et al.* (2002) model also

shows that price declines associated with falling lending-fee effects are likely to be greater for companies with a smaller free-float (i.e. a smaller proportion of a company's shares being tradable in public markets) or with larger differences of opinion between investors (as revealed by a proxy such as higher turnover). This is consistent with poor average returns following an Initial Public Offering, when investor opinions are likely to differ greatly (due to low levels of knowledge about the new company) and when free float is likely to be lower (due to lock-ins of stock held by directors and officers).

Whereas Miller (1977) asserts that, under short-sale constraints, higher prices will be seen in securities with greater divergence of opinion about the future returns from the security, Jiang (2005) develops a model that shows that both under-valuation and over-valuation are possible in a market with divergence of investor opinions. Hong, Scheinkman, and Xiong (2003) claim that "a speculative bubble arises because investors, with heterogeneous beliefs due to overconfidence and facing short-sales constraints, anticipate the option to resell the stock to buyers with even higher valuations." Bai *et al.* (2006) argue that if short-sale constraints eliminate some informed investors, market prices become less informative about their information. However, "less informative prices need not bias the expectations of less informed investors since they are fully aware of the possible negative information held by the constrained investors." Under such a rational expectations framework, short–sale constraints increase the perceived risk for uninformed investors, who require lower security prices in compensation. The authors also argue that short-sale constraints reduce hedging activity and that this has the effect of increasing asset prices. Thus, there are [at least] two effects from short-sale constraints, and these drive asset prices in opposite directions. Bai *et al.* (2006) conclude that "when the information effect is significant, short-sale constraints can actually cause prices to decrease and to be more volatile." Although there remains much debate on the impact on asset prices from short-selling constraints, Asquith *et al.* (2005) argue "that it is now widely accepted that if short-selling is costly and there are heterogeneous investor beliefs, a stock can be overvalued and generate low subsequent returns."

3.3 Empirical Studies on Short-Selling and Asset Pricing

3.3.1 Introduction

There is a growing body of empirical literature on short-selling and asset pricing. To date, empirical research has tended to be concentrated in the US stock markets, but as only monthly information on short interest has been publicly available in the USA prior to 2005, this has limited the scope of research into the topic[4]. A number of well-regarded empirical studies make use of *private* US databases, or else consider other markets where greater disclosure on short-selling or stock lending makes them well-suited for empirical study. Below, I classify the empirical literature into five distinct strands: 1) the extent of short-selling and stock lending; 2) the behaviour of short-sellers; 3) the relationship between short selling (or the release of information about short-selling) and stock returns; 4) the costs of short-selling; and 5) the impact of short-sale constraints on asset pricing and market efficiency.

3.3.2 The Extent of Short Selling

Asquith and Meulbroek (1996) and Dechow *et al*. (2001) examine the extent of short selling in stocks listed on the New York Stock Exchange and American Stock Exchange during the period 1976-1993. Dechow *et al*. (2001) use as their short interest variable the percentage of outstanding shares shorted in each company. From their sample of over 34,000 firm-years, they show that 36.6% of firm-year observations show no short positions. Approximately 46% of observations show small short positions (greater than zero but less than 0.5% of outstanding shares). Less than 2% of observations have over 5% of outstanding shares shorted. They observe a pattern of long-term growth in short selling (from less than 0.2% of outstanding shares being shorted in 1976 to approximately 1.4% in 1993) and

[4] Regulation SHO (2004) required transaction level short-sale data on US stocks to become publicly available from January 2005.

suggest that this might be due to deregulation of the capital markets and the growth of the hedge fund industry.

D'Avolio (2002) studies stock loan data from 2000 to 2001 and shows that at the New York Stock Exchange (NYSE), the supply of securities to lend appears plentiful, and yet only a fraction of the shares available are borrowed at any time. He states that market short interest is typically only 1.5% of market value. In a prepared statement to the US Securities and Exchange Commission Roundtable of Hedge Funds on May 15th, 2003, James Chanos, President of Kynikos Associates, a US firm specialising in short selling and managing over $1 billion of assets, argues that "In almost any environment, professional short-sellers are a small percentage of those actively engaged in the markets." He argues that whereas strong equity market performance in the 1990s made conditions difficult for short-sellers, by 2003 "a number of new participants have emerged and, with them, heightened public, corporate and regulatory scrutiny of the practice of short selling has ensued, as it does during almost every prolonged market downturn." Angel *et al.* (2003) study 3 months of short trades reported to NASDAQ through its ACT trade-reporting system (from 13/9/00 to 12/12/00). They find that 2.36% of trades are short trades, with the median being less than the mean, suggesting that short sales tend to be concentrated in certain companies on a subset of days. Based on the percentage of shares shorted, they find that 2.88% of shares traded were shorted. The median (1.10%) was much lower, again suggesting a concentration of shorting activity in certain companies. According to Almazan *et al.* (2004), approximately 30% of US mutual funds are allowed by prospectus to sell short - and only about 3% actually do sell short. Asquith *et al.* (2005) state that shares sold short, as a percentage of shares outstanding, more than doubled in the twenty years prior to their study. However, the general uptrend in short interest was interrupted during the bull market of the 1990s before reaching a new peak in the bear market of 2002. Short interest ratios are skewed, with only a small number of stocks having high ratios.

In a study of US daily short-sale data from 2000 to 2004, Boehmer *et al.* (2008) find that aggregate short-interest is 2.0% in 2004, but that 12.86% of trading volume

involves a system short-seller (i.e. a short-seller other than a market maker or floor broker). These statistics indicate that, on average, the holding period for short positions is less than that for long positions. Diether *et al.* (2008) use regulatory tick-by-tick short sale data for a cross section of 3800 stocks from both the NASDAQ and NYSE markets for 2005. They find that short selling is more prevalent in the USA than revealed in earlier studies, with 24% of NYSE and 31% of NASDAQ trading volume by shares represented by short-sales.

Bris *et al.* (2007) examine short-selling in 47 countries around the world. They find that short selling is prohibited in 12 of these 47 countries and that it is only practised in 28 of the 35 countries in which it is allowed. Laws, regulation, frictions and costs vary by country. Au *et al.* (2007) examine UK stock lending data from September 2003 to September 2006 and observe that "the typical firm in the UK sample has very little short interest." The mean percentage of outstanding shares on loan is around 3%; the median is around 2%. The 95th percentile by percentage of outstanding shares on loan is around 11% in mid-2006. MacKenzie and Henry (2008) examine a subset of 95 stocks listed on the Hong Kong Stock Exchange that have continuous stock lending activity during the period 2005-2007 and find that the average weekly short sales volume was around 5% of total traded volume across the sample period and that it ranged from approximately 2-7%.

Taken together, these studies suggest that short-selling activity in the USA has been generally increasing over the past thirty years. Although aggregate short-interest remains small, the proportion of trading that is due to short-selling has risen to as high as one-third. When viewed in conjunction with low levels of short-interest, the large number of short-sales indicates brief mean holding periods for short-sellers. The growth of short-selling over time suggests that short-sale constraints in one form or another have been reducing. Outside the USA, there have been fewer studies into short-selling, but those studies that have been conducted reveal a picture of generally low levels of short interest.

It is important to note that during 2008 there were extraordinary changes to short-selling regulations in almost all major stock markets. Several, including the USA and UK, placed temporary prohibitions on new short sales for a defined list of financial companies. Australia temporarily prohibited new short sales of any stock. These prohibitions represented a regulatory response to the severe problems experienced in the global banking industry, credit markets and stock markets during 2007 and 2008, including the collapse of US investment bank, Lehman Brothers Inc., in September, 2008.

3.3.3 The Behaviour of Short-Sellers

Dechow *et al.* (2001) investigate the trading strategies of short-sellers. The authors identify a strong relation between the trading strategies of short-sellers and ratios of fundamentals to market prices. They show that short-sellers target equities that have low fundamental-to-price ratios, and then unwind their positions as these ratios revert to the mean. They also show that short-sellers refine their trading strategies in three ways: by avoiding equities where short-selling is expensive; by using information other than fundamental-to-price ratios that has predictive ability with respect to future returns; and by avoiding equities with low fundamental-to-price ratios where the low ratios are due to temporarily low fundamentals (as opposed to temporarily high prices). Their evidence suggests that "short sellers are sophisticated investors who play an important role in keeping the price of stocks in line with fundamentals." The authors also conduct telephone interviews with nine global short-selling hedge fund companies, and determine that these short-sellers are selling equities that they perceive to be 'over-priced' in some manner. They note, though, that these short-sellers might inadvertently be loading up on the 'book to market' risk factor hypothesised by Fama and French (1992). Some practising short-sellers have publicly described their decision-making processes and this can provide clues to the behaviour of short-sellers. For example, Chanos (2003) states that Kynikos Associates, a short-selling firm of which he is President, conducts financial analysis on companies and identifies for short-selling those that have "(1) materially

overstated earnings; (2) an unsustainable or operationally flawed business plan; and/or (3) [are] engaged in outright fraud."

Angel *et al.* (2003) find that short-selling is more common in actively traded companies and in shares with higher price volatility. They argue that liquidity considerations are important to short-sellers, in the sense that they do not wish to have to cover positions is stocks with poor trading liquidity, where their market impact could be high.

Sloan (1996) documents the accrual-related mispricing effect in equity markets, consistent with investors focusing on corporate earnings data and ignoring cash flow and accrual components of earnings. Cash flow earnings are found to be more persistent than accrual earnings and the author describes a trading strategy to exploit this finding. The strategy involves buying shares in companies that fall into the bottom decile by accruals, and short-selling those in the top decile by accruals. This strategy generates significant positive abnormal returns before transaction costs. Richardson (2000) investigates the relationship between high earnings accruals at the company level and short-interest at the stock level and "[does] not find systematic evidence that short-sellers trade on the basis of information contained in accruals." Collins *et al.* (2003) show that non-persistent accruals are concentrated in stocks with low institutional ownership. Kraft *et al.* (2006) demonstrate that the abnormal returns described by Sloan (1996) depend on a small number of observations from within each decile. Mashruwala *et al.* (2006) consider the distribution of the accrual anomaly, and find that it is concentrated in smaller or hard-to-short companies. Such stocks would generally be characterised by poorer trading liquidity, higher transaction costs, poorer loan availability and higher stock lending fees. With poorer trading liquidity, the risk associated with a stock loan recall would be elevated. This acts as a limit to arbitrage and, along with higher transaction and shorting costs, could help explain why the accruals anomaly has persisted, despite being known for many years. Palmon *et al.* (2008) examine a subset of US-listed stocks from 1971-2003 and identify an interaction between the accrual anomaly and company size that yields returns in excess of the adjustment for size in Sloan (1996). Their results

suggest a “modified accrual trading strategy that gives more weight to small companies in its long positions and to large companies in its short positions.” They argue that this will produce better results in practice, as short-selling large-cap stocks is likely to be less constrained and less costly than short-selling small-cap stocks.

Christophe *et al.* (2004) investigate short-selling around the time of earnings announcements and find that short-interest increases ahead of negative earnings surprises.

Short sellers might be expected to take advantage of any ‘day of the week’ effect in choosing when to initiate or close out a short position. Furthermore, a day of the week effect could suggest a profitable arbitrage strategy, if transaction costs did not exceed possible gains. Gibbons and Hess (1981), Abraham and Ikenberry (1994), and Dubois and Louvet (1996) suggest that returns on certain days of the week are greater than returns on other days. However, Connoly (1989, 1991) and Chang, Pinegar and Ravichandran (1993) question the statistical robustness of such findings. Chen and Singal (2003) argue that speculative short-sellers may be the *cause* of the Monday effect, as they initiate short-sales that are later closed before the next weekend. Angel *et al.* (2003) assess the frequency of short-selling by weekday for their sample. Little day-to-day variation is shown for the percentage of short trades and percentage of shorted shares.

Chen *et al.* (2008) examine mutual funds that use short sales of US domestic stocks as an investment strategy. They find that managers tend to establish short positions in the larger and more liquid stocks, perhaps to minimize the possibility of short squeezes. They also find that the shorted stocks have low book to market ratios, higher total accruals, and higher prior sales growth. The shorted stocks earn significant negative abnormal returns, suggesting that the fund managers are able to successfully use valuation and financial indicators to identify stocks that perform poorly.

Asquith *et al.* (2005) consider differing motivations for short-selling. They differentiate between situations where short-sellers identify over-valued securities ('valuation shorts') and those where a short-seller identifies a convertible bond that is cheap compared to the equity of the same firm ('arbitrage shorts'). The authors state that, arbitrage short-sellers do not profit to the same extent as valuation-based short-sellers, at least for high short-interest stocks in their sample study. Such results do not, however, take account of the use of leverage in a trade – it is possible that arbitrage trades are less risky and so can support greater leverage than valuation trades. Diether *et al.* (2008) agree that "short sellers are not all alike." Some traders speculate on prices reverting to fundamentals, whereas others hedge long positions or options in the same stock, and yet others conduct convertible or index arbitrage. The authors also find evidence that some short-sellers act as voluntary liquidity providers, trading when a temporary buy order imbalance arises in markets. Furthermore, some short-sellers provide additional risk-bearing capacity in periods of elevated uncertainty. For their sample period (i.e. 2005) the authors find that short-selling activity is higher for larger stocks, growth stocks, high price stocks, stocks with high institutional ownership, and those with actively traded put options. Note, though, that this is a short sample period.

As described in Section 2.3, there has been suspicion amongst investors in the USA since at least the Great Crash of 1929 that short-sellers destabilize markets and cause falls in the level of the stock market. Foster (1932) states: 'There is every reason to believe that short-selling has been a substantial cause – not the chief cause, by any means, but a substantial cause – of the depth and duration of the present business depression." However, in the same article, the author cites Emery, who argues that the short-seller "keeps prices down by his short sales, and then keeps them strong by his covering purchases." For a number of years, there has thus been a debate as to whether short-selling provides a stabilising or destabilising influence on the market. This debate is far from concluded. For example, the UK's financial regulator, the Financial Services Authority, described short-selling in a 2002 discussion paper as a "legitimate investment activity which plays an important role in supporting efficient markets. It accelerates price corrections in overvalued securities, it supports

derivatives trading and hedging activities and facilitates liquidity and trading opportunities"[5]. And yet in September 2008, The Financial Services Authority announced a four month prohibition on the initiation of new short positions in a defined list of UK-listed financial companies, amidst a stock market 'panic'. Several other countries around the world followed with similar, and in some cases harsher, constraints on short-selling. The empirical literature sheds some light on this ongoing debate. For example, Woolridge and Dickinson (1994) find that short-selling increases after stock prices rises; and short positions are reduced after stock price falls. Albert *et al.* (1997) use data on NASDAQ stocks between 1987 and 1991 and conclude that short-sellers do not destabilize the market, but add liquidity by short-selling stocks that have risen strongly in price during the preceding 30 days. Angel *et al.* (2003) find that short-sellers generally target firms exhibiting greater than average price performance. For large short-sale positions, the authors find negative market-adjusted returns in the following three days. This supports the notion that short-sellers help to stabilize a market, but the study is conducted over an extremely brief sample period (specifically, three months during a 'bear market'). Diether *et al.* (2008) show that "past returns remain a significant predictor of future short-selling even after controlling for the contemporaneous returns, buy-order imbalances, volatility and spreads, and after controlling for the autocorrelation in short-selling activity and volume." They conclude that "short-sellers are not the villains they are made out to be by the media and issuers. Instead, traders do seem to target stocks where prices are out of line with fundamental value."

A different perspective is provided by Brunnermeier and Nagel (2004). They study the behaviour of hedge funds around a time of rapid ascent in technology stocks (1998-March 2000) and their subsequent sharp decline (March 2000 – March 2003). An investor who had a negative relative opinion on a technology stock might have attempted to short-sell that stock, to benefit from predicted future under-performance against an index. Instead, the authors find that hedge funds were, in aggregate, 'over-weighted' in technology stocks during 1999 and early 2000. If short-selling was too difficult or too costly, a hedge fund would simply hold a zero position in the security,

[5] Financial Services Authority Short Selling Review, 2002. Discussion Paper 17. Available from: http://www.fsa.gov.uk/Pages/Library/ Policy/DP/2002/discussion_17.shtml [Accessed 3/3/08].

or at the very least some under-weighted position relative to the benchmark weight of the security, but would certainly not have held an over-weighted position. Perhaps this can be explained by high short-selling costs; however, Geczy *et al.* (2002) find little support for the notion that short-selling constraints made it difficult for arbitrageurs to short "DotComs" during the late 1990s or in 2000: "Short exposure to DotComs was not costly or difficult; a portfolio constructed from easy-to-borrow stocks tracks an internet index closely over [the] sample period, and the wholesale specialness cost of a portfolio with harder-to-borrow stocks, which tracks even more closely, is only 1.15% for the year." In light of this evidence, Brunnermeier and Nagel argue that hedge funds were 'riding the technology bubble', rather than short-selling apparently over-valued stocks. This casts doubt on the notion that short-sellers are continuously engaged in short-selling over-priced securities.

This empirical finding can be related to a theoretical model introduced by De Long *et al.* (1990). The model comprises four time periods, two assets (cash and stock) and three types of traders (positive feedback traders, utility maximizing informed rational speculators and fundamental-versus-price-comparator 'passive investors'). Positive feedback traders are investors who buy securities after their price has risen, and sell after prices fall. They are associated with price momentum trading or trend following, stop-loss orders (selling a risky asset after a price drop below some pre-defined level), dynamic hedging (selling a risky assets after a price fall, and vice versa), and the liquidation of positions by investors unable to meet margin calls. Rational speculators, on learning some news about a security, not only trade in response to the news, but also trade additionally in anticipation of positive feedback traders' response to the rational speculator's trading. Price moves in response to news are exaggerated as informed rational speculators drive prices away from fundamental value, in anticipation of the actions of positive feedback traders. The pattern of stock prices observed with the model is consistent with empirical evidence of positive serial correlation of returns over periods of weeks or months, followed by mean reversion over several years (see, for example, Jegadeesh and Titman, 1993, 2001). The authors argue that in the presence of positive feedback traders, it might be rational for investors to "jump on the bandwagon and not buck the trend" when

prices are trending. This is consistent with the empirical findings of Brunnermeier and Nagel (2004): even though technology stock prices had risen to the extent that they appeared to be over-priced, it might have been rational to avoid short-selling these stocks in the presence of a body of positive feedback traders. This pattern of behaviour stands in contradistinction to the traditional depiction of short-sellers as traders who help to stabilize asset prices, by exploiting differences in asset prices away from fundamentals. Section 3.3.6 considers further examples from the literature on the behaviour of short-sellers and their influence on market efficiency and asset pricing.

3.3.4 The Relationship between Short-Selling (or the Release of Information about Short-Selling) and Stock Returns

A substantial body of literature examines the relationship between announcements of short-interest (i.e. the proportion of shares outstanding that are shorted) and subsequent stock returns. Early research focuses on the relationship between aggregate short-interest in the stock market, and the return of a stock market index. For example, Seneca (1967) and Kerrigan (1974) show that high aggregate short interest is associated with lower S&P 500 index returns. Bowlin and Rozeff (1987) study the behaviour of NYSE 'specialists' and find that the short-interest ratio amongst specialists is inversely related to subsequent returns from NYSE stocks.

A number of papers study the empirical implications arising from the theory of Dimaond and Verrecchia (1987). In particular, these examine stock returns after increases in short interest or after the announcement of an increase in short interest. Vu and Carter (1987) examine daily abnormal returns for stocks with large increases in short interest. They find a significant positive abnormal return prior to the announcement day, but find no significant abnormal return on the announcement day. Senchack and Starks (1993) investigate the market reaction to monthly short-sale announcements from both the New York and the American Stock Exchanges. They examine the wealth effects of short-interest announcements, and the relation

between wealth effects and the degree of unexpected increases in short-interest. Using monthly common-stock short-interest figures published monthly in the *Wall Street Journal* from 1980 to 1986, they identify companies showing 'unusually large' increases in short interest - defined by the authors as increases in short interest of at least 100% over the previous month. They use an event-study methodology, forming portfolios of each month's sample of stocks, to examine the abnormal returns associated with unusually large short-interest announcements. The event period extended from 15 days before the short interest announcement to 15 days afterwards. They find "weak support for the hypothesis that the market reaction to an unusual increase in unexpected short interest is negative." The authors refine their analysis by determining the expected change in short-interest using OLS regression with market capitalisation, beta, dividend yield and the existence or non-existence of options on the company's equity as explanatory variables. They find evidence that some significant negative price reaction occurs in an extended period around the announcement of a substantial increase in short-interest. Dividing the sample into optioned and non-optioned equities, they find that non-optioned equities closely follow the results for the full sample, but to a stronger degree. Optioned equities display a negative but insignificant reaction around the announcement date. In a cross-sectional analysis, they find that the greater a change in unexpected short interest, the more negative the market's reaction to the short-interest announcement. For firms with traded options, the reaction is less negative. Thus, conditioned on the forecast model of short sales used, they find empirical support for the theoretical implication of the Diamond-Verrecchia model. The authors comment that their analysis, and any empirical analysis on short selling, is complicated by the "many reasons to sell short that are unrelated to information." Furthermore, negative abnormal returns after the announcement day "may simply reflect the release of unfavourable news subsequent to the release of short interest." Aitken *et al.* (1998) analyse information provided by the Australian Stock Exchange (ASX), covering intra-day information on short positions in listed ASX equities. Short trades were reported to the market soon after execution. Using details of all limit and market orders placed, and trades executed on the ASX's automated trading system, they investigate the market reaction to short sales. They study short periods of time (up to

45 minutes) after short sales, and also the 30 trades that immediately follow the short-sale. Abnormal returns are calculated by comparing short-sales to matched non-short sale trades. They find a significantly negative abnormal return in calendar time following short-sales, for both limit orders and market orders, consistent with Diamond and Verrecchia (1987).

A related strand of the empirical literature has been to determine the relationship between *levels* of short-interest and subsequent stock returns. These tests often start with the notion that short-selling is costly and constrained, leading many uninformed traders to avoid short-selling. This leads to he hypothesis that there should be a higher proportion of well-informed traders amongst short-sellers (i.e. that short-sellers in aggregate are well informed). McDonald and Baron (1973) find that "the estimated average return on short positions was superior to that in an untimed short-selling strategy with less than one-half of the sample stocks. Their results are supportive of the efficient markets hypothesis, and suggest that short sellers in aggregate do not possess "superior information or insight." Similarly, Figlewski (1981), Brent *et al.* (1990), Figlewski and Webb (1993) and Woolridge and Dickinson (1994) do not find evidence of a strong relation between short-interest and abnormal returns. However, by focusing on firms with large short-interest only, Asquith and Muelbroek (1996) argue that the power of such tests can be improved. They find a strong and consistent relation between short-interest and excess returns. Shares with high levels of short interest (defined in their paper as greater than 2.5% of shares outstanding) perform significantly worse than comparable shares without high levels of short interest. This finding inspired a series of research papers, including Dechow *et al.* (2001), Angel *et al.* (2003), Desai *et al.* (2002), Gopalan (2003), Ackert and Athanassakos (2005) and Diether *et al.* (2008) each of which produced results consistent with the notion that short-sellers are 'well informed', by revealing a negative relationship between high levels of short interest in a stock and subsequent abnormal returns.

Boehmer *et al.* (2008) build on this work and investigate short-sellers by 'type'. They show that institutional non-program trades are the 'most informed' of all types. The

authors also pose an important question: “What is the source of this information?” At the time of writing, this question remains unanswered in the finance literature. If it is ‘inside information’ (material, specific non-public information), the use of which is prohibited by regulators, then it will prove very difficult to identify this in any formal study. However, clues to possible sources of information can be found in other parts of the literature. Ofek *et al.* (2004) suggest that cross market anomalies can exist, either due to market segmentation or frictions in trading across markets. This suggests that any anomalous pricing could arise in either the underlying equity market, the alternative market being considered, or some combination of the two. If the market segmentation theory holds, and if at least some of the cross market pricing anomaly is due to mis-pricing in the equity market, then this suggests that observation of cross market arbitrage opportunities could be the source of some of equity short-sellers’ ‘information’. A further source of information could be knowledge of the predictable behaviour of other market participants, such as full replication index funds or those facing asset fire sales. For example, Chen *et al.* (2006) estimate that up to $2.1 billion per annum is lost from funds that track the S&P 500 and Russell 2000 indices, due to predatory trading (including the short-selling of stocks ahead of demotion from an index) by those who anticipate the predictable actions of full replication index funds.

Jones and Lamont (2002) criticise the use of short interest as a proxy for shorting demand. They note that the quantity of shorting represents the intersection of supply and demand. A stock with an infinitely high borrowing cost might have high demand for shorting, but would still show zero short interest. Accordingly, “short interest can be negatively correlated with shorting demand, overpricing and shorting costs.” Asquith *et al.*, (2005) investigate the intersection of supply and demand for short-selling. They use proxies for the supply of stock to borrow and for the demand for short-selling, so as to identify situations in which short-selling constraints are binding. They posit that the short interest ratio is a proxy for short sale demand (despite the Jones and Lamont critique of this measure) and that institutional ownership is a proxy for lendable supply. They further assume that “short-sale constraints are most binding when there is strong demand and limited supply.” The

authors define short-sale constrained stocks as “those in the highest percentile of short interest ratios that are also ranked in the lowest third of stocks by institutional ownership.” Portfolios of stocks meeting these criteria underperform by 2.15% per month during 1988-2002 on an equal-weighted basis and by a statistically insignificant 0.39% per month on a value-weighted basis. Typically 21 stocks per month are classified as short-sale constrained under this methodology, out of a universe of 5,500 stocks. The authors find that the underperformance of stocks with high levels of short interest is “fairly brief”. This suggests that frequent portfolio rebalancing would be required to capture the negative abnormal returns from such stocks,

Cohen *et al.* (2007) use a four year panel dataset, comprising stock loan prices and quantities from a large institutional investor, to examine whether it is shorting demand or stock loan supply that drives the relationship between shorting indicators and stock returns. They identify weaknesses in the extant literature, in that most studies construct proxies for shorting demand or for stock loan supply (e.g. institutional ownership or breadth of ownership), or use equilibrium prices (i.e. stock loan fees) or equilibrium quantities (i.e. short interest) to identify a relationship with stock returns. The authors attempt to “disentangle” supply and demand shifts in the stock lending market, rather than taking an intersection of the two. They do this by, for example, identifying situations where the price of a stock loan increases at the same time as the quantity lent increases. In these cases, there must have been at least a demand shift outwards. The authors then explore the effect of these demand shifts on future stock returns. They find that shorting demand plays a key role in influencing stock returns - more so than supply shifts, high stock loan fees or high levels of short interest. A weakness in the literature on the effect of short sale constraints on stock prices, according to the authors, is that few papers address the endogeneity of common shorting indicators. To identify if shorting indicators are simply correlated with changes in public information flows, or if they have explanatory power abstracting from public information, they isolate firms and times of scarce public information. The authors find that their results “are unlikely to be driven by public information flow” as the impact of shorting demand on stock returns

is concentrated during times when sell-side analyst earnings revisions are absent. Furthermore, it is shown that increased shorting demand is not merely a proxy for future public information releases. Taken together, this suggests that short-selling "is an economically important mechanism for information revelation in prices." The authors argue that investors forming trading rules from these findings would have earned statistically and economically significant returns, even after taking account of stock loan fees, trading commissions and market impact estimates.

MacKenzie and Henry (2008) examine the relationship between stock returns and trading volume on the Hong Kong Stock Exchange. They find that the information content of trading volume is strongest for trades initiated by short-sellers. Further, they follow the procedure of Cohen *et al.* (2007) to "consider whether information about changes in conditions in the market for borrowing stock may provide superior information about the future returns than short volume alone." They find that shifts in the demand curve in the stock lending market are most informative, although shifts in supply are also important. Whereas Cohen *et al*. (2007) find that shifts in the demand curve provide information that persists for one month; MacKenzie and Henry (2008) find their information shorter lived. The authors argue that their findings provide further evidence that short-selling "is a major channel for the transmission of information about prices."

In summary, the empirical literature generally finds a negative relationship between unexpected increases in short-selling and abnormal returns at the individual stock level, consistent with the Diamond-Verrecchia model. Empirical studies also find that high levels of short-interest are associated with poor returns at the individual stock level. Furthermore, there is evidence of a negative relationship between increasing demand from short-sellers and abnormal returns at the individual stock level. The empirical literature thus yields results that are consistent with the notion that short-sellers are, in aggregate, well-informed.

3.3.5 The Costs of Short-Selling

The setting of fair prices in a market is determined through the interactions of arbitrageurs and noise traders (see for example, Gemmill and Thomas, 2002). However, securities prices can vary from fair value, as expected under full information, due to a number of frictions, including transaction costs (see, for example Madhaven, 2002). For an arbitrageur, transaction costs include securities lending fees and other costs associated with short-selling. Knowledge of securities lending fees is thus an important consideration for those seeking to study asset pricing.

Jones and Lamont (2002) study the centralized stock loan market (known as the 'loan crowd') that existed on the floor of the New York Stock Exchange from 1926-1933. The authors state that most large-capitalization stocks in the loan crowd "can be shorted fairly inexpensively, but sometimes even large-cap stocks become expensive to short. Small stocks tend to be more expensive to short, but only during the first half of the sample." Most stocks are lent slightly below the call-money rate (i.e. the rebate rate reflects a modest stock lending fee). A "large mass of stocks" exhibits a rebate rate of zero, and some stock loans attract a negative rebate rate. The average stock borrowing cost is 0.35% per month. The authors show that as stocks 'enter the loan crowd', they generally have high valuations and low subsequent returns. The cost of borrowing stock in the loan crowd is negatively related to the abnormal returns achieved on those stocks. Size-adjusted returns are 1-2% lower for stocks that enter the loan crowd for the first time, and despite the high costs of borrowing and shorting these securities, it is profitable to short them.

D'Avolio (2002) examines US stock lending from a large, institutional lending intermediary and finds that 91% of stocks lent out cost less than 1% per annum to borrow. The value-weighted mean fee for such 'general collateral' stocks is 17 basis points per annum. For the remaining 9% of stocks (known as 'specials'), the mean fee is 4.3% per annum. The greatest fee observed in his sample is 79% per annum. 'Specials' tend to be smaller stocks with lower levels of institutional ownership.

The finance literature identifies a number of 'zero-cost' long-short factor portfolios that earn positive returns, including the book-to market strategy from DeBondt and Thaler (1987) and Fama and French (1993), and the price momentum strategy from Jegadeesh and Titman (1993, 2001). In practice, however, there are a number of constraints on obtaining the returns documented in the literature. These include transaction costs, liquidity problems and short-sale constraints such as access to (and costs associated with) stock loans. D'Avolio (2002) and Geczy *et al.* (2002) each show that constraints on short-selling are not uncommon, and proceed to examine if these constraints fully explain the apparent anomalies discussed above. D'Avolio (2002) examines stock lending fees and shows that 'growth' and 'low-momentum' stocks are relatively more likely to be 'special', leading to practical difficulties and costs in creating the long/ short factor portfolios found in the finance literature. Geczy *et al.* (2002) obtain a database comprising all US equity loans for one year (November 1998 to October 1999) for a large, but unidentified, lender. Data is daily and includes loan size, pricing and end date. This allows the authors "to replicate short-selling strategies subject to actual stock-by-stock short-selling constraints on the correct days." The authors replicate each strategy at three levels of access to equity loans. The first level mimics the availability of loans to retail investors, where there is no access to 'specials'. The second level mimics the access available to a large institution, where access to 'specials' is available at the market rate. Finally, to compare to a number of other academic papers, they assume that borrowing and short selling is free from costs and constraints. They examine if investors can actually realize the returns of documented long-short factor portfolios found in the literature. The authors find that the expected-return difference between unconstrained factor portfolios found in the literature and portfolios that investors could actually hold is significantly smaller than the unconstrained factor portfolios' documented profitability, but still greater than zero. They argue that if short-selling problems explain the availability of factor portfolio returns to unskilled managers, then these short selling problems are not borrowing costs, but perhaps prohibitions on short-selling or liquidity constraints. They argue that "specialness is a stock-specific, rather than categorical, consideration." In other words, although borrowing problems and

costs can compromise stock-specific trades, there is not significant evidence to suggest that categorical (i.e. factor) portfolios are severely compromised.

Geczy *et al.* find that "short exposure to IPOs is generally feasible for those with good access to equity loans, even in the first days of trading." Loans of shares within one month of an IPO are all 'special' with wholesale borrowing costs of approximately 3% per annum, falling to 1.5% per annum after 25 trading days. These are not large enough to offset the approximately 5% per annum underperformance of IPOs highlighted by Loughran and Ritter (1995). The authors also find that for stocks that have been public for 6-12 months, borrowing costs are small enough to reject the hypothesis that none of the profits arising from the underperformance of these shares is available. In support of Miller's (1977) notion of investors having divergent opinions, Geczy *et al.* find that there is a higher cost to shorting 'hotter' IPO offerings. Weaker IPOs, subject to price support or stabilization as discussed in Aggarwal (2000) and Ellis *et al*. (2000) are also more expensive to short, providing indirect evidence that short-sellers target IPOs they believe to be inflated. Geczy *et al.* find that it is significantly profitable to short securities ahead of the expiration of a 'lock-up' that prohibits major pre-IPO shareholders from selling. In summary, Geczy *et al.* find that "the documented underperformance by IPOs cannot be attributed to equity-loan frictions alone." Ofek and Richardson (2003) find that stock lending fees are negatively correlated with the period of time that the firm has been listed on a public market. They also find that short interest is positively correlated with firm age.

Ali and Trombley (2006) examine observable stock characteristics as proxies for stock loan fees. These characteristics are firm size, trading volume, cash flow, IPO status and book to market ratio. They combine these measures into an aggregate measure and find that this measure is positively correlated with higher short interest and short sale constraints. It is negatively correlated with subsequent six month returns. Their results suggest that "short sale constraints constitute a coherent explanation for many of the previously documented patterns in momentum returns."

In a study of the returns available from merger arbitrage, Mitchell and Pulvino (2001) analyse the returns from merger arbitrage assuming that the risk-free rate is paid on short proceeds. They state that: "results from unreported analyses indicate that annual returns are reduced by approximately two percent if interest is not paid on short proceeds" thus providing some estimate of the impact on returns from borrowing shares at 'special' securities lending fee rates, where the 'special' rate might be such that no interest is paid on the collateral for borrowing stock. Geczy *et al.* (2002) incorporate information about the cost and availability of borrowing shares in the acquiring company in a take-over. They find, for their dataset, that the incidence of loans of shares in the acquiring company in a take-over is generally low. Profits resulting from a merger arbitrage strategy are "greatly reduced – though still large" in their sample period for a strategy in which borrowing is only permitted when their data provider lends. In addition, their data shows that demand for borrowing shares involved in mergers is highest on the merger announcement days. This supports Jensen and Ruback (1983) who find that merger announcement days are the most profitable for merger arbitrage strategies.

In summary, short-sale constraints in the form of stock loan unavailability and stock lending fees mitigate the returns available from zero-cost long-short factor portfolios and other strategies designed to exploit apparent stock market anomalies. Whereas stock lending fees for most stocks (known as 'general collateral') are very low, a limited number of stocks (known as 'specials') can only be borrowed at higher fee rates. However, 'specialness' or difficulty in borrowing a stock does not fully explain the positive abnormal returns achieved from strategies aiming to exploit known stock market anomalies.

3.3.6 The Impact of Short-Sale Constraints on Asset Pricing and Market Efficiency

A number of papers test Miller's theoretical prediction that stocks subject to large divergences of investor opinion could, under short-sale constraints, become over-

valued. Identifying divergences in the opinions of all investors is not possible, and so proxies have been developed for divergence of opinion. Miller (1977) suggests stock turnover as such a proxy, but later work has tended to use differences amongst sell-side analyst forecasts instead. Diether *et al.* (2002) and Gopalan (2003) use the dispersion in sell-side analyst's forecasts as a proxy for divergence of opinion and show that this measure is associated with equity over-valuation, consistent with Miller's (1977) prediction. Doukas *et al.* (2006), however, criticise the use of this dispersion measure and use instead a 'diversity' measure that attempts to adjust analyst dispersion for uncertainty, leaving 'divergence of opinion'. The authors find the opposite effect from Diether *et al.* (2002). There are, however, potential problems associated with using sell-side analyst forecasts, including biases due to conflicts of interest within integrated investment banks (see, for example, Dugar and Nathan, 1995, and Hong and Kubik, 2003) and herding behaviour. Doukas *et al.* (2004) attempt to correct for these potential biases, but do not collect buy-side analyst data, which is not subject to the same conflicts of interest. Furthermore, Doukas *et al.* (2006) use a proxy for short-selling costs, based on size and institutional ownership, rather than collect stock lending fee data. Using US data from 1983 to 2001, Doukas *et al.* (2004) argue that divergence of opinion is priced at a discount, consistent with Merton's (1987) argument that divergence of opinion represents risk, and in contradistinction to Miller's (1977) prediction.

Reed (2007) obtains stock lending fees from a large US stock lending institution for the year from November 1998 to October 1999 and examines stock returns around quarterly earnings announcements. He separates his sample into 'specials' (stock with fees greater than general collateral by a defined margin) and non-specials, and describes specials as stocks where short-selling is constrained. He finds that specials are slow to incorporate private information. Furthermore, they experience a stronger reaction to information announcements and exhibit more left-skewness. These results are consistent with the Diamond and Verrecchia (1987) hypothesis. Constrained stocks also produce a slow reaction to publicly released earnings information, offering a partial explanation for the post-earnings announcement drift anomaly. Reed concludes that short-sale constraints in the form of specialness cause a

reduction in the informational efficiency of a market, increase the magnitude of returns on the announcement of information and increase the probability of large negative returns.

By comparing the behavior of stock markets with different degrees of constraints, our understanding of the impact of short-sale constraints on asset pricing and market efficiency is improved. Daouk and Charoenrook (2005) survey the regulation and feasibility of short sales and put option trading across a number of stock markets and employ this data to analyse the effects of short-sale constraints. They assert that in countries where short selling is possible, volatility is lower and liquidity is higher. They also argue that in countries where short selling is permitted, markets have "lower cost of capital and the stock market price increases when short-sale restrictions are lifted. The authors argue that: "These findings appear to support the argument that short-sale constraints reduce market quality". Chang *et al.* (2006) find that short-sale constraints tend to cause over-valuation, and that this effect is more pronounced in stocks with greater dispersion of investor opinions. Bris, *et al.* (2007) find empirical evidence supporting the hypothesis that short-sale constraints are associated with security mispricing. They analyze a sample of countries where short-selling is permitted, using time-series and cross-sectional difference techniques, and compare with countries where short-selling is not allowed or is not practiced. They construct two measures of price efficiency that quantify the asymmetric response of individual stock returns to negative or positive information. They find that prices reflect information faster in countries where short-sales are allowed. This evidence is consistent with more efficient price discovery at the individual security level in the absence of short-selling constraints. Saffi and Sigurdsson (2007) use a dataset covering 26 countries from 2004 to 2006 to investigate the effect of short-sale constrains on price efficiency. They find that short-sale constraints, as measured by limited lending supply and high borrowing fees, are associated with poorer price efficiency. Specifically, stocks subject to greater short-sale constraints respond more slowly to market wide shocks. Limited lending supply is associated with greater skewness in the distribution of stock returns, but is not associated with fewer extreme negative returns. The authors argue that this latter observation "mitigates regulatory

concern that removing short-sale constraints increases the frequency of crashes at the stock level." Wu (2008) analyzes daily shorting flow data from 2005 to 2006 for a large sample of New York Stock Exchange-listed stocks. She finds that stocks with greater shorting activity are "more efficiently priced, in the sense that their transaction prices follow more closely to a random walk." Furthermore, faster incorporation of information is observed in stocks with greater shorting activity, suggesting that short-sellers contribute to price discovery.

The empirical evidence above provides support for the notion that short-selling constraints reduce pricing efficiency. Accordingly, short-sellers are often depicted in the literature as market participants who promote market efficiency and assist in driving securities towards fair value. However, a deeper investigation of the literature reveals that such a depiction is too simplistic. Attari *et al.* (2005) and Brunnermeier and Pedersen (2005) outline theoretical models for 'predatory trading' - behaviour that exploits knowledge of the positions, strategies and capital of one or more other traders. Predatory traders drive prices *away* from fair value, drain liquidity from the market and impose losses on weakened market participants. Predators benefit from the market impact of forced transactions by weakened traders, who capitulate under the weight of losses. Empirical evidence for predatory trading is provided by Cai (2003), who examines the trades of prime brokers and finds evidence that a prime broker 'front runs' the trades of the Long Term Capital Management hedge fund immediately prior to its collapse in 1998; and by Coval and Stafford (2007) who examine mutual fund asset fire sales. Brunnermeier and Pedersen (2005) provide examples of situations that could be exploited by predatory traders: "Hedge funds with (nearing) margin calls may need to liquidate, and this could be known to certain counterparties such as the bank financing the trade; similarly, traders who use portfolio insurance, stop loss orders, or other risk management strategies can be known to liquidate in response to price drops." The authors also highlight the risk of a short squeeze, one of the key risks associated with short selling.

Bentson and Wood (2006) build on the work of Harris and Shultz (1998) and discuss trading strategies associated with the small order execution service (SOES) on

NASDAQ. From June 1998, NASDAQ market makers were obliged to instantly honour trades placed through SOES at quoted prices for up to 1000 shares, with up to five repetitions. Investors and traders used this right to pursue a variety of trading strategies, one of which involved a form of predatory trading. According to Bentson and Wood (2006), "SOES day traders…[attempt] to identify the onset of buy/ sell programs by institutional investors, stepping in front of these programs by absorbing the available liquidity, and then resupplying the liquidity at short-term profit." This predatory trading technique profits from the desire or need of institutions to trade large positions in securities that have limited liquidity. Predators attempt to predict their actions, then remove liquidity by 'front running' the anticipated trades with buy or short-sell orders. Later, and at more advantageous prices, they resupply liquidity to the market.

Shkilko *et al.* (2008) examine all trades and quotes on NASDAQ from May 2005 to May 2006 to study "a relatively unexplored class of short-sellers; the class that, instead of enhancing market efficiency, occasionally manipulates prices." They show that short-sellers substantially increase their activity following significant negative order imbalances created by non-short trades, contributing to price overshooting. Thus, intra-day liquidity crises are exacerbated by short-sellers. Their results provide empirical support for the predictions of Brunnermeier and Pedersen's theoretical model of predatory trading.

Safieddine and Wilhelm (1996) investigate short-selling activity around seasoned equity offerings (SEOs) and state that there has been suspicion that short-sellers target stocks prior to SEOs, so as to produce artificial discounts in the price of new shares. The authors find that short interest between the date of announcement of an SEO and the offer date is approximately three times the level prior to the announcement. Short interest returns to normal levels after the offer date. In 1988, the Securities and Exchange Commission adopted Rule 10b-21 as an anti-manipulation measure. The rule prohibits the use of shares purchased at the offer price to cover short positions established after the filing of an SEO registration statement. Post 1988, the level of pre-offer short interest has fallen. Where the rule

appears to be binding, issuing firms suffer smaller discounts. However, Safieddine and Wilhelm find evidence of regulatory arbitrage where issuing firms have listed options – short-sellers develop synthetic short positions using options, and Rule 10b-21 fails to constrain this activity. This study provides evidence of short-sellers temporarily driving stock prices away from fair value for their own gain, at the expense of shareholders in firms undertaking SEOs. Henry and Koski (2007) examine a sample of SEOs between 2005 and 2006 and find that: "Around issue dates, higher levels of pre-issue short-selling are significantly related to larger discounts, consistent with manipulative trading."

To summarise this section, there is only limited empirical support for Miller's notion that differences in opinion in the face of short-sale constraints can lead to over-pricing. Arguably, this could be due to the difficulties in measuring differences of opinions between investors, and disagreement over the best proxies to use. Short-selling constraints at the country level are associated with higher volatility, poorer liquidity and less efficient price discovery at the individual stock level. This suggests that short-sellers play an important role in market efficiency, and that short-sale constraints act as a limit to arbitrage. There is, however, theoretical and empirical evidence that short-sellers/ arbitrageurs do not always behave in a manner consistent with driving asset prices to fair value. It could be argued that short-sellers usually improve market efficiency, but that, occasionally, they do the very opposite and drive asset prices away from fair value.

3.4 Indirect Short-Selling Constraints as Limits to Arbitrage

3.4.1 Introduction

The literature describes a number of indirect short sale constraints that make short-selling difficult and thus serve as limits to arbitrage. A limited number of theoretical papers and also a nascent empirical literature can be found on this topic.

3.4.2 Theoretical Perspectives

Black (1986) argues that securities prices reflect both the information upon which information-traders trade, but also the noise upon which noise-traders trade. Noise can create the opportunity for profitable trading, but simultaneously makes it difficult to trade profitably. Even without short-sale constraints, the existence of noise trading means that shares may not always be rationally priced. However, noise trading also makes arbitrage risky. Information can give a trader an edge, but not a guaranteed profit. Consequently, informed traders will not take large enough (i.e. risky enough) positions to eliminate the noise and thus noise trading acts as limit to arbitrage.

Shleifer and Vishny (1997) investigate the process of arbitrage. They describe a "textbook description of arbitrage" as a strategy that requires no capital, entails no risk and generates guaranteed and immediate profits. Such arbitrage would play a critical role in financial markets, as it would bring prices towards fundamental values and thus keep markets efficient. However, they argue that "the textbook description does not describe realistic arbitrage trades and, moreover, the discrepancies become particularly important when arbitrageurs manage other people's money." Even apparently simple examples of arbitrage, such as that between two similar bond futures contracts traded on different exchanges, can take on the characteristics of risk arbitrage, when considered fully. Risk arbitrage bears risk of loss and requires capital – an important distinction from the textbook definition of arbitrage. The authors thus argue that the model of arbitrage assumed in asset pricing models such as the Capital Asset Pricing Model (Sharpe, 1964), the Arbitrage Theory of Capital Asset Pricing (Ross, 1976), and in Fama's (1965) analysis of efficient markets, is not consistent with how arbitrage is practised in financial markets. Instead of vast numbers of small arbitrageurs, arbitrage is in practice conducted by relatively few specialised professionals, who generally use outsiders' money to take large positions. An agency relationship exists between the specialised arbitrageurs and their clients. These latter often have limited knowledge of arbitrage. As a result of this, and the requirement

for capital associated with risk arbitrage, Shleifer and Vishny (1997) introduce the notion of 'performance based arbitrage', whereby funds under management are related to the past performance of the arbitrageur. With the existence of noise traders, arbitrage positions can widen, thus leading to poor performance for the arbitrageur. For an arbitrage position, expected returns are high exactly when past returns are low; however, poor performance can lead to clients withdrawing assets from the arbitrageur. Consequently, arbitrageurs can be forced to close positions that offer high expected returns, exacerbating deviations from fundamental value. This model suggests that arbitrage is even more constrained than shown in previous models such as De Long et al. (1990). Devices such as 'lock-in periods', whereby investors suffer contractual restrictions on withdrawing funds, are attempts by arbitrageurs to mitigate the problems associated with performance based arbitrage. However, potential clients might fear being locked in to a poorly performing arbitrage fund. This suggests that only those managers with successful track records of performance might be able to persuade clients to accept lengthier lock-in periods.

Abreu and Brunermeier (2002) identify a further limit to arbitrage arising from noise and co-ordination problems between arbitrageurs. They develop a model whereby rational arbitrageurs do not act immediately on knowledge of stock over-valuation, but instead wait for other rational arbitrageurs to learn about the over-valuation. Acting immediately might lead to losses, if other rational arbitrageurs do not know of the over-valuation and so fail to act at the same time. Acting in isolation makes an arbitrageur more vulnerable to the activities of noise traders – a problem they call 'synchronization risk'.

3.4.3 Empirical Studies into Indirect Short-Selling Constraints

Jones and Lamont (2002) show that stock borrowing costs alone do not explain the under-performance of 'loan crowd entrants'. They argue that unwillingness to short (or some other unobserved indirect short-sale constraints) must be partially responsible for the low returns on stocks that enter the loan crowd. The authors

suggest five possible indirect short-sale constraints: institutional constraints, cultural biases (such as social stigma), the cost and time of searching for stock to borrow, the risk of being unable to meet calls for additional collateral, and finally, recall risk. In an empirical study of stock loan data, D'Avolio (2002) finds that stock loan recalls are rare on average, but that recall risk increases with trading volume and low availability of stock loans.

Ofek *et al.* (2004) find substantial evidence of limits to arbitrage across a universe of US stocks. A significant proportion of these stocks face high stock lending fees (a direct short-sale constraint) which has an impact on conducting arbitrage between equity and options markets. Limits to arbitrage can lead to violations of the put-call parity relationship - a 'no-arbitrage' relationship that one expects to hold in options markets. They show that these violations are "asymmetric in the direction of short sales restrictions" and thus "consistent with the theory of limited arbitrage". They argue, however, that these violations cannot be fully accounted for by shorting costs or transaction costs. Thus, if short-selling constraints explain these violations, it is indirect and not direct constraints that matter. Assuming that stock lending fees relate directly to the difficulty of shorting, they find a general relation between violations of no-arbitrage in the options market and short sale constraints. They also create a framework that allows one to interpret the difference between a stock's value on the equity market and its option-implied value as a mis-pricing in the equity market.

Nagel (2005) argues that "A central element of any mispricing story has to be an explanation as to why these abnormal returns are not arbitraged away." He investigates the extent to which short-sale constraints play a role in limiting arbitrage, by arguing that the supply of stocks to borrow is likely to be sparser in companies with low institutional ownership. Accordingly, short-sale costs should be higher and short-sale constraints more binding in such stocks. Using institutional ownership as a proxy for short-sale constraints, he finds that short-sale constraints help explain cross-sectional return anomalies such as "the underperformance of stocks with high market-to-book ratio, analysts forecast dispersion, turnover or volatility." These results hold even after accounting for the company size effect.

However, direct short-selling constraints fail to account for all the cross-sectional return differences, and he calls for further research into indirect short-sale constraints.

Au *et al.* (2007) argue that positive abnormal performance amongst value-weighted portfolios of stocks exhibiting the greatest degree of stock borrowing may be caused by short squeezes. However, the authors do not adjust for the obfuscating effect of dividend tax arbitrage and so their results should be treated with caution.

Cavazos and Savor (2007) study a short selling dataset of NASDAQ stocks for the period June 1998 to August 2001. They investigate the determinants of short interest changes, and find that short sellers are likely to cover their short positions after stock prices rise, and increase their short positions after stock prices fall. By establishing a separate portfolio for arbitrage-motivated short selling trades, they further suggest that while this relationship is strong for short positions based on a perception of over-valuation, it does not hold for trades motivated by arbitrage, because these investors are largely insensitive to stock price movements. Their result suggest that short sellers cannot, or are not willing to, maintain short positions in the face of adverse stock price moves, and so are unable to drive stock prices towards fair value. This violates the effectiveness of arbitrage as envisioned by the efficient market hypothesis.

3.5 Gaps in the Literature

D'Avolio (2002), Ofek *et al.* (2004) and Nagel (2005) each argue that further research is required into the nature of indirect constraints on short-selling. Although we have theoretical models that describe 'synchronisation risk' and 'performance based arbitrage', the literature on other indirect short-sale constraints is limited at best. A number of indirect constraints are named and described in the literature, but little else is known of their nature and the extent to which they limit arbitrage. There is thus a need for a comprehensive survey of short-sale constraints, and for these

constraints to be placed fully into context. Such a study would improve our understanding of limits to arbitrage, of the short-sale reluctance puzzle, and of why short-selling has become more common over the past thirty years.

In describing 'performance based arbitrage', Shleifer and Vishny (1997) demonstrate that arbitrageurs and short-sellers can face path-dependency problems. Academics and market historians are well aware of rare events that have had important consequences for some investors, their agents, and regulators. These include the stock market crash of October 1987 (see, for example, Gennotte and Leland, 1990), the collapse of Long Term Capital Management in the autumn of 1998 (see MacKenzie, 2003) and the quantitative fund crisis of August 2007 (see Khandani and Lo, 2007). Accordingly, to gain a fuller understanding of indirect short-sale constraints, it is important to consider events that are unlikely to transpire, but that can have important consequences for short-sellers if they do transpire. One widely recognized problem faced by short-sellers is the risk of falling victim to a 'short squeeze', described by Dechow *et al.* (2001) as a situation where a stock loan is recalled and the stock borrower is unable to find an alternative lender. The stock borrower must then purchase shares in the open market to repay the stock loan and close the position. This risk is also described by Duffie *et al.* (2002) and Geczy *et al.* (2002), but no further work is undertaken. D'Avolio (2002) examines the frequency of stock loan recalls and the ease with which a recalled stock loan is reinstated, thus providing clues about the potential frequency of short squeezes. Nevertheless, we currently have limited knowledge of the frequency of short squeezes, the types of stocks most likely to be subject to a short squeeze, and the abnormal returns associated with these events. Knowledge of these would assist in understanding the importance of this short-sale constraint. The more specific case of a 'manipulative short squeeze', where a short squeeze is engineered for profit by a stock lender, has yet to be examined in the literature. Such work would provide a link between the literature on manipulation and the literature on stock lending and short-selling.

Short squeezes can be related to a more general class of liquidity problem that I refer to as 'crowded exits'. A 'crowded exit' is a liquidity problem that arises where short-

sellers hold large positions in a stock relative to normal trading volume, and when a catalyst prompts short-sellers to cover their positions rapidly and simultaneously. Catalysts include, but are not limited to, public news releases by companies, stock loan recalls and the use of stop loss mechanisms. The temporary excess of demand for stock relative to normal trading volume leads to upward pressure on the stock price. Crowded exits in the broadest sense have yet to be described in the literature, but are widely feared by risk-conscious short-sellers and can deter short-selling. There is a need to describe and define crowded exits, to measure their frequency, the type of stock affected and the abnormal returns associated with the phenomenon.

The literature documents that short-sellers, unlike long-only investors, face potentially unlimited losses, but does not describe how short-sellers manage this risk. There is a need to understand the extent to which this risk can act as a short-sale constraint, and how short-sellers manage the risk. Furthermore, the impact on asset pricing that arises from this risk, and from attempts to mitigate it, has yet to be fully understood.

3.6 Summary and Main Research Questions

There remains much debate in the literature about the impact of short-sale constraints on asset prices. Saffi and Sigurdsson (2007) state that "regardless of whether short-sale constraints have positive or negative impact on prices....these constraints reduce the informational efficiency of prices i.e. [prices] do not reflect all available information."

The empirical literature generally finds a negative relationship between unexpected increases in short-selling and abnormal returns at the individual stock level, consistent with the Diamond-Verrechia model. Studies also find a relationship between high levels of short-selling and abnormal returns at the individual stock level. Furthermore, there is evidence of a negative relationship between increasing demand from short-sellers and abnormal returns at the individual stock level. The

empirical literature thus yields results that are consistent with the notion that short-sellers are, in aggregate, well-informed. However, knowledge of such studies presents uninformed traders with a potentially profitable strategy, namely to short-sell companies observed to have high or rising levels of short-interest. Where such 'imitation' becomes more common, the prices of heavily shorted stocks will begin to reflect more 'imitation' and less 'information'. It could also lead to increased short positions relative to the normal liquidity offered by a stock. Consequently, liquidity problems could arise if short-sellers attempt to cover their positions simultaneously. MacKenzie (2004) shows that large scale imitation of trading strategies can lead to unexpected consequences in markets, including liquidity crises. Short-selling and imitation by uninformed traders has yet to be fully investigated in the finance literature, and is the subject of analysis and discussion in Chapter 6 of this thesis.

Short-selling constraints at the country level are associated with higher volatility, poorer liquidity and less efficient price discovery at the individual stock level. This has led to the widely-held view amongst academics and financial regulators that short-selling generally assists in improving market efficiency. Nevertheless, there is a growing body of theory and empirical evidence to suggest that short-sellers can also act in a manner that not only fails to promote market efficiency, but instead actively seeks to drive asset prices *away* from fair value.

D'Avolio's (2002) short-sale reluctance puzzle has yet to be resolved. Thomas (2006) examines short-sale constraints and argues that "we still do not know why so little short selling takes place." Duarte *et al.* (2006) argue that liquidity events, including short squeezes, margin calls and stock specialness could be important constraints on short-selling. D'Avolio suggests that: "To fully understand the observed [short-sale] reluctance, researchers must explore less explicit measures of short-seller costs and risks – ones that extend beyond the loan market." Some insight to the puzzle is provided by the earlier work of Shleifer and Vishny (1997) and Abreu and Brunnermeier (2002), but a more comprehensive investigation of the puzzle is likely to require a qualitative approach. Such an investigation would address two key research questions: "Why is short-selling not more common?" and

"Why has short-selling been generally increasing over the past thirty years?" These research questions are addressed in Chapter 4 of this thesis.

A common problem for short-sellers that has yet to be addressed in the literature is that of a 'crowded exit'. In Chapter 6, I describe crowded exits and address the following research questions: "how frequent are crowded exits?"; "what are the abnormal returns experienced by short-sellers around crowded exits?" and "what types of stocks experience crowded exits?" Given the answers to these questions, I discuss the extent to which crowded exits pose a risk to short-sellers and thus deter short-selling.

In Chapter 7, I define the pattern of market behaviour that one would expect to find around the time of a manipulative short squeeze, and then examine patterns in market behaviour that are *consistent* with this definition. In this way, I address the following research questions: "what are the abnormal returns associated with apparent manipulative short squeezes?"; "how frequent are apparent manipulative short squeezes?" and "what type of stocks are associated with apparent manipulative short squeezes?" I also address a further research question: "should short-sellers fear manipulative short squeezes?"

In Chapter 8, I build on the work of Gamboa-Cavazos and Savor (2007) and pose the following research question: "how do short-sellers respond to accounting losses?" I answer this question by estimating the average cost basis of short-sales made in each stock. I then examine the behaviour of short-sellers on each occasion that a stock price rises above the average cost basis of short-sellers. The findings from this study also help to address a related research question: "do short-sellers suffer from loss realization aversion?"

I use a mixed methods approach to address the above research questions. In Chapter 4, I use semi-structured interviews to investigate the short-sale reluctance puzzle. I then build and describe in Chapter 5 a new database of stock lending data. I use this data in Chapters 6, 7 and 8 to investigate crowded exits, manipulative short squeezes

and short covering after losses. Following from these studies, I anticipate a better understanding of a number of constraints on short-selling, including an understanding of the frequency of these events, the nature of stocks affected and the abnormal returns experienced by short-sellers. Together, this thesis aims to undertake the type of work proposed by D'Avolio (2002), Ofek *et al.* (2004) and Nagel (2005): to investigate indirect constraints on short-selling in greater depth. In so doing, I aim to fill gaps in the literature related to indirect short-sale constraints and so improve our understanding of their impact on asset-pricing.

4. THE SHORT-SALE RELUCTANCE PUZZLE

4.1 Introduction

An aspect of short-selling that has puzzled academics is: "Why is short selling not more common?" D'Avolio (2002) calls this the "short sale reluctance puzzle" and illustrates it by showing that at the New York Stock Exchange (NYSE), the supply of securities to lend appears plentiful, and yet only a fraction of the shares available are borrowed at any time. A low level of borrowing implies a low level of short-selling. Asquith and Moelbroek (1996) and Dechow *et al.* (2001) examine stocks listed on the New York Stock Exchange and American Stock Exchange during the period 1976-1993 and find that most firms have less than 0.5% of outstanding shares shorted. Angel *et al.* (2003) find that less than 3% of shares traded on the NASDAQ market during late 2000 - a period of pronounced falls in share prices - were shorted. Jones and Lamont (2002) study a centralized stock loan market on the NYSE (known as the 'loan crowd') from 1926-1933 and argue that "it must be that unwillingness to short (or some unobserved shorting cost) is partially responsible for the low returns on stocks entering the loan crowd for the first time", suggesting that the reluctance to sell stock short is not simply a recent phenomenon.

Although D'Avolio asks why short-selling should be so 'uncommon', there is as yet no definitive view as to exactly how much short-selling should be expected in a market. Recall that Fama (1965) assumes that stock markets comprise large numbers of arbitrageurs - market participants able to hold both long and short positions - whereas Shleifer and Vishny (1997) argue that, in practice, there exist a smaller number of arbitrageurs, generally acting as agents for investors. Neither of these models provides a clear guide as to the proportion of trades that should be short-sales, or to the extent of 'short-interest' expected in equity markets. Furthermore, Dechow *et al*. (2001) observe that the percentage of outstanding shares shorted has grown from less than 0.2% in 1976 to approximately 1.4% in 1993. The authors suggest that this might be due to deregulation of the capital markets and growth in

hedge funds. D'Avolio (2002) studies 18 months of data from 2000 to 2001 and argues that the low level of stock borrowing observed is a puzzle. Nevertheless, continued long-term growth in short-selling might lead to it becoming more common, and Boehmer *et al.* (2008), using data from January 2000 to April 2004, are the first authors to suggest that short-selling in the USA is 'common'. Each of these studies should be considered within a theoretical framework that provides no firm guide as to the extent of short-selling that should be expected in an equity market.

Understanding why short-selling of stocks is uncommon, but also why it is becoming more prevalent, is of importance to those seeking to understand how markets work and why market participants behave the way they do. It is also important to those (such as regulators) seeking to ensure that markets operate fairly and efficiently. Bulmer (1982) argues that social scientists have a role in considering policy research, and it is possible that findings from this research could assist regulators in developing policy and regulations with respect to short-selling[6].

The topic of this research is attitudes to (and barriers to) the short-selling of stocks. It has been suggested by Blaikie (2000) that there are three main reasons for undertaking research: personal, academic and social reasons. The motives for this study are to address a current puzzle in the literature (an 'academic' reason); and to contribute to decision making with respect to financial regulation and the development of investment processes by fund managers ('social' reasons). This section aims to investigate the short-sale reluctance puzzle by examining the constraints on short-selling that are experienced by practitioners. I intend to test if ideas presented in the finance literature as possible explanations of the puzzle are indeed credible, and to uncover other possible causes not yet addressed in the literature.

[6] In fact, whilst planning the design for this research, a colleague and I were hired by the United Kingdom's Financial Services Authority to consult on proposed new rules allowing hedge funds to list on the London Stock Exchange.

4.2 Barriers to Short Selling

The literature identifies a number of barriers to short-selling. These include 'fundamental risk', 'noise trader risk', 'recall risk' and 'synchronization risk' (see Section 2.1.3). D'Avolio (2002) highlights that the very securities the short-sellers want to borrow are often those that are difficult and expensive to borrow, suggesting practical and cost barriers to selling-short. He also hypothesises that a fear of tracking error (deviation in results from a benchmark) might constrain managers to follow a narrowly defined process, and thus limit short-selling by investors. Duarte *et al.* (2006) suggest that liquidity events, including short squeezes and margin calls, could play an important role in constraining shorts-selling. By showing that the cost of buying options as insurance against liquidity events exceeds the abnormal profits that short-sellers appear to earn, they argue that liquidity problems might explain the short-sale reluctance puzzle.

Geczy *et al.* (2002) note that a derivatives transaction can be functionally equivalent to a short-sale. Thus, a trader does not need to short-sell, to express a negative opinion on a stock. However, Koski and Pontiff (1999) find that 79% of equity mutual funds make no use of derivatives, indicating that they are not taking 'synthetic' short-positions via derivatives. Furthermore, I find from discussions with prime brokers that the counterparties to synthetic short sales generally hedge their own positions, ultimately by short-selling the underlying stock. Thus, the availability of derivatives for expressing negative opinions on securities is unlikely to explain the uncommonness of short-selling.

Nagel (2005) argues that there are two types of short-sale constraints: direct constraints, including costs and difficulties in borrowing stock, and indirect constraints, including institutional and cultural reasons that lead to a "general lack of short-selling in the stock market". He argues that both direct and indirect constraints are associated with low institutional ownership of stocks.

Short-selling can also be constrained by regulation. At the time of writing, the mainland Chinese stock exchanges prohibit short-selling; some countries limit its use in certain situations, or restrict its use to certain classes of investor. Jones and Lamont (2002) state that "governments often restrict short-selling [through regulation and moral suasion] in an attempt to maintain high security prices." They continue: "Short selling restrictions historically follow major price declines as short sellers are blamed." They attribute an unwillingness to lend to "fears of legal persecution in a hysterical political environment."

Hardie and MacKenzie (2007) document the *agencement* that makes up a London-based hedge fund: "the arrangement [in the broadest sense] of people, technical systems, and so on that constitutes it." One of their key observations is that the hedge fund, comprising no more than five people and an intern, was able to research, trade and monitor long and short positions in global (especially emerging market) bonds, bond derivatives and currencies. They argue that the fund's capacity to enact trades depended on people and technical systems not physically present in its trading room – in particular, 'prime brokers' and a fund administration firm that is based in Dublin. They thus observe 'distributed cognition' (see Hutchins, 1995). The growth in hedge funds has coincided with growth in prime brokerage and in fund administration that is capable of processing and accounting for short-sales amongst other things. This growth in turn has the potential to reduce the costs and complexities involved in short-selling, and so to facilitate additional short-selling.

Although there are various barriers to short-selling, our understanding of which barriers are most influential is only partial at best. D'Avolio (2002) argues that to solve the puzzle, researchers must explore less explicit measures of short-seller costs and risks, extending beyond the loan market. He suggests studying some of the constraints listed above, but does not research these himself, instead leaving it to others to undertake such work. It is this research that I undertake for this thesis. This chapter is qualitative in nature. It explores the nature of barriers to short-selling and how some investors overcome these barriers while others do not. This research is

inter-disciplinary in nature, building on an understanding of both the financial economics and economic sociology literature. More specifically, this work falls into the Social Studies in Finance literature.

4.3 Research Design

4.3.1 Epistemology

A review of the literature and preliminary discussions with practitioners showed that there is unlikely to be a single, definitive 'truth' behind the short-sale reluctance puzzle. Discussions revealed a different set of opinions and perspectives from each individual, often related to firm culture or to a manager's beliefs, rather than to clearly definable barriers. The multi-faceted, complex and sometimes contradictory views emerging from my preliminary discussions suggested that inductively developing a pattern of meaning, and identifying themes in practitioners' views, was an appropriate epistemology. This is akin to the social constructivist perspective, as espoused by Berger and Luckmann (1967), Crotty (1998) and Lincoln and Guba (2000). By relying on the participants' views of why short-selling is rare, and on why they themselves do or do not practice short-selling, I was able to form a socially constructed theory of why short-selling is uncommon. An implicit ontological assumption is that reality is constructed by its social actors (Blaikie, 2000).

An alternative perspective is to relate this study to advocacy or participatory knowledge claims (see Neuman, 2000, or Fay, 1987). Under these knowledge claims, research should contain an agenda for reform or change. Typically, the theoretical perspectives such as feminist perspectives or racialized discourses are integrated with the philosophical assumptions that build a picture of the issues being examined. One would not ordinarily claim that investment managers are a marginalized or disadvantaged group, and so it would appear unusual to set this work within an advocacy approach. But one can hypothesise that some form of cultural constraint is

preventing these individuals and groups from achieving their full potential. After consideration, I decided to reject advocacy claims for this research, but note that an advocacy approach need not be inadmissible.

R.K. Merton (1972) discusses the relative strengths and weaknesses arising from 'Insider' and 'Outsider' status in social research. Whereas the Insider (a member of a specified group or occupant of a specified social status) might have privileged access to particular kinds of knowledge, the Outsider is able to bring needed perspective to our understanding of a social problem. Merton argues that individuals have a 'status set' as opposed to a single status. Consequently, individuals "typically confront one another simultaneously as Insiders and Outsiders." In this research, I might have been considered an Insider by virtue of my work experience in the investment field, and the fact that I was known to some of the participants. However, as an academic researcher, I might also have been perceived as an Outsider. I believe that my work experience allowed me to understand and respond to what I heard during the research process, but that my status as a researcher allowed me access to information that might not otherwise be available to those with full Insider status. I am aware that my background might have influenced my interpretation of what I heard and could have influenced the behaviour of the participants. However, each participant is well-informed, able and willing to state his/ her own opinion. Mason (1996) refers to the need for "active reflexivity", or "critical self-scrutiny" in social research. I believe that my stance with respect to the research process and participants was that of the empathetic observer, seeking objectivity but also being able to consider myself in the interviewee's position, so as to better understand their actions.

4.3.2 Strategy of Inquiry and Research Method

My research addressed the processes of interaction amongst a community of investors and supporting actors who are linked via social networks. It focused on the specific contexts of the managers' work, so as to understand the cultural and historical settings of the managers. With respect to a socially constructed

epistemology, Cresswell (2003) states: “Often, these subjective meanings are negotiated socially and historically…they are not simply imprinted on individuals but are formed through interaction with others.” As I was attempting to understand better how a series of individuals, committees and firms make choices, grounded theory appeared to be an appropriate research strategy. I aimed to identify a general theory of actions and interactions, grounded in the explanations provided by the research participants. This strategy allowed me to collect data from a greater number of sources in a given time than would have been possible with a case study approach. It was also less intrusive and thus more practical to implement than an ethnographic strategy.

Given this strategy of inquiry, I selected semi-structured interviews as the most appropriate research method. I also considered surveys, but noted that surveys can suffer from low response rates. Furthermore, Becker (1996) argues that a survey generally limits the type of information that one receives. I also believed that they could have restricted the depth of understanding arising on more complex issues. As new explanations for the short-sale reluctance puzzle could have emerged from this research, I used a data collection procedure that allowed for the capture of such information. Having formed a personal network of investment managers, I believed that I had a ‘competitive advantage’ in a research process that involves gaining access to senior investment professionals. I also believed that my personality was suited to conducting in-depth interviews with practitioners, and to understanding the subtleties within the answers that I received.

Another possible approach was to have used focus groups - these might offer insights into people’s shared understanding of the research question (Gibbs, 1997) and the degree of consensus on the topic (Morgan & Kreuger, 1993). However, it would likely have been difficult to assemble a number of busy investment managers from different firms at one time, and there would have been a loss of anonymity for each participant, which could have hindered this research project.

Whereas I initially intended to study the phenomenon from a global perspective, I realize that this would yield only a very small sample from a disparate pool of managers. Working in a variety of countries would also have made it more difficult to gain access for interviews. Instead, I chose to focus on investment managers based in Scotland. Collectively, the Scottish investment community comprised 24 firms managing £100 million or more in assets as of December 31st 2004. Fourteen of these firms had their headquarters in Scotland; the remainder were branches of foreign firms. In total these firms managed £560 billion of assets (source: Financial Times 29/5/05), making Scotland the twelfth largest centre for fund management worldwide. The Scottish financial community has prided itself on its innovation over many years, including the development of investment trusts and early adoption of global investment strategies. Given its scale and track-record of innovation, one might expect Scottish investment managers to be active practitioners in the field of short-selling. However, Scottish hedge funds assets under management are estimated by the author to have only reached £1.5 billion by 2005 - less than 1% of total asset under management in the country, and approximately one one-thousandth of worldwide hedge fund assets under management (source: Financial Times 29/5/05). Furthermore, several prominent Scottish asset managers have publicly declared their hostility to hedge funds. Thus, as an innovative country and centre for fund management that has not taken up short-selling in scale, Scotland makes a particularly interesting location for study into the short sale reluctance puzzle.

4.3.3 Data Collection Procedures

Cresswell (2003) argues that, when employing a socially constructed epistemology, interview questions should be open-ended and the researcher should listen carefully to what people say or do in their work. Only after receiving responses to my initial, open-ended questions did I then enquire about attitudes to the specific constraints discussed in the literature.

I interviewed 31 individuals in total from 23 firms. Within each firm, I identified the individual whom I believed had the best knowledge of the subject area, and who had influence in setting policy within the firm. This tended to be the chief investment officer, senior investment manager, head of asset allocation or director of risk. All of my interviewees had over 10 years of industry experience. I identified three Scottish firms that had introduced short-selling funds in recent years, and I included managers of these funds amongst my interviewees. I also interviewed one firm that was 'incubating' its first hedge fund. Understanding why these four firms made the decision to introduce short-selling portfolios, and learning about the barriers to growth that they were facing, was likely to shed light on short selling constraints. I also identified two managers who had launched hedge funds but closed them soon afterwards – interviewing these managers provided valuable information. In some cases, I interviewed more than one participant within a firm so as to obtain additional information or a different perspective on a constraint.

There are potential cultural difficulties in running both hedge funds and long-only funds within the same organization, and it is possible that new firms, with generally simpler institutional structures, might be more likely to practice short-selling. I identified a recently established firm, where experienced and knowledgeable managers had created a new investment processes, and interviewed a founding partner at the firm.

I supplemented the Scottish investment manager interviews with selected interviews in other markets where this could have provided fresh insights. For example, I interviewed securities lending agents and a prime broker, to gain a different perspective on the key issues. Such individuals provide services that facilitate short-selling. Consequently, they are familiar with any trade processing or 'mechanical' constraints experienced by prospective short-sellers. Their firms tend to be based in London and New York. I had contacts in a number of these firms, and so was able to gain access for interviews. Some of the risks associated with short-selling might make the practice unsuitable for certain types of institutional investors. I included a pension fund trustee and two consultants to institutional investors in my interviews,

to obtain their opinions on this matter. If end-consumer demand for short-selling was found to be diminished for some reason, this could shed light on the short-selling reluctance puzzle.

Where I did not have an existing contact at any one of my targeted firms, I used a 'snowball technique' (i.e. identifying respondents who refer the researcher to other respondents) to obtain access. Atkinson and Flint (2001) argue that, although 'snowball sampling' violates some of the principles of sampling (presenting representativeness problems, for instance), it can provide a means of accessing hard-to-reach groups, such as disadvantaged individuals or social elites.

Through my interviews, I collected primary data in a semi-natural setting: I offered participants the choice of their own office, my office or an external location in which to hold interviews.

4.3.4 Data Analysis Procedures

I coded each interview in terms of firm characteristics and explanations offered to the short-sale reluctance puzzle, so as to identify themes that emerge from the interviews. Factors that might have influenced attitudes to short-selling include: the age and type of firm, and the education of directors and managers of each firm. In particular, I wished to compare between distinct types of investment company: insurance companies with a large share of captive business (who might be expected to be more risk averse in nature), and independent investment managers who compete globally for business (and would thus tend to be more entrepreneurial in nature). My sample of interviewees is drawn from both types of firms, so as to provide insights into differences in attitude and actions between the two.

A strength of this research is that it is involved in-depth discussion with participants from almost all of the largest firms within one financial centre. There are, however, some potential weaknesses. For example, Robotti (2005) studies a change to short-

selling regulation in the USA, and highlights that whilst the USA has introduced additional short-selling legislation (e.g. Reg. SHO, 2004) in recent years, others (e.g. Hong Kong) have been liberalizing. This raises dependability issues for my research – direct constraints are subject to change and my research must take account of this. I addressed this by involving firms that had been developing new processes, and asking about the catalysts for their process changes; by asking all participants about their expected future attitudes to short-selling; and by directly asking about regulatory constraints, if the interviewees did not address this issue themselves.

A further key issue concerns the 'generalizability' of results from this research. Although the Scottish industry competes globally for clients, invests globally and makes use of research produced by organizations from around the world, it nevertheless has a distinct culture, and this is likely to be a limitation of the research. However, this research can assist in revealing what is *not* 'generalizable'. For example, the (US) literature suggests that short-sellers might fear cultural pressure against their activities, but my interviews revealed a clear rejection of this notion. Although it might be considered unpatriotic in the USA to short-sell (see, for example, Diether *et al.*, 2008) it was clear from my interviews that this cannot be generalized to every other country.

To test the robustness of my findings, I compared what I heard in interviews to what firms were doing, and what they had already said in the public domain. Additionally, in some cases I interviewed two people within the same organization, and compared their comments on the firm's attitude to short-selling.

4.3.5 Ethical Issues

The participants in this research were knowledgeable, senior managers, who were readily able to give informed consent. I had established a level of credibility amongst many of the interview participants, such that they had confidence that I would treat information received with discretion. Grinyer (2002) states that "Anonymity for

respondents/ participants is assumed to be an integral feature of ethical research", but highlights special circumstances where anonymity might not be preferred. The British Sociological Association's (1992) Code of Ethical Practice states that "Research participants should understand how far they will be afforded anonymity and confidentiality and should be able to reject the use of data gathering devices…" I explained in advance the nature of my research, offered anonymity to all interviewees and asked if I may record the interview. I did not offer any payments or incentives to interviewees – Thompson (1996) argues that payments are unlikely to be desirable when dealing with socially powerful people. I received written consent, in the form of an e-mail response, to conduct interviews from the majority of participants and received verbal consent from the remainder. I offered to show interview transcripts to each participant. For two of the firms targeted for interviews, I had provided consultancy services in the past. However, these consultancies were in areas unrelated to this research, and so I believe that no conflicts of interest arose. Gorard (2002) asks researchers to consider ethics in social science research from the perspective of those not involved. Although highly relevant in some situations, I saw few ethical implications from this work for non-participants.

4.3.6 Preliminary Work

Van Teijlingen and Hundley (2001) argue that pilot studies can uncover potential problems with research design and can serve as tools to increase the likelihood of success in a research study. They advocate greater reporting of improvements made to the research process as a result of pilot studies. With a limited universe of interviewees from whom to draw in Scotland, I chose not to undertake a pilot study. However, I undertook preliminary, unrecorded discussions with three individuals who were chosen as being people with whom I had established goodwill from previous engagements, and who were willing to participate in preliminary discussions as well as later, formal interviews. I sought to learn if the interview candidates had a sound knowledge of the research topic, and if they felt able to discuss the issues, subject to anonymity. I learned that the subjects had a good

knowledge and understanding of the research topic, and that they were willing to answer questions. However, questions on the subject of 'predatory trading' (i.e. actions designed to harm other short-sellers) were met with coyness. I attributed this to the emotiveness of the phrase in question, and used this finding to re-word my proposed interview questions. One question: "Do you ever practise predatory trading against other short-sellers?" was altered to become two, less emotive, questions: "Are you aware of the presence of short-sellers in stocks that you hold?" and "Does this knowledge influence the way in which you behave?" The success of the initial discussions with prospective participants suggested that planning a 'fall back option' for this research was not necessary.

4.4 Interviews

I obtained an interview with at least one senior individual from almost all of the largest investment management firms in Scotland, and from many of the smaller firms. I also interviewed a number of individuals working for firms that interact with or provide support to investment management firms, including investment consultants, risk consultants, fund trustees and securities lending agents. These latter interviews provided a robustness check on the claims made by the investment managers, and also provided a different perspective on client-related issues.

In each case, I requested an interview by sending a letter or an e-mail to my targeted interviewee. The letter stated that I was researching attitudes to (and barriers to) short-selling. The vast majority of individuals agreed to be interviewed. A small number of targeted interviewees argued that they did not practice short-selling and therefore could not help with my research; when I explained in more detail why I had targeted them (namely, that I wished to speak to non-short-sellers as well as short-sellers, to better understand the barriers to short-selling), most agreed to be interviewed. I attribute this willingness to be interviewed to the fact that I was known to many of them in advance, and also to the University of Edinburgh's reputation for research amongst many of the interviewees. Some interviewees asked for questions

in advance, and I met this request. It was not uncommon for me to ask additional questions during the actual interview, if interesting points arose, and none of those interviewees that had requested questions in advance expressed unhappiness with this technique.

I began each interview by requesting to record the session with a Minidisc – only a small number of interviewees objected to this. I also stated that results would not be attributed to themselves or their firm, but would instead be aggregated or quoted in general terms such as “an investment manager states” or “the risk manager of a large partnership argues” etc. Each interview ended with an open-ended invitation, as suggested by Gaskell (2000); “Is there anything that we had not discussed that you think might be relevant?” I thanked interviewees for their time.

Each interviewee is assigned a code in the form of a letter plus a number (e.g. A1, B1, B2) where each letter corresponds to a firm and each number corresponds to an individual working for that firm, so that it possible to ‘audit’ each quote in this text, and refer it back to its original source, if required.

Interviews took place between June 2005 and February 2009. All but three interviews took place in person (two were conducted by e-mail; one made use of a proxy due to a timing constraint). I allowed the interviewee to choose the location of the interview. The majority of interviews took place in the offices of the interviewee; however, a small number took place in my own office, and some took place in restaurants or coffee houses. Interviews ranged in duration from eleven minutes to just over one hour, depending on the responsiveness of interviewee. All but the two e-mail interviews was recorded on Minidisc with the permission of the interviewee. Each of the interviews was transcribed, either by myself or by an individual with experience in investment matters who is thus familiar with the specific language used in the interviews. Slightly different sets of interview questions were used with different actors. A list of the standard questions used for interviews with investment managers is shown in Appendix A.

4.5 Analysing the Interview Results

I knew about each firm's investment process and history prior to the interview, via information obtained from each company's website and from background knowledge gained through working in the investment industry over a period of years. This gave me the ability to assess the credibility of each answer and to ask probing questions if an answer seemed inappropriate or inconsistent with other knowledge.

Within some firms, a number of individuals were interviewed to gain different perspectives on an issue. This also provided a check on answers received earlier, and allowed for any apparent problems over accuracy of answers or interpretation by individuals to be investigated.

The trustworthiness of the results in enhanced by two factors. First, I interviewed only senior individuals within firms – these individuals have established their reputations over many years, and know that they could suffer loss of reputation if they made false claims. Secondly, I was able to compare the statements of interviewees to my own knowledge of the subject, and query any apparent anomalies between an interviewee's responses and finance theory, for example. This is one of the advantages in using a semi-structured interview style. I was able to test the credibility of interviewee responses by comparing across the statements from each firm. I interviewed individuals from a series of firms, some of which have similar ownership structures and corporate goals. Any anomalies between firms were investigated further.

Another important issue is the transferability, or 'generalizability', of the results from my interviews within the Scottish investment community. The results I obtained could be unique to this community, or biased by specific 'Scottish' factors. In fact, one interviewee argues that "Edinburgh is an investing city" (as opposed to a 'trading' city) suggesting at least one 'local' factor of importance to this study. However, I am able to test whether or not a series of constraints suggested in the

literature can be generalized to a global context. Where a suggestion made in the literature was found not to hold true amongst my interviewees, the notion that such a suggestion is universally true should be rejected.

The 'confirmabilty' of this work is underpinned by my taking as objective an approach as possible to the interview data – drawing evidence-based conclusions and interpreting the responses in light of the existing theory and evidence on the subject.

Research is 'dependable', according to Miles and Huberman (1994), if it has been conducted with 'reasonable care'. Through the use of a considered research design, the undertaking of preliminary work and the maintenance of a detailed audit trail, including the transcription of each interview where permission was given to make a recording (and a paper record of the interviews where permission was not given) I believe that this research has been undertaken with reasonable care.

In terms of applicability, the results I obtained are 'plausible' in the sense that they accord with much of the theory on limits to arbitrage and short-sale constraints. However, my results contradict some of the suggestions related to culture that have been put forward in the literature to explain the short-sale reluctance puzzle. My results also introduce several institutional, social and risk-related factors that act as indirect constraints on short-selling. By identifying and better understanding indirect barriers to short-selling, stock market participants should ultimately be able to consider short-selling with the fullest information, and this could enable them to ultimately improve their investment processes.

I read each interview transcript several times and created a matrix of responses[7]. Most squares in the matrix are left blank as most interviewees suggested only a limited number of reasons why they believed short-selling is uncommon or why their own firm does not short-sell. I used this matrix to identify the key reasons given or themes emerging from the interviews, and to produce summary statistics.

[7] This matrix is 33 x 35 and is not published here due to size constraints. It is, however, available on request.

From the transcripts, I drew out key quotes to illustrate the interviewees' thinking. I did not make use of software packages such as NUD*IST or Nvivo, preferring instead a thorough reading and interpretation of the reasons given, as this allowed me to understand the subtleties of the arguments better. For example, a number of respondents mentioned 'institutional constraints', but differed in what they mean by this. Whereas a mechanical coding mechanism might simply have identified 'institutional constraints' as a barrier to short-selling, I scrutinized the source documents to obtain better granularity. For example, institutional constraints could include conflicts of interest with respect to client portfolios, problems with a firm's business model or reliance upon an unsuitable investment process – each of these being a different concern.

4.6 Observations and Themes

The median number of reasons suggested by each interviewee for the uncommonness of short-selling in equity markets is 5. The mean is around 6. Overall, I count 33 distinct reasons cited by interviewees. It is clear that the short-sale reluctance puzzle cannot simply be explained by a small number of indirect short-sale constraints. Answers were not uniform across interviewees, in the sense that interviewees suggested a series of explanations that generally differed from one another. In section 4.8, I suggest a reason for this phenomenon. Of the explanations given by interviewees, some have already been mentioned in the literature, but others, to the best of my knowledge, have yet to be described. Some of the explanations are similar, over-lapping or related, and I make sense of these by categorizing the explanations into related groupings. In Figure 4.1, I show the appropriate linkages between the explanations offered. Figure 4.1 reveals a web of inter-linked explanations for the short-sale reluctance puzzle.

A further discovery was that several firms were in the process of revising their thinking on the issue of short-selling. During the period over which I conducted my interview research, two phenomena emerged: first, a number of firms approached me

after our initial interviews to ask questions about short-selling and academic research on the topic. Secondly, where I interviewed more than one person within the same firm, the later interview tended to reveal that the firm had developed its investment approach or attitude towards short-selling, compared to the state of affairs at the date of the earlier interview. This provided me with additional interview material and allowed me to consider changes over time to indirect short-selling constraints.

Most interviewees highlight both *direct* and *indirect* constraints on short-selling. For a small number of respondents, direct constraints dominated their initial thinking on why short-selling was uncommon and these were the only answers provided until further probing was under-taken. The indirect constraints mentioned by interviewees often accorded with those covered in the academic literature. For example, 12 interviewees highlight either synchronization risk (see Abreu and Brunnermeier, 2002) or performance-related arbitrage risk (see Schleifer and Vishny, 1997). However, some new suggestions were put forward, including the notion that short-sellers are not investors, but are instead 'traders', and that short-selling lacks acceptability amongst a community of clients, consultants and peers. This concept was highlighted by 10 interviewees.

Below I list the main explanations for the short-selling reluctance puzzle that emerge directly from interviews. I list 33 explanations in total:

legal constraints
tax barriers
cost of borrowing stock
availability of stock loans
operational cost and complexity
unpatriotic
anti-capitalist
vilification
gambling
trading not investing

reputational risk

stakeholder acceptance

peer effects

fear of recall risk

fear of manipulative short squeezes

crowded exits

synchronization risk/ time horizon problems

performance-based arbitrage

lack of transparency

benchmark constraints

unlimited loss potential

negative expected returns

unattractive distribution of returns

negative income

psychological barrier around ownership

losing positions grow

lack of knowledge/ experience

lack of skill

unsuitable process

institutional conflicts

business model problems

shortage of short-selling ideas

high management fees

I explain below each of these terms and provide quotes from interviews to further illustrate the explanations.

Direct Constraints:

Several barriers to short-selling can be described as ‘direct constraints’. These include legal constraints, tax barriers, costs associated with borrowing stock, non-availability of stock loans and operational costs and complexity.

Legal Constraints

Legal constraints can include broad regulatory prohibitions (e.g. no stocks listed on a particular stock market may be sold short, as is the case on mainland Chinese stock markets at the time of writing) or specific regulatory constraints (e.g. In the USA, the Investment Companies Act of 1940 allows mutual funds to short-sell only if permission is incorporated into the fund prospectus). It can also include legal constraints on short-selling set by the client in a client-agent contract such as an investment management agreement. There was some ambiguity over legal constraints amongst interviewees. Some (e.g. R1, U1) stated that short-selling is not permitted for the funds they manage, before admitting that it was indeed legally permitted, merely not mandated in the investment management contracts or conditions of employment under which they operate. One interviewee (E2) cited legal constraints as the primary reason for the limited use of short-selling in equity markets. Deregulation and liberalization were also cited as reasons behind the increasing use of short-selling in recent years.

Tax Barriers

One former investment trust manager commented on the risk of losing the tax advantages of investment trust status if an investment trust manager is perceived to be ‘trading’ rather than investing:

R1: “You had to be careful with [managing] investment trusts…you were limited because you could lose your investment trust status if you were perceived to be trading…you might want to trade in and out of a stock to take advantage of

anomalies such as big short positions, but doing that once too often you could lose your investment trust status."

One investment manager (U1) argued that proposed changes to the tax status of income relative to capital gains in the United Kingdom were likely to make short-selling relatively more attractive in future, suggesting that tax constraints to date have been a barrier to short-selling.

Cost of Stock Borrowing

The lender of stock to a short-seller typically receives a fee (and collateral) in exchange for the stock loan. This fee is normally modest, but on occasion can become extreme - in these circumstances, the stock is said to be 'special' (see D'Avolio, 2002). Long-short managers are sensitive to the high fees associated with specials:

J1: "In terms of costs, the costs were very punishing on the Markets Fund." Furthermore: "Some markets are more expensive than others. Sometimes you get hot stocks and your costs can suddenly change and you have to make a decision on that, again thankfully we have not been hit too much by that." He added: "The costs, specifically, that were most punitive were: to get sufficient absolute return we had to have emerging markets included and to short these is very expensive. And when you are dealing with a back to back swap, which would be analogous to an OTC type trade, it is dependent on a counterparty and the prime broker arranges that. But, for example, if you are shorting the market you may have to accept LIBOR-350bps [i.e. effectively pay a 'special' stock borrowing fee of 3.5% per annum] so you have to be really sure. Also a break fee will attach to it so even if you lock in any gain you are maybe paying 1-2%. So you can see why it would stack up."

Availability of Stock Loans

One of the prime brokers highlighted the importance of stock loan availability to his clients, who included stock borrowers, short-sellers and hedge funds. In particular, the availability of hard to locate securities was important:

Question: “So how do you compete with your rivals in terms of service provision?”
O1: “I think for us on the Securities Lending side it really is the ability to...I guess to supply the hedge funds”. Furthermore: ”If you find a portfolio with a very strong spread of assets and nobody has been in and borrowed them, then the chances are they will be much more valuable to the borrowers within your programme.”

Operational Cost and Complexity

Some interviewees cited the complexity and costs of operations and trading needed for stock borrowing and short-selling, as a barrier to short-selling itself. They also partly attributed the growth in short-selling to improving operational abilities, including the growth of the prime brokerage industry: “the facilities have become better to do it, although it’s still expensive” (J1).

One interviewee, a prime broker, argued that since 1997, his firm had been able to provide a series of prime brokerage services to long-short managers such as hedge funds. These services included custody, trade clearance and settlement, securities lending and financing, capital introduction and start-up consultancy. Consequently, operational complexity has diminished for long-short managers, provided they were able and willing to employ the services of a prime broker.

O1: “This chap [investment manager] can basically carry on with his own investment mandate, focusing on buying and selling stocks....but we will provide everything else.”

One former long-short manager argued that as equity market–making activity occurred mostly around the London Stock Exchange within the United Kingdom, it was natural to see London emerge as a long-short equity management centre ahead of the Scottish financial community. Market–making involved short-selling as a matter of course, and the infrastructure to support this activity grew up near to the exchanges. However, he argued that operational complexity is no longer a problem for Scottish based managers:

Q1: "...the brokers that we used helped explain the process in terms of the nuts and bolts of what you do and of course they make it very easy. You have a number to ring – I'm thinking of shorting these stocks...can I borrow them? Back comes the answer – no problem, no problem, no problem and away you go, so it's not as foreign or as difficult as you would imagine."

Indirect Constraints:

A number of interviewees argued that although direct constraints helped to explain the uncommonness of short-selling, it was some combination of indirect short-sale constraints that best explain the uncommonness of short-selling. One employee (H1) of a large, diversified investment firm that rejected the management of long-short funds cites institutional conflicts of interest in personnel, remuneration and investment process (i.e. indirect short-sale constraints) as the main reason for this decision. A risk manager (B1) cited a lack of skill and an unsuitable investment process as the primary reasons for his firm rejecting short-selling (again, a set of indirect constraints). Direct constraints, such as legal and regulatory barriers, were of secondary importance in forming this position:

B1: "I think it [a set of direct constraints] would be an additional barrier, but I don't think it would be the key aspect,"

Below, I group the 'indirect constraints' into five categories: social barriers, risk-related barriers, distribution of returns problems, institutional constraints and personal constraints.

Social Barriers –

Short-Selling is Unpatriotic

D'Avolio (2002) suggests that cultural barriers could limit the extent of short-selling. Diether *et al.* (2008) argue that many issuers and media representatives characterize short-sellers as "downright un-American". When questioned on this argument, all interviewees responded that they did not believe that patriotic factors were important as a barrier to short-selling. Indeed, some respondents were strongly opposed to the notion. However, it can be argued that short-selling is 'un-American' not because of patriotic considerations but instead due to anti-capitalist considerations.

Short-Selling is Anti-Capitalist

The notion that short-selling is anti-capitalist struck a chord with some interviewees, but was strongly rejected by others. For example:

C1: "The market is not morally neutral, the market is a barometer of a country's health. It is in the interests of every country for its market to grow in a sustained fashion rather than for it to fall down and so people who short-sell are not on the side of long-term capitalism."

Amongst those who rejected the notion:

E1: "...ultimately capitalism is naked self-interest."

Vilification of Short-sellers

During stock market downturns, short-sellers are often 'blamed' for falls in share-prices and short-sellers are consequently vilified by some members of society. The fear of vilification could lead some investment managers to reject short-selling in favour of long-only investing.

Question: "Do you feel there is a cultural vilification of short-sellers, that it's something in the market that is not well regarded?"
C1: "Undoubtedly, yes."
Question: "How has that developed? Why is that the situation?"
C1: "Because they are seen as being essentially destructive, I think. You are not an owner, you are the reverse of an owner. You are a punter, you are indeed hoping to drive down the price of something, not hoping that the price of something will rise. So it does not differ in any way from bear raiding in centuries past. These people were not held up to be great moral exemplars of capitalism." This comment clearly shows the connection between short-sellers being vilified and the notion that short-selling is anti-capitalist.

M1: "Maybe in Scotland, and perhaps ourselves, another reason why we wouldn't be interested in short selling is that we are very aware of historical impacts and atmospheres that short selling has created…and the 1907 crash was blamed a lot on short selling."

One long-short manager (J1), when asked about cultural barriers and fear of vilification replied: "The vilification thing: not at all. We are lowly correlated and a very transparent, simple, easy to understand sort of product, so the stigmatic stuff with hedge funds doesn't apply, I don't believe."

Short-Selling as Gambling

One pension trustee (R1) states that: “Short-selling is perceived in some quarters as a form of sophisticated gambling”.

MacKenzie (2007) discusses the notion that certain market practices could be equated with gambling. For example, it was necessary for the developers of financial futures on the Chicago derivative exchanges in the early 1970s to persuade regulators that those financial derivatives that involved ‘cash settlement’ (as opposed to physical delivery of the underlying asset) did not constitute gambling. Academic research (such as Black, Scholes and Merton’s work on option pricing formulae) played a valuable role in providing validity to financial derivatives. Arguably, recent academic work on short-selling could play an equally important role in dispelling the notion that short-selling is a “sophisticated form of gambling.” For example, Clarke *et al.* (2002, 2004, 2008) show how short-selling can be used to improve the informational efficiency of an actively managed fund (see Section 2.1.2).

One interviewee (U1), an investment manager, rejected the notion that short-selling is related to gambling. However, later in the same interview he compared short-selling to betting on a horse race and argued that intra-day short-selling is gambling - there is clearly some ambiguity over the distinction between short-selling and gambling. One of the interviewees (Q1), a practising long-short sole-trader, stated that he expresses his negative opinions on stocks not through short-selling, but through the placing of spread-bets with specialist financial counter-parties. Gambling on stock prices falling can be functionally equivalent to short-selling, but (in the United Kingdom) is exempt from tax. The difference between short-selling and gambling on falling stock prices is, in at least one experienced practitioner’s mind, no more than a difference in tax treatment.

Short-selling as Trading and not Investing

An argument put forward by a number of interviewees is the notion that short-selling is 'not investing'. Instead, short-selling constitutes a form of 'speculation' or 'trading' that has little to do with long-term investing in real assets. Several interviewees mentioned this concept:

N2: "Most people like us are owners of stocks rather than traders of stocks. Within the Scottish framework, I think you will find perhaps a longer-term horizon taken and… most people are not dissimilar to ourselves in that they take the ownership of stocks quite seriously."

N1: "We want to own a part of a company and grow with the company rather than trade paper."

M1: "I think that from most people's perspective, investing is about buying things. So you are trying to buy things that will go up and the concept of selling something you don't have is an alien concept to a lot of people. Particularly in Scotland, the concept of selling something you don't have is very alien. The concept in Scotland is all about fundamental, intense, rigorous knowing what you are investing in and buying it."

Question: "Do you feel that there is a distinction between investing and identifying an over-valued share and taking advantage of that opportunity? Do you feel that short-sellers are not investors?"
C1: "Yes, I would agree with that. I think they are sophisticated punters. Their horizons are fundamentally short-term, they are not interested in having title to what they are investing in because they are short-selling it. Yes, they're punters and plungers!"

A number of these comments suggest a relationship between investing and ownership. Short-selling is distinct from investing not only because of a generally'

shorter' time horizon – a rather subjective measure – but also because short-selling confers no ownership rights (and responsibilities) on the short-seller. One manager (C1) argued that, in addition to ownership, voting rights were an important part of investing. It is thus possible to definitively and legally distinguish between the two practices: *investing* involves ownership and voting rights. *Short-selling* involves neither. This matters to some market practitioners because of institutional and social structures. There is a reputational benefit in being regarded as an investor, as distinct from a trader. It is socially acceptable for pension fund trustees and investment consultants to engage the services of an investor, but less acceptable to engage a trader. For some tax-exempt organizations (e.g. investment trusts and charities) tax-exempt status is dependent upon not being judged to be involved in trading activities

Not all interviewees, however, believed that short-selling relates primarily to trading and not investing. One pension trustee discussed the role of short-selling in promoting market efficiency:

R1: "…short-selling can be a corrective mechanism in the market. Stocks can get seriously over-valued and… this was well exemplified in the run up in the 1990s bull market that, because so many professional investors had become so benchmark-orientated, there was a fear that NASDAQ had gone up x% and tech[nology stocks] accounted for 35% of the S&P 500 index."

One hedge fund manager argued that, in conducting rigorous analysis before shorting a stock, his activities could be distinguished from pure speculation:

I1: "Ultimately if you are shorting a stock you have to be comfortable fundamentally with it. You can't just...traders...you can be a momentum trader and if you see something happen you're in and out very short-term. That's not what we do. We're using the skills that we built up on the long-side. Just transferring these skills, and these skills are just analysis, fundamentally analysing companies, ideally putting them into two baskets and going long of the companies you like and short of the companies you don't like. It's as simple as that."

Another interviewee, an investment manager, discussed the difficulties in differentiating between ‘trading’ and ‘investing’ on the basis of time horizon:

U1: “I mean trading is a bit of an amorphous description anyway because ...how do you define trading as a time period? I think if you’re talking intra-day trading I would agree with that – that is gambling, in my view. But if you take a position because you are convinced that a stock is over-valued on a three year view, assuming you’ve got the facilities to do so, and you get that right, then would you call that a trading strategy?”

This notion, of there being a distinction between ‘investing’ and ‘trading’ activities, is, to the best of my knowledge, new to the academic literature. I show above that this view was not uniform amongst interviewees, although a number of respondents cited this argument as a major reason for the uncommonness of short-selling.

Reputational Risk:

Several interviewees highlighted the perception of a link between stock market crashes and short-selling. With respect to the 1907 and 1929 US stock market crashes, references were made to stock price manipulation, stock pools and short squeezes.

R1: “After the 1929 crash, a lot of blame fell on short-sellers. I think it was felt that they had distorted the market and caused a crash somehow and the authorities put on pretty strict regulations following the 1929 crash...”

M1: “All that short-selling at the time, manipulation etc. – that gave short-selling a very bad image.”

Such a perception, built on historical examples of stock price manipulation, short-selling and dramatic stock price changes, has led to a fear of loss of reputation if known to be engaging in short-selling.

M1: “In investment your most important thing is reputation so from our point of view we want to keep the purity of our investment style and don’t want ourselves to be damaged by anything like that which in itself we don’t really believe in but could have added a little bit of performance perhaps but in the longer term could be such a damage to our reputation. And that may be one of the reasons why the Scottish investment community in particular doesn’t get involved too much in that. We know fine well how to operate it, we could make money on it but we’re not prepared to do it from the point of view of the reputational damage.”

One interviewee, recounting his understanding of short-sellers prior to becoming a hedge fund manager, states:

Q1: “At that point I knew nothing about hedge funds beyond that they were sort of bad boys of the industry who sort of you know came out of the Cayman Islands or Dutch Antilles and basically were not controlled and therefore something of a slippery wicket.” This individual researched the subject further and, armed with greater knowledge and understanding, decided to become a hedge fund manager in 2000 despite the reputational risk.

Acceptance – by Clients, Consultants and Peers

The notion of short-selling being ‘socially unacceptable’ or lacking acceptance by stakeholders in the investment process was mentioned by a series of interviewees:

B1:” Most people who still make decisions for big sums of money are still kind of lay trustees. The idea of buying a company at a reasonable price is easy to

understand. Selling something in anticipation that it is going down is less easy, less acceptable and raises questions. I think there is an acceptance issue".

N2: "Culturally a lot of them [shareholders of an investment trust] would not expect us to be doing that [short-selling]." He adds: "It would be seen to be us doing something spivvy when it's not spivvy at all".

Question: "What do your clients think of short selling?"
J1: "Remember that the bulk of [our] business is life related, so this was a bit of a new area for them. We had to go down and present properly, show them the merits of it, ... but it took a bit of education and explaining and justification for them to see it."

Scheff, 1988 argues that people are strongly influenced by anticipation of how their behaviour will appear to others, even if approval or disapproval has no direct material consequence. It can be argued that such a phenomenon is at work amongst this community of investors. Alternatively, there could be real consequences (perhaps loss of clients) for not conforming. However, not all interviewees agree that short-selling is unacceptable. One experienced hedge fund manager (I1) argued: "It's respectable, because it's exactly just what you're doing with investing, except that you're short rather than long." The same manager stated: "I always thought that hedge funds would become more and more mainstream, so I think it is acceptance, but also it's a reality that if a company does a good job then it has nothing to fear from short-sellers." As well as highlighting acceptance from clients, consultants and peers, his argument also introduced the notion of acceptance from companies who to some extent control information flow to investors. Growing attention on short-selling from the academic community has also contributed to growing acceptance:

S1: "I think first of all the growing importance of a quantitative approach to your investment process which makes this approach easier. In the context of that, the academic research that points out that it's more efficient. And also from the market point of view, the convergence in returns from markets in the last few years, where

generating alpha from just your longs is much more difficult. And I guess finally, a bit in line with point one, that there are institutions which have picked it up and become very good at this and are competing…"
Question: "So in a sense, the academic work has led to changes in investment approach and changes to how the market works…?"
S1: "Yes, I think it gives theoretical support for that."
Question: "And does that also explain the increasingly quantitative approach you are seeing in the market or is that separate?"
S1: "Yes, I also think that some of this is behavioural, in that it worked shorting stocks. Some people were good at it as a result of the fact that the mainstream long-only managers had a psychological blind spot of going short, so some of the behavioural biases are now being exploited and one of them is shorting. So I guess it's not only the modern finance academic research but also the behavioural finance research that is shifting the sands in this business."

Nevertheless, lack of acceptance remains important in some quarters. One pension trustee commented:

R1: "If you were to stand in front of the General Assembly of the Church of Scotland and explain that you were short-selling, hoping to drive a stock down in the hope of profiting from it – I don't think it would go down well."

Peer Effects

Hong *et al.* (2003) use a database of mutual fund holdings to show that the stockholdings of any given fund manager respond more sensitively to the holdings and trades of other managers based in the same city, than to holdings and trades of fund managers in other cities. They further show that this effect is distinct from any local-preference/ home-bias effect in stock selection, and that it is robust to controls for investment style. Their work improves our knowledge of how word-of-mouth effects can influence investment decisions.

In interviews, I found a number of references to the 'community of hedge fund managers' and also found evidence that the behaviour of some investment managers and firms could act as a catalyst to others. For example, one short-selling entrepreneur had trained a number of hedge fund managers who now work in other firms, practising short-selling. Whilst under-taking this research, I received a number of requests to attend or speak at practitioner seminars on the subject of short-extension portfolios and the use of short-selling in portfolios – effectively requests to share knowledge amongst a community of investors.

In terms of knowledge and staff, as one firm starts to undertake short-selling, the pool of potential employees or entrepreneurs who can switch firm or set up their own firm increases. This is particularly important where a job market is 'segmented' (i.e. workers are not fully mobile). To illustrate this segmentation:

H1; "When we were talking about recruiting people for fund of hedge funds we were told it would be very difficult to get anyone out of London [to move to Edinburgh] and that is where they should be as that is where all the gossip and chat is." The lack of experienced and knowledgeable short-sellers is thus highlighted as a barrier to short-selling.

A comment from a risk consultant (D1) illustrated some of the linkages between the various social explanations for limited short-selling: "This is a huge generalization but I'll say the Scottish firms are more conservative than the others or they like to be perceived as being more conservative. It's back to the old Scottish Protestant work ethic that we're old men of the game and we know what we're doing, you know. Although that's more perception than reality. If you look beneath the surface they're all there at the forefront looking to create new products with interesting bits and pieces." She added: "And I guess the general public who is buying into these products is more aware too so they're demanding more innovative products." Comments such as this reveal some of the linkages between the various social constraints: a firm's reputation, stakeholder acceptance and peer effects.

Risk-related constraints:

The academic literature contains references to a series of risk-related constraints on short-selling. These include recall risk, short squeezes, synchronicity risk, performance-related arbitrage and the potential for unlimited losses. Interviewees refered to each of these risks and also to an additional risk that I refer to as 'crowded exit risk'.

Recall risk

Recall risk is described in Section 2.1.3. This risk is well documented in the literature, and was known to interviewees. One long-short manager commented on his fear of recall risk, but also his own recall of stock loans made to others:

Question: Did you have any problems with recalls at all?
J1: "No, that was a big fear I had. It's one thing to say we can be patient and persevere but recalls could have upset that."
Question: "So the contracts allowed for it but you didn't suffer that at any point?"
J1: "That's right, although we did do that to other people occasionally where for whatever reason we decided to pay the break fee, giving them 48 hours notice or whatever"
Question: "Is that because you did your analysis and you felt it was the right thing for you or was there a little bit of gamesmanship involved thinking you could cause a little bit of stress to someone by breaking?"
J1: "No, we're too nice for that. It would typically be a position where we had made a little bit of money and thought there is downside here and the additional gain might be small potatoes compared to what we might give up so we just did it."

One interviewee, a prime broker, discussed the lending of stock from within a hedge fund's account with the prime broker, and argued that recall risk was a problem for borrowers of stock:

O2: "...hedge fund managers have high turnover and that is not particularly attractive to a borrower given the likelihood of recall."

The prime broker went on to argue that stock would only be borrowed from a source likely to recall the stock when other less risky sources of stock borrowing had been exhausted. There was good general awareness of recall risk. For example:

G3: "In respect to stock loan recalls, these normally occur around corporate events - takeovers etc. where 60 to 90 days shareholder notice is required ahead of the vote, or dividend dates."

There was also some degree of fear around an inability to hold on to short positions in the face of loan recall. Prime brokers responded by putting in place processes to minimize the risk that clients suffer from loan recalls.

Manipulative Short Squeezes

Where a loan recall cannot be replaced, the short-seller must repurchase stock in the market and this is known as a short squeeze. Short-sellers fear these because of the possible market impact from any forced covering. Jacobs and Levy (2007) make the point that the fear of short squeezes deters some short-sellers, but that this fear is largely unfounded as they argue that these are rare events and confined to illiquid stocks. One interviewee refers to manipulative short squeezes, a situation in which a manipulator takes a position in a stock and 'engineers' a short squeeze so as to profit from the forced covering of a short-seller.

Q1: “I’m sure it goes on among the investment banks; that from time to time they get the bit between the teeth and squeeze the shorts.”

Crowded Exit Risk

A crowded exit is a liquidity problem that arises in stocks where short-sellers hold large positions relative to normal trading volume, and when a catalyst prompts short-sellers to cover their positions rapidly and simultaneously. Catalysts include, but are not limited to, public news releases by companies. The temporary excess of demand for stock relative to normal trading volume leads to upward pressure on the stock price. Crowded exits can lead to losses for short-sellers and thus act as an indirect constraint on short-selling. Several interviewees discussed crowded exit risk:

N2: “you have to have liquidity around it [the stock] to be able to buy it back and cover your short.” He adds: “How the doors seem to narrow as you run for the exit!”

V1: “Short-sellers try very hard not to be in crowded trades...” He added: “If they end up in crowded trades, what you find is that if a company comes out with good news then you can see 6-7% moves even in big stocks and I assume that’s because people were short [and covering their positions].”

Some interviewees commented on the relationship between short squeezes and crowded exits:

E2: “When you get a squeeze….then there is a panic to get in or out and liquidity dries up.” Furthermore; “It’s a crowded ownership or non-ownership issue divorced from the specifics of the stock or bond.”

G3: “Crowded exits can be a problem. I only experienced it once over a three year period. It’s more of an issue with an independently enforceable stop loss regime. If

your fund doesn‘t get sucked into the initial squeeze then a little patience can be rewarded with better exit terms a few days down the line.”

Synchronization risk/ time horizon problems –

Abreu and Brunnermeier (2002) introduce the notion of synchronization risk (see Section 2.1.3). Delaying short-selling until other arbitrageurs have also detected an over-valuation has the effect of reducing the amount of short activity in overall terms. This problem is related to the negative expected return problem and to costs, in the sense that short-sellers require rapid convergence in share price to a lower fair value to overcome the negative expected returns and costs of short-selling. It is also related to noise trader risk (see Section 2.1.3) in that uninformed investors can ‘overwhelm’ the more informed activities of a short-seller with limited capital.

Interviewees cited specific examples of problems associated with time horizons and synchronization risk:

R1: “To my mind, the [1999 technology stock] valuations were grossly over-exaggerated… and therefore I think there was an opportunity for short-sellers to act as a correction mechanism in an over-heated technology market. The corollary of that is that if you had shorted the tech market in 1999, you would have had to have waited until I think 2002 for the NASDAQ to correct back to its 1999 levels, so you would have got killed in the meantime, so there are disadvantages.”

M1: “There is a bit of that in that it is very short term. Short-selling could be about investment and it could use your investment timing and your investment knowledge to see a company is overvalued. We can see a company is overvalued however we don’t claim to have any short term knowledge of that so to us it is the timescale that is alien. We don’t see how you can predict what a share is going to do over a very short period of days or months. And there are so many other external factors that could influence other people’s ways of valuing the stock that means that although

you may believe in your valuation parameters that the stock is overvalued, that may not be in other people's valuation parameters such as venture capital people, asset buys, etc."

One fund manager, when asked if he believed he had any ability to identify over-valued shares, raised the issue of timing and synchronization risk:

C1: "Oh, yes…but no ability whatsoever to predict when that over-valuation will be recognized. It may be recognized within five days or it may be recognized within five years, it may go on longer than that. So we have considerable faith in our ability to say this thing is too bloody dear, but no faith whatsoever to say when that will be recognized."
Question: "So do you feel that short-selling is riskier than long-holding because of the fact that the time horizon is so important…"
C1: "Undoubtedly, yes."

Opinions varied, however, on the importance of synchronization risk as a barrier to short-selling. For example:

Q1: "What is difficult is knowing the times of when some of these things are going to change". He adds: "But at the end of the day it's not that that stopped us."

I1: "...if you go long of something you need a catalyst as well. The stock could be under-valued for years." He adds; "You've got to look for a catalyst on every decision, that's one of the pillars of investment."

One quote linked the concept of synchronization risk to the costs and the negative returns expected from short-selling in an efficient market, but also to the concept of short-selling as trading and not investing:

B1: "Short selling is associated with high turnover, event driven, investment speculation if you like. That is a specific type of investment trading really. I don't see

why it has to be associated with that, maybe it's because of the cost, if you have the view that fundamentally something is over valued, you don't know when it's going to come down, may be 3 years maybe 5 years…, or other negative costs. Actually shorting that stock for that period may outweigh the potential gains you might get, that may be the reason you don't get more long term short-sell."

Performance-based Arbitrage

Shleifer and Vishny (1997) introduce to the literature the concept of performance based arbitrage (see Section 2.1.3). Long-short managers were aware of this risk, and used 'lock-up periods' – whereby clients cannot withdraw funds immediately - to mitigate the problem where possible:

Question: "If clients see losing positions and panic and try and pull out that can actually mean closing potentially successful positions. How do you solve that risk or problem?

J1: "We have a lock-up period or a notice period for liquidation of 45 days. That doesn't solve the problem, it just helps."

A 'lock-up' reduces the ability of a client to liquidate an account at short notice. This loss of liquidity can be regarded as a disadvantage to a client. However, lock-ups are designed to enhance long-term performance by reducing the need for the fire-sale of attractively-priced assets. There is thus a trade-off between liquidity for the ultimate client and long-term returns for the fund in which the client is invested.

In Shleifer and Vishny's model, clients are generally uninformed and have a poor understanding of risk arbitrage. One former hedge fund manager argued that not only clients but even some specialist agents charged with selecting hedge funds in which to invest undertook performance-based arbitrage –

G3: “On stop losses, it’s standard hedge fund practice to have a stop loss framework both at an individual trade and portfolio level – managers are extremely careful to prevent drawdown as it hits the reported stats that fund-of-fund managers employ in screening investment candidates.”

Lack of Transparency

Brunnermeier and Pederson (2005) show how a predator can exploit the forced sale of an asset by another market participant to earn a profit. Their approach could also apply to the forced purchase of an asset by a short-seller (such as might happen with a short squeeze). To minimize this risk, short-sellers prefer to keep their stock positions private. Full transparency about holdings and intentions can not only be used by others to earn profits at the short-sellers expense, but can also be used by imitators to copy the strategy of a successful short-seller at little cost. Furthermore, they could be used to trade ahead of a short-seller whose trading intentions could be predicted, so as to benefit from the market impact of the short-seller’s trades. Informed short-sellers thus eschew full transparency. However, poor transparency can raise suspicion amongst other market actors about the activities of short-sellers.

Most developed stock markets lack a centralized loan market (i.e. there is no ‘stock exchange’ for stock loans). Jones and Lamont (2002) discuss a centralized loan market that existed in 1930s Wall Street, but such markets are rare. Because stock loan markets are generally decentralized, this can result in publicly available information about stock lending activity being far from comprehensive. Such limitations can lead to fear and suspicion amongst investment managers and clients about the activities of other market participants.

D1: “Another thing we didn’t touch on that puts off a lot of people is lack of information or transparency.”
Question: “And that lack of transparency leads to a lack of confidence or a lack of trust at the client level or the portfolio manager level?”

D1: “At the portfolio manager level. I don’t think the clients are necessarily aware of lack of transparency”

Lack of transparency was cited by several interviewees as a constraint for institutional clients such as pension funds. The trustees of such funds tend not to want to invest in portfolios or products that are opaque or difficult to understand. There is personal risk for trustees if they fail to undertake sufficiently rigorous due diligence on investments made for a pension fund. If a hedge fund held within a pension fund were to produce large losses, a trustee would not wish to admit in public that he/she did not know what securities were held in the portfolio, or admit to a poor understanding of the investment process applied by the hedge fund. It is far safer for a trustee to avoid investment in products lacking in transparency. This risk-related argument is also, in a sense, an institutional constraint. Pension fund trustees (in the United Kingdom, at least) are generally volunteers and are unpaid for their work. However, they can suffer downside risk in terms of personal loss of reputation if they produce poor results for the beneficiaries of the pension fund. The institutional structure associated with the oversight of some pension funds thus creates a fear of risk and a reluctance to invest in funds involved in short-selling.

Benchmark Constraints

A suggestion put forward by D’Avolio (2002) to help explain the uncommonness of short-selling is that investment managers fear that short-selling will increase their tracking error against common benchmarks or indices. The vast majority of interviewees adamantly rejected this notion. For example:

E2: “...the concept of tracking error has no traction in the long-short space, it doesn’t mean anything. As a hedge fund manager I’ve never used the phrase once. And the reason is that tracking error is a guide to expectation, whereas in terms of risk in the hedge fund world they are much more ‘Value at Risk’ based because there is a threat of annihilation.”

One interviewee reinterpreted D'Avolio's suggestion and argued that the growth in short-selling over recent years could be explained partly by investment managers *seeking to break away from tracking error constraints*. This suggests that it is the setting of tracking error targets by risk managers or clients that has been a barrier to short-selling, rather than investment managers' fear. A pension consultant suggested that tracking error constraints had been a relevant issue:

E1: "In pension funds, to benchmark your long-only manager relative to an index was the natural way to look at things and still is, but pension fund trustees and consultants, the whole industry, are getting a lot more comfortable about absolute return rather than any benchmark and obviously that is going to help long-short products."

In a related discussion, one long-short manager argued that any shortfall in returns for a hedge fund against a long-only benchmark could be perceived by clients and colleagues as failure by the hedge fund manager. When benchmark returns were high in absolute terms (i.e. during a bull market in equities) absolute-return funds were likely to under-perform a long-only benchmark. This could lead to disappointment and a loss of support from clients, ultimately leading to less short-selling. Effectively, this is a 'mis-benchmarking problem', rather than a tracking error constraint. Another interviewee cited *peer-group benchmarking* as an example of a benchmarking problem that limits short-selling:

H1: "we are still measured against our competitors so how we invest our money is still largely driven by what everyone else is doing & it would be difficult for us to put 20% of the With Profits fund into a hedge fund without being way off what our competitors are doing"

Thus, tracking error constraints and the inappropriate benchmarking of long-short funds can act a barrier to short-selling. Waring and Siegel (2006) address the problem of determining appropriate benchmarks for long-short funds.

Potential for Unlimited Losses

A short position has maximum gain of 100%, which occurs when a share price falls to zero. Losses, on the other hand, are potentially unlimited, as there is no upper limit to the price at which a share can trade. Effectively, this means that short-sellers face unlimited liability if they are unable to close their positions, a feature not normally associated with investment. One risk consultant argued:

D1: "I think you need stop losses to be a disciplined investor and especially with short-selling where things can move very quickly against you and then the cost ratchets up almost with a kind of 'optionality-type' profile". Furthermore; "with short-selling you've got to recognize almost immediately when you're wrong". The automatic use of stop losses leads to the early recognition of mistakes and, other things equal, leads to potentially shorter holding periods for short positions."

One investment manager (U1) argued that 'potentially unlimited losses' were one of the reasons why his firm prohibits the use of short-selling when managing money for its own clients.

<u>Distribution of Returns:</u>

Negative Expected Returns

In asset pricing models such as the Capital Asset Pricing Model, the expected return from holding a risky asset exceeds the risk free rate of return – there is said to be a 'risk premium' for owning a risky asset. A short-seller holds a negative position in a risky asset and the cash proceeds from the short sale must be used to collateralise the stock loan. A 'rebate rate' that reflects prevailing interest rates less a stock borrowing

fee is paid on this collateral (see Section 2.2.2). Any dividends must be manufactured by the stock borrower to make the stock lender whole. Within an efficient markets framework, a short position in a stock would have an expected return equal to: (rebate rate on collateral) – (expected return on long stock position). Where the collateral is invested at the risk free rate of return, the rebate rate must be below the risk free rate of return. Because of the risk premium embedded in the risky stock's expected return, the expected return from the short position will be negative. Thus, the short-seller bears investment risk by virtue of having a non-zero holding in a risky asset, but expects to receive a negative return. This is an unattractive proposition and thus a barrier to short-selling. To expect a positive return from the short-sale of a stock, one must believe in some form of mispricing in the market (the stock must either be currently mispriced or about to become mispriced) and the 're-pricing' of the stock must occur quickly enough to outweigh the costs of short-selling. Finding the catalyst for the stock re-pricing becomes important and 'synchronization risk' (Abreu and Brunnermeier, 2002) becomes a consideration in investment decision making. According to Credit Suisse/ Tremont Hedge Fund Index, a compiler of data on hedge fund assets and performance, 'dedicated short bias' funds are of limited popularity, accounting for less than 1% of hedge fund assets at all times between inception of the index in 1994, and October 1st, 2008[8]. Furthermore, dedicated short bias funds recorded negative ex-post cumulative returns between these dates.

However, it should be noted that many market participants involved in short-selling hold a combination of long and short positions. There exists a spectrum of investment strategies ranging from pure short-selling to 'market neutral portfolios' and through to 'beta-one portfolios' such as short-extension portfolios (see Clarke *et al.*, 2004, 2008). For a market neutral investor, the investor earns the difference in expected returns between the long and short equity positions, plus the risk-free return on cash deposited as collateral or held back to cover margin calls, less stock borrowing fees. The investor assumes no market risk (if market neutral) but suffers exposure to the relative movements of the two securities. In an efficient market,

[8] http://www.hedgeindex.com/hedgeindex/secure/en/datadownload.aspx?cy=USD. Accessed on 23rd November 2008.

he/she expects to receive the risk-free rate of return less stock borrowing fees. With a short-extension portfolio, short positions are balanced with additional long positions so that the portfolio remains 100% net long. The expected return is similar to that for a long-only position in shares, but with the added cost of the stock borrowing fees and a credit risk premium (for borrowing additional money to provide the active extension). Assuming efficient pricing in a market, the expected return from all the above strategies that use short-selling is unattractive, on a risk-adjusted basis. The cost of borrowing stock provides a 'headwind' that diminishes the return per unit of risk. Only with a mis-pricing story does the return per unit of risk become more attractive.

The problem of negative expected returns was mentioned by several interviewees.

M1: "I would think that anyone who is slightly knowledgeable would realise that equity markets on the whole tend to go up and produce positive returns therefore by short-selling you are intrinsically going to under-perform and lose money over the long term."

One experienced hedge fund manager argued that short-selling was against the 'mentality' of many Scottish investment managers, who had programmed themselves to buy securities that were falling, secure in the belief that this provided an attractive entry point for long-term investment. A more short-termist approach might be to exploit the momentum effect (see, for example, Jegadeesh and Titman, 1993, 2001) and short-sell securities whose prices were falling. Thus, the 'negative expected return' problem can be linked to that of the time horizon of the investor: a long-term investor would tend to view falling share prices as an opportunity to accumulate 'depressed' stock; a shorter-term market participant would see negative momentum and thus a short-selling opportunity. The origins of the Scottish investment community are most associated with longer-term investing, rather than with 'trading' or shorter time horizon investing.

A relatively new type of portfolio structure, generally known as 'short-extension portfolios', provides a possible solution to the negative expected return problem. These portfolios build upon the Fundamental Law of Active Management (Grinold, 1989) and the generalised version of the Fundamental Law (Clarke *et al.,* 2002). A typical short extension portfolio is described in Clarke *et al.* (2004). Short-extension portfolios permit a limited degree of short-selling and this is entirely offset by borrowing (or its equivalent) so as to purchase securities to the same value of those sold. As an illustration, a portfolio might be 120% long of stocks, 20% short of stocks and thus 100% net long of stocks. This has the effect of setting the beta of the portfolio to (approximately) one, so that the expected return of the portfolio is similar to that of a traditional long-only portfolio. Amongst interviewees, awareness of this type of portfolio was rather limited, but I am aware of at least two Scottish firms that at the time of writing are planning to establish short-extension portfolios. If such portfolios are successfully launched, then (everything else equal) short-selling will increase amongst the Scottish investment community. The acceptance of the 'short-extension' portfolio structure – one that 'solves' the negative expected return problem associated with short-selling - suggests that negative expected returns have been a significant barrier to short-selling.

Question: "What stops you from investing long-term in short positions? Are there constraints there?"
M1: "Yes, there's a couple of things. We actually looked at that in the study we did – stocks that were at extreme valuations produced poor returns. The poor returns were often still positive. So although these stocks were massively under-performing the market, they were still producing positive absolute returns. So over the long term that would suggest that you don't invest. Also if you believe markets do produce between 5-7% real returns, so 8-10% nominal, your population of stocks which are negative nominal is going to be quite small. So just on pure numbers it is not a sensible view point."

Unattractive Distribution of Returns

Related to the negative expected return from short positions is the skewed distribution of returns associated with some long-short hedge fund strategies. For example, merger arbitrage strategies tend to produce small gains under most circumstances. However, as highlighted by Mitchell and Pulvino (2001), large stock market falls tend to lead to failed merger and acquisition activity, resulting in large losses for merger arbitrage strategies. This leads to a pattern of small gains in successive periods punctuated by the occasional large loss. Such a distribution of returns can be unattractive to some clients, and could interact with the performance-based arbitrage effect described earlier. It might also be referred to as 'blow-up risk', in recognition of a number of high profile hedge fund failures, including Long-Term Capital Management in 1998, or Amaranth in 2006.

M1: "…some of the more adventurous [hedge funds] have gotten themselves into some difficulties and they've collapsed and they tend to make the headlines, so the investing public tends to look at these and think: 'This is something we want to steer well clear of." This shows a link between an unattractive distribution of returns and reputational risk.

A number of interviewees commented on the *perception* of risk from clients, even if this was not fully justified by the strategy employed or structure of the investment vehicle that undertakes short-selling: For example:

H1: "I know as a trustee of one of our pension funds that pension funds generally are very nervous of short-selling. I think most of them don't understand that if they invest in a hedge fund they can't lose any more money than they put in, they believe that if the fund is short selling they can lose their shirt." And further: "When Prudential went into hedge funds the headline in the Evening Standard was 'Prudential breaks the last taboo of investment management and bets on hedge funds'. It doesn't matter what they say in the Financial Times as the man who buys

the Prudential products is reading the Evening Standard and thinking: 'Oh my God, I'm going to lose my shirt', even though the amount invested was a tiny £65million."

A particular risk associated with short-positions is that of a take-over bid. A typical bidder will be required to pay a premium to the 'undisturbed' share price – effectively a premium for control. This works in favour of long-holders of a stock and is thus a risk to short-sellers. It would be difficult to argue, though, that this risk makes short-selling any riskier than long-only investing. For example, long holders face the risk of profit warnings, which can produce sharp and sudden drops in a share prices, and this would work to the advantage of a short-seller. Nevertheless, fear of take-overs was mentioned by one investment manager:

M1: "Stocks in the overvalued part of the curve, if you look at the survivor bias element of it, a lot of the stocks that are very expensive actually get taken out [i.e. acquired] one way or another. Some do go bust but a lot actually get taken over for asset reasons and we can't predict that when we are looking at the valuation of the company."

Negative Income

Some portfolios are run to generate a high or rising stream of income for clients to whom income is important (this clientele might include retired individuals who require a regular income from their investments). Such income is generated primarily from the dividends received from companies as a result of ownership of shares in those companies. As explained in Section 2.2.2, the borrower of a share is required to manufacture a dividend for the lender of that share, so as to 'make the lender whole' in terms of income foregone as a result of lending out the shares. This results in a negative income for the borrower of a share. Accordingly, short-sellers do not receive income, but instead suffer negative income as a result of their activities. This can create a 'negative clientele effect' – income-seeking investors will tend to eschew funds that short-sell because of their generally unattractive income profile.

To illustrate this, several managers highlighted the importance of income to the firm.

F1: “They [my clients] require an income flow”.

N2: “We seek to grow our dividend as well, so yield is important to us”

This latter manager argued though that this would not prevent the firm from short-selling, as capital gains could be transformed into income through the use of a trading subsidiary and the payment of capital gains as a dividend to the holding company. Nevertheless, for more constrained or less creative firms, income requirement could act as a barrier. Manager F1 argued that a need for income flow prevented her from suggesting short-selling to her clients.

Another manager (C1) argued that dividend income compensates long-holders of equity as they wait for convergence to the perceived higher fair value of a share. Dividend income works *against* short-sellers awaiting convergence to a lower share price target – one aspect of synchronization risk.

<u>Personal Constraints:</u>

Psychological Barrier around Ownership

One interviewee (S1) argued that ‘psychological’ barriers are the main impediment to short-selling being more common. “Particularly fundamental qualitatively-oriented managers have a tendency to pick stocks that they believe in, feel comfortable with management and believe the story. It’s much harder psychologically to go through that same process, gathering information and then deciding that I don’t like the company, I don’t have faith in management and I’m going to short the stock.” The same interviewee described a “psychological blind spot” around short-selling. This view was echoed by a risk consultant:

D1: There's a psychological aspect...there's also certainly managers that come from a long-only environment [who] tend to fall in love with their stock – their babies – and they don't want to get rid of them and that aspect goes on and that's why they don't tend to make very good short-sellers."

Both interviewees thus argued that long-only investing involved ownership, and that this was psychologically more satisfying than short-selling, which involved no ownership.

Losing Positions Grow

One long-short fund manager argued that it is: "psychologically difficult to see losing positions grow." This refers to the fact that short positions held in stocks that rise more in price than others become a greater proportion of the overall portfolio. The portfolio manager's mistakes thus become a 'growing problem' in the portfolio. This is in contrast to the situation experienced by long-only managers, where under-performing (losing) positions become a smaller part of the total portfolio, and thus might appear to have become smaller problems for the portfolio manager. Arguably, this barrier is related to risk, in the sense that bad short-sales become a larger proportion of the portfolio and so a bigger risk concern, but it is described by the interviewee as a psychological barrier.

Lack of Knowledge/ Experience

Lack of knowledge or experience of the process, benefits and risks of short-selling is one of the most commonly cited constraints on short-selling.

H1: "It [short-selling] is difficult to understand. The people in the UK who are responsible for most investment decisions, trustees of institutions, individuals and

even actuaries within our assurance company who set the investment strategy don't understand how you make money out of an arbitrage strategy. It is difficult for them to justify the time it would take them to understand it for the actual difference it is going to make."

C1: "We don't have clients as such, we have shareholders. I would imagine most of them would regard it [short-selling] as anathema, but that's because most of them are private individuals, private shareholders, and do not understand or appreciate what short-sellers are trying to do."

One manager involved in charity fund management, commented on a lack of knowledge amongst some fund trustees about short-selling, and suggested that this serves to limit the extent of short-selling.

F1: "I don't think you should have any product in a client portfolio without them understanding how it operates. That just leads to disaster further down the road."

The same interviewee also highlighted her own lack of knowledge on the subject.

F1: "There might be some knowledge problems. People have to go out and learn – I don't feel I know enough about it."

One investment manager argued that even well-educated market practitioners could be lacking in knowledge of short-selling:

U1: "I suspect a lack of knowledge primarily, even amongst the market professionals. I think even if you asked an investment manager who is fairly highly qualified, but not a specialist in that field, he would profess to have very little knowledge." This suggests not so much a lack of knowledge in investment matters, but a specific lack of training on the subject of short-selling.

One experienced hedge fund manager argued that lack of knowledge was a possible reason for lack of interest in short-selling in Scotland, but stated that "that's why you bring [new] people in, but I think obviously maybe the people at the top would have to get comfortable with it."

One former hedge fund manager argued:

Q1: "The textbooks, all the textbooks that people like me learned from did not have anything on short-selling. It might have been referred to briefly as something that stock jobbers [market-makers] did but it wasn't something that investors needed to know about."

To explore this notion further, I identified six popular textbooks used by graduate students in business schools, and analysed the index of each, to identify the number of pages devoted to short-selling, stock lending, arbitrage, risk arbitrage and hedge funds. This is a crude measure, but nevertheless instructive. The results are displayed below in Table 4.1. In each cell, I show the number of pages devoted to a specified topic. In brackets in each cell is the number of discrete index references to the topic (noting that some index references span several pages). I find that standard business school textbooks on investment management contain little material on short-selling (between 0.2% and 1.5% of total page count in all cases). Stock borrowing or lending is not listed in the index of any of these books, although stock borrowing is generally mentioned in most of the textbooks as a line or two in the summary of the mechanics of short-selling. Arbitrage is more frequently mentioned in most of the textbooks (up to 4% of total page count in one case), primarily because each seeks to describe Arbitrage Pricing Theory, a major finance theory. It should be noted however, that this theory makes simplifying assumptions about short-selling (namely, that it is inexpensive, unrestricted and widely practised) that are unrealistic in practice. Thus, the theory suggests that arbitrage is a standard practice, but give few clues as to how to *practice* arbitrage. Hedge funds are, perhaps surprisingly given their growing popularity, scarcely mentioned in the editions of the textbooks studied. In several of the textbooks, there are references to 'hedging' within the context of derivatives, and

I include these in Table 4.1 when directly related to short-selling, and exclude when these refer solely to the concept of removing some form of risk (e.g. exposure to commodity price moves).

Table 4.1 References to Short-Selling, Stock Lending and Arbitrage Amongst Popular Textbooks on Investment

Author(s)	Fabozzi & Modigliani	Lofthouse	Reilly & Brown	Levy & Post	Jones	Reilly & Norton
Title	Capital Markets – Institutions and Instruments	Investment Management	Investment Analysis and Portfolio Management	Investments	Investment Analysis and Management	Investments
Edition	3rd	2nd	8th	1st	9th	7th
Total Page Count	644	589	1174	914	641	734
Short-Selling	4 pages (3 references)	1 (1)	4 (3)	5 (3)	9 (6)	6 (6)
Stock-Lending	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Arbitrage	27 (12)	37 (10)	33 (9)	30 (11)	6 (2)	6 (2)
Risk-Arbitrage	Included above	0	3	Included above	0	0
Hedge Fund and Other Related	0	0	5	2	0	2

These findings correspond with my interview results, where lack of knowledge is cited by a number of interviewees as a barrier to short-selling. Q1 argued that it is those with *practical* experience of the mechanics of short-selling – the market-

makers and traders who are principally London based within the UK- who have tended to practice short-selling within the investment industry. This suggests that a lack of education in short-selling, combined with a lack of practical experience due to the limited scale of market-making and prime brokerage in Scotland, has contributed to the scarcity of short-selling within the Scottish investment community. Furthermore, lack of experience can be 'location specific'.

One of the interviewees (M1) is Partner at a recently established firm that is staffed by a small number of very experienced professionals. The CEO studied economics for his D. Phil. and has written a number of academic articles and a book on investing that includes sections on short-selling. The firm chooses not to short-sell. This example indicates that amongst those who do not practice short-selling, not all suffer from a lack of knowledge.

Lack of Skill:

Skill can be defined as the ability to generate positive risk-adjusted returns over the long-term. It is sometimes referred to as 'alpha' in the jargon of the industry. Only if the manager has skill is it worth paying an active management fee; otherwise it should be possible to employ low-cost, passive investment management or to use derivatives such as index futures. When studying the performance history of an investment manager, it is difficult to separate luck from skill over the short-term, although a variety of performance measurement techniques attempt this task (see, for example, Edwards and Caglayan, 2001)). Active long only managers deliver 'beta' (passive market or index returns) and 'alpha' (or skill-related) returns. In 'market neutral' funds, beta should be zero, and the expected return is the return from cash plus manager skill, less costs. In long-short funds, beta is generally expected to be close to zero over time, and alpha is expected to dominate (but long-short funds sometimes have beta greater than zero, as alluded to in some of the interviews). Generally though, alpha dominates beta in long-short funds because of the low-beta. As a result, obfuscation between the two sources of return is lower than for long-only

funds that combine beta and alpha. Consequently, it is easier for investment consultants and clients to detect a lack of skill in a long-short fund manager.

Where performance is measured in risk-adjusted terms, the sum of alpha in the market amongst all participants is, by definition, zero. Thus, not all participants can exhibit positive alpha or 'skill'. With long-only funds, beta and alpha components of return are commingled, and clients of investment managers might be content with returns that are positive (because of the impact of beta in a generally rising market environment) even though there is no evidence of skill. With long-short funds, under-performance is quickly detected by clients, and this can lead to the rapid termination of management contracts by clients. As such, the increased transparency of skill can become a constraint on the amount of long-short management that takes place in a market. This issue was raised by two long-short managers who had abandoned their long-short portfolios. One manager (Q1) stated that returns had been satisfactory in average magnitude, but not *consistent* enough to appeal to prospective clients. This suggests that risk-adjusted returns and consistency of alpha are important to clients. The greater 'transparency of skill' in long-short funds that have a target beta near to zero can combine with a 'lack of skill' amongst long-short managers to limit the amount of short-selling in the market.

Investment managers who had not yet practiced short-selling were often unsure if they have skill in this activity:

B1: "first, we are not sure if we are any good at short-selling"

G1: "....we could debate whether we have the skills to do it [short-selling] even if we thought it was a good plan."

One investment consultant commented:

E2: "I think the advisory business is very uncomfortable with alpha as a durable source. It's hung up on [the notion that the total added value of investors] is less than

or equal to zero." In other words, investment advisors know that the weighted sum of all risk-adjusted returns in the market is zero. Including trading costs, it is negative. They are sceptical of claims by investment managers of their ability to earn positive risk adjusted returns." This is sometimes referred to as the 'Lake Wobegone syndrome' - a reference to the Garrison Keiller novel in which it is claimed that all children in a mythical town are 'above average'. Active managers might all aspire to produce positive risk-adjusted returns, but they cannot all succeed. After fees and costs, the average investor fails to out-perform the market.

Each interviewee was asked if they believed that short-sellers had special skills relative to long-only managers. Answers were mixed, but the most common answer was 'yes', based on the need to be more aware of the catalyst for convergence to fair value, and the time horizon for the short-seller. A typical comment on the additional skills required of short-sellers was: "The mindset is much more objective and will probably translate into a separate process where the separation between companies and stocks (if we talk about equities) is much clearer, whereas here traditionally I think fund managers made the case that a good company typically reflects a good stock."

Institutional Constraints

Unsuitable Process

Investment management firms, especially those that interact with investment consultants in an attempt to win additional clients, are required to make their investment processes known, so that the consultant can undertake 'due diligence' on the investment manager. Developmental changes to investment processes, so as to incorporate new research or new financial tools, are generally acceptable to an investment consultant. However, dramatic changes to investment processes can be regarded with suspicion, as they lead to the creation of new and untested processes, at least until a track record has been established. Consequently, there is a cost to an

incumbent manager in changing an investment process. This can act as a barrier to the introduction of short-selling at successful long-only firms. Consequently short-selling is more likely to involve new products or new divisions within an existing firm (requiring a gradual building up of assets under management from a zero base) than the conversion of existing long-only business to a long-short process. This has the effect of slowing any transition from long-only to long-short management. Thus, there exists an institutional constraint on short-selling, in the sense that time must elapse for a process to become 'proven' in the eyes of others. There are also costs associated with acquiring new skills and knowledge to develop an investment process. A number of interviewees described how their current investment processes were ill-adapted to long-short equity management:

B1: "A lot of our process is aimed at identifying quality companies, in terms of sifting through potential investment opportunities, identifying attractive companies then looking into them further, and so you don't necessarily look into the ones you dislike to find out which ones you really hate."
Question: "Would it require a change to the current process?"
B1: "I think that is the issue."

H1: "We don't have the support, risk processes, etc. to enable people to do that [short-selling]."

M1: "The other main reason is, to look at these stocks long term you have to focus on stocks and take a long time to decide your parameters and what the valuation is. Once we decide a stock looks overvalued we abandon it at that point, we don't do the intensive work to find the stock is overvalued, so it wouldn't fit in with that parameter at all."

N1; "[we] have a team of investment managers who tend to look at things positively and look to expose gems. We don't have anyone who looks to inherently expose the chaff."

Institutional Conflicts of Interest

Institutions can impose constraints on themselves in an attempt to avoid conflicts of interest, minimize staff rivalries or demonstrate strong corporate governance. Such constraints were mentioned by several interviewees. A typical line of argument was that larger institutions might hold permanent minimum positions in some larger companies, even if the stock were disliked, because of tracking error constraints that were self-imposed or else set by clients or consultants. Taking short positions in some portfolios could create the appearance of a conflict within such a firm, as the stock might also be held 'long' at the same time in other portfolios.

I1: "If you are running a lot of money…if you are going to short something, it may be in direct conflict with what you were doing."

L1: "the key thing on clients' minds is how we manage contradictory positions and how we manage potential conflicts of interest."

G1: "If you are short-selling within one of your funds then this could push down the price of that stock and this might not be conducive to the absolute value of a fund that has a [long] position in that [stock]." He adds that this problem is "not insurmountable but gives us something to think about."

Arguably, smaller or more focused firms might be less constrained in this respect, and so more likely to practice short-selling.

A number of interviewees highlighted remuneration problems within firms that undertook both long-only and long-short fund management. For example:

G1; "I've seen hedge fund operations set up within long-only asset management companies, feeding off the same research and taking a perhaps bigger than deserved share of the firm's profits and this has led to dissent."

H1: “I know why we don’t do hedge funds - mainly because of the conflict of the key selling points of hedge funds in the market at the moment (e.g. star manager) with our team process that we sell ourselves on, particularly within our most successful strategies. The people running our teams producing the most alpha at the moment are not keen on hedge funds at all.”
Question: “Is it more to do with conflicts of process or conflicts in personnel to do with remuneration, etc?”
H1: “Without doing any detailed work, conflicts in personnel and pay. A small amount of feasibility work shows conflicts in administration and process as well. e.g., will you be allowed to short sell something that is on your Winners list in the long only funds, etc?”

Not all investment managers felt constrained by institutional problems:

Question: “What about institutional constraints within the way an organisation like this works? Did you find the organisation said yes let’s do it, let’s push for it, or did you find that they were reluctant or did you find issues in the nature of your client base?”
J1: “Good question. I felt that the management here were actually very supportive of it, in fact in some ways they drove it, they said to me ‘would you consider doing this?’ and I almost played Devil’s advocate so perhaps it was the reverse of normal.”

Business Model Problems:

Two former hedge fund managers described how each of their hedge funds failed due to lack of growth and insufficient capital to survive. Growth from a tiny base did not come quickly enough to allow for the survival of their firms on a thin base of capital. Because large companies can suffer from conflicts of interest, unsuitable processes and compensation problems, some aspiring long-short managers set up small

companies as breakaways. Such firms have problems that are typical of small businesses, including high failure rates.

Two small specialist firms each said that they had imposed a business model upon themselves that did not permit short-selling. One of these firms had considered short-selling when designing the business model and investment process, but chose to focus its resources on long-only investing. The other firm had held discussions with investment banks about business opportunities involving short-selling, but rejected them. Thus, both firms do not short-sell because of self-imposed business model constraints.

Shortage of Short-Selling Ideas

Within a fund management company, there is the need to determine which securities are attractive or unattractive (investment analysis) and to create and manage a portfolio of securities (portfolio management). The two roles are combined in some firms, separated in others.

Sell-side analysts/ stockbrokers (often employed within the brokerage divisions of banks and investment banks) liaise with investment analysts and portfolio managers at fund management companies, seeking to win business in the form of commissions on trades. As such, brokerage firms employ investment analysts to identify 'buys', 'sells' or 'holds' and to generate ideas that prompt trading. These ideas and recommendations are communicated via electronic, telephonic or paper media to analysts and portfolio managers at fund management companies. Analysts working for brokerage firms are generally referred to as 'sell-side analysts' (as they are seeking business); whereas analysts at fund management firms are generally referred to as 'buy-side analysts'.

Barber *et al.* (2006) highlight the low proportion of 'sell' recommendations relative to other types of recommendation amongst sell-side analysts. One suspicion is that

conflicts of interest within integrated investment banks could prevent sell-side analysts from announcing sell recommendations on unattractive firms. This is so as not to offend a potential corporate client (i.e. a firm that might wish to use the investment bank for, say, a secondary offering, capital restructuring or acquisition). An alternative notion is that a buy recommendation might catalyse action from any of the broker's clients, whereas a sell recommendation would only catalyse action amongst those who already owned the stock, or those who were able to short-sell. A third explanation (Chasan, 2007) is that sell-side analysts fear lawsuits and other forms of pressure from companies that are the subject of negative research reports. Whatever the true reason for this bias, Hong and Kubik (2003) show that sell-side analysts with positive biases to their investment recommendations achieve greater career success. Regulatory reforms during 2002 (specifically, the issuance of NASD 2711 and SEC Rule 472) require, amongst other things, the proportion of an issuing firm's recommendations that are buys, holds and sells to be made public, and for sell-side analysts to sign-off on the integrity of their recommendations. Table 4.2 below shows the proportion of UK stock recommendations that were 'buys', 'holds' and 'sells' at six leading investment banks as of 31/12/2007.

Table 4.2 Distribution of 'Sell-Side' Stock Recommendations as of 31/12/2007

Name of Firm	Number of Securities Analysed	Percentage of recommendations that are 'buys'	Percentage of recommendations that are 'holds'	Percentage of recommendations that are 'sells'
Morgan Stanley	2,345	43	42	15
Goldman Sachs	2,994	29	58	13
Merrill Lynch	3,706	46	45	9
Dresdner Kleinwort	625	61	26	12
Citigroup	3,421	50	37	12
Cazenove	720	51	35	14

Source: Author, based on published documents from each of the investment banks.

From Table 4.2, it is clear that sell recommendations remain scarce in comparison to 'buys' and 'holds'. The notion that a lack of short-sale ideas could impedes short-selling emerged in one discussion, where the interviewee remarked that some of his colleagues, responsible for 'market-neutral' funds, were in fact 'net-long'. They had cited a shortage of 'sell-ideas' as their rationale. This might merely have been an excuse to allow for speculation on a rising market trend, or might have been a valid problem for the 'market neutral' managers – it is difficult to prove either way. I sensed a note of scepticism in the interviewee's voice, suggesting that he felt it was a 'story' to excuse speculation on a rising market trend. Nevertheless, it raises the possibility that conflicts of interest within integrated investment banks, combined with the dominance of such banks in sell-side analysis, lead to a scarcity of 'sell' ideas. To compensate for this, greater buy-side research would be required and this imposes a cost on short-selling, making it relatively less attractive.

There have been a number of studies into information flows in the investment community. For example, Hong *et al.* (2003) examine 'word-of-mouth' effects in mutual fund management; and Hardie and MacKenzie (2007) study a hedge fund from an anthropological perspective. Both studies highlight the importance of communication between different parties in identifying investment ideas. As Scotland has a limited community of long-short or hedge fund managers, this suggests less word-of-mouth activity, and thus provides a barrier to further growth: stock research costs are higher as a consequence of less idea-generation. Hedge funds appear to cluster in certain parts of the world (Greenwich, CT, USA, London's West End, Zurich, Geneva etc.) and several interviewees referred to these clusters as 'communities' of long-short managers. In so far as information is shared amongst community members, short-sale stock ideas are more plentiful and research costs are likely to be lower in these clusters.

High Management Fees:

The majority of interviewees believed that the hedge fund industry as a whole does not justify its management fee levels. However, they also believed that some managers within the universe of hedge funds do justify their fees, based on strong ex-post performance. One consultant argued that he finds it difficult to recommend hedge funds to his clients, because of high fees:

E1: "The perception has been that fees have been an issue, but we're reaching the conclusion that maybe fees are not such a big issue compared to long-only managers for the alpha being generated."

Whereas some argued that high fees deter investors from using hedge funds (i.e. high fees curtail the demand for long-short management), others suggested that high fees attract a growing supply of long-short managers:

Question: “What reasons do you believe lie behind the growth in short-selling over the past, say, five or ten years?”
C1: “Because people see there’s a buck to be made. And people are always trying to make a buck, that’s life...” This argument was also proposed by an experienced long-short manager (Q1) and these sentiments are echoed by a number of renowned practitioners including Warren Buffett, who is reported to have described hedge funds as a “compensation scheme dressed up as an industry”[9].

4.7 Discussion and Analysis

Many of the arguments as to why short selling is uncommon put forward by the interviewees fit into themes. In accordance with Nagel (2005), I initially group these into ‘direct’ and ‘indirect’ constraints. I categorize five types of short-sale constraint as direct constraints: these are ‘legal’, ‘tax’, ‘cost of borrowing stock’, ‘availability of stock loans’ and ‘operational cost and complexity’. All others I categorize as indirect constraints. I further group indirect constraints into a series of themes, entitled ‘risk’, ‘distribution of returns’, ‘social’, ‘personal’ and ‘institutional’. As an illustration, synchronization risk, recall risk and a fear of manipulative short squeezes can all be considered as ‘risk’ barriers to short-selling – each is related to an increase in some form of risk (for example, the risk of suffering losses) that might arise if short-selling were to be introduced into a traditional long-only portfolio.

Amongst the various constraints, some help to explain why a client might be loathe to fund short-selling, others help to explain the reluctance of (some) investment managers to practice short-selling. In general, direct constraints, such as cost of borrowing stock and tax problems, were well-understood by interviewees. A number of indirect constraints, such as the potential for unlimited losses or the loss of income, were also well-understood. Others, though, appear to be more subtle and ambiguous - in particular, the social constraints on short-selling.

[9] Source: The Daily Telegraph, 14th November, 2008.

The results of these interviews also reveal the opinions of a set of market practitioners on some of the theories and suggestions on indirect constraints described in the literature. For example, the theoretical work of Abreu and Brunnermeier (2002) on synchronization risk; and Shleifer & Vishny (1997) on performance-based arbitrage risk, met with universal acceptance. Interviewees described how long-short managers have devised practical means of mitigating both these types of risks. D'Avolio (2002) suggests that a fear of tracking error amongst money managers could serve to explain the short-sale reluctance puzzle. This notion was not met with strong acceptance amongst the interviewees in this study. It is possible that the results of my interviews are 'location specific' or 'group specific'. However, this alone reveals that D'Avolio's suggestion is not universally generalizable – an important finding. One interviewee re-interpreted D'Avolio's argument and suggested that it is the setting of tracking error limits by risk managers or clients that has been a barrier to short-selling, rather than investment managers' fear of tracking error.

Market practitioners with different functional roles believe that different factors hinder short-selling. As an illustration, one investment consultant (E1) who advises pension funds on investment strategy, argued that his firm had "been reasonably sceptical of hedge funds; a) because of transparency issues and being able to know what's going on inside, and; b) fees – they've taken a view that fees seem very high relative to what they are trying to generate." He further argued that this had not been a client-led view, but instead was one that had been generated inside the firm and then communicated to advisory clients. By contrast, an investment risk consultant (D1) whose clients are money managers, argued quite differently: "I think the things that stop them are : 1) they don't want to be seen as speculators, but as investors,...and 2) they don't necessarily have the expertise to do it". This suggests that different factors create barriers for different market participants with respect to short-selling.

A number of interviewees (e.g. B1, H1, M1) argued that although direct constraints help to explain the uncommonness of short-selling, it is some combination of indirect

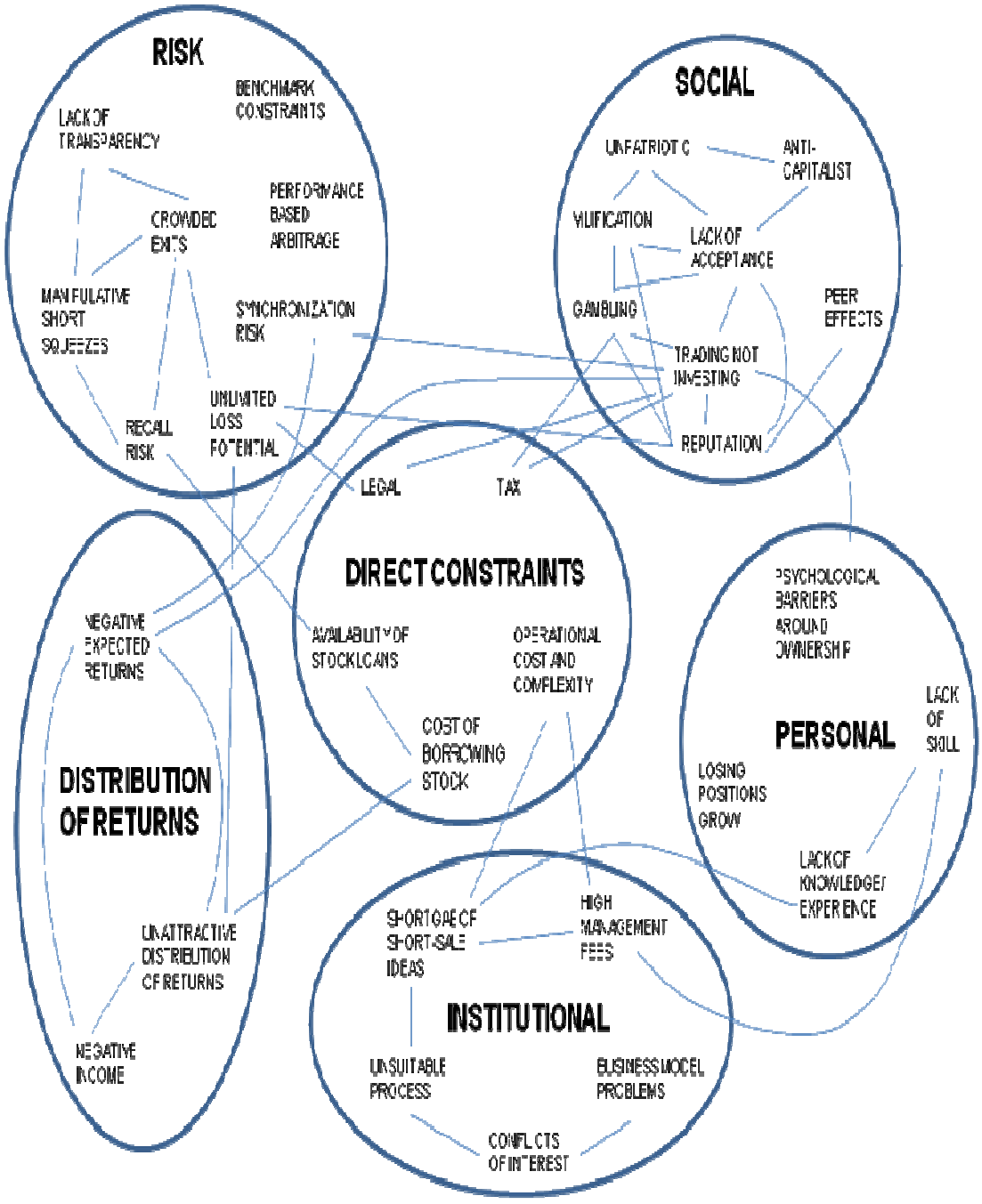
short-sale constraints that best explains why their own firms do not practice short-selling. This confirms the importance of *indirect* short-selling constraints in understanding the short-sale reluctance puzzle.

For many firms, there is no single indirect constraint to explain their reluctance to short-sell, but instead a series of constraints. A comment from the Head of Risk at a long-only investment firm (B1) highlights the multi-faceted nature of indirect short-sale constraints from the perspective of each organization: "there are certain things associated with hedge funds: high turnover, speculation, star fund managers, high fees and a question mark about integrity. All of those things go against some of the founding principles of the firm and what people do believe in." He thus referred to a series of constraints: 'speculation not investing', 'institutional constraints', 'high fees', 'reputational risk' and 'stakeholder acceptance' – rather than just one constraint - in explaining why his firm was not involved in short-selling.

My interviews also reveal the inter-relatedness of various constraints on short-selling. For example (B1): "short-selling is associated with high turnover, event driven, investment speculation if you like. That is a specific type of investment trading really. I don't see why it has to be associated with that, maybe it's because of the cost, if you have the view that fundamentally something is over-valued, you don't know when it's going to come down, maybe 3 years, maybe 5 years...or other negative costs." – he thus argued that the 'trading not investing' problem is linked to 'direct costs', 'synchronization risk' and 'negative expected returns' – three different types of barrier. As a further example, the notion that large pension funds should not invest in funds that short-sell is related to lack of transparency around short-selling (a risk related constraint), but also to the institutional framework that surrounds pension funds and the role and incentives of trustees (an institutional constraint). Furthermore, this framework also creates a culture of 'unacceptability' around short-selling and pension funds - it becomes socially or culturally unacceptable for 'prudent' market participants to become involved in short-selling. It becomes clear from this example that social, institutional and risk-related constraints are not separate from one another, but are indeed inter-related.

To understand better the relationships that exist between the various explanations and reasons proposed by interviewees, I create a 'map' of the explanations given by interviewees (Figure 4.1):

Figure 4.1. Constraints on Short Selling



I have placed ‘direct’ short-selling constraints in the centre of Figure 4.1. I have grouped indirect constraints into the five themes entitled ‘risk’, ‘distribution of returns’, ‘social’, ‘personal’ and ‘institutional’. Where there exists a clear connection or association between two constraints on short-selling, I have joined these with a line. Some of these connections exist between two constraints within one theme (e.g. the social constraint entitled ‘lack of acceptance’ is connected to the social constraint ‘trading not investing’). Other connections span two themes (e.g. the direct constraint entitled ‘legal’ is connected to the risk-related indirect constraint named ‘unlimited loss potential’, as legal prohibitions on short-selling are sometimes the result of the potential for unlimited losses that short-selling introduces.). A closer examination of the diagram reveals that some constraints on short-selling appear to be more ‘connected’ than others. The two most connected short-sale constraints are both social in nature. These are ‘trading not investing’ and ‘lack of acceptance’. It is also possible to observe a series of connections that form a complex around the risk-related constraints: ‘recall risk, ‘manipulative short squeezes, ‘crowded exits’, ‘lack of transparency’ and ‘unlimited loss potential’. There are also connections between ‘lack of skill’, shortage of ‘short-sale ideas’, ‘operational costs’ and ‘high management fees’. Finally, there are connections between ‘unattractive distribution of returns’, ‘unlimited losses’ ‘reputational risk’, ‘negative expected returns’ and ‘negative income’.

Interviewees made only limited references to academic work on short-selling. MacKenzie (2006) and Bernstein (2007) consider the impact of academic theory and thinking on financial markets. Each notes that it can take many years for academic thinking to permeate market practice and to become widely accepted. Short-selling and arbitrage play a central role in several neo-classical finance theories, including Arbitrage Pricing Theory and the Black-Scholes-Merton option pricing model, both of which are over 30 years old. The more recent work of Clarke *et al.* (2002, 2004, 2008) demonstrates that actively-managed portfolios can be made more ‘informationally efficient’ by permitting the limited use of short-selling, Such

research assists in building an academic ‘framework’ in which to place short-selling, thus making the practice more ‘acceptable’ to practitioners. Nevertheless, short-selling comprises only a small proportion of most current postgraduate textbooks on finance and investment. Even some apparently well-educated and experienced investment managers admitted to me in interviews that they had poor knowledge of short-selling.

A key finding from this research relates to the description of two ‘social’ short-selling constraints. First, I describe a distinction between ‘investing’ and ‘trading’. There are two facets to this argument. One is that long-only investing differs from short-selling in terms of rights and responsibilities. Effectively, there is a legal distinction between the two activities. Long-only holders of shares are *owners* of part of the business, and have the right (and arguably, the responsibility) to vote on certain routine and extraordinary corporate matters. There is thus a relationship between ‘investing’ and ‘ownership’. The other facet to this argument concerns time horizon – investment is associated with longer-term time horizons. Speculators or traders are associated with shorter-term time horizons, because of phenomena such as negative expected returns and synchronization risk. This difference between the two activities is somewhat blurred, in the sense that long-only holders can have short holding periods for ‘investments’ and short-sellers can also have long-term short positions. Indeed this ‘greyness’ in how to define long and short-term was highlighted by some interviewees. To the best of my knowledge, this ‘trading not investing’ barrier to short-selling is new to the literature on indirect short-selling constraints.

Secondly, there has developed a social perception or general belief that short-selling is less socially ‘acceptable’ and less productive than long-only investing. Only a few interviewees counter-balance this perception with the potential benefits to market efficiency arising from risk arbitrage activities. In fact, one highly experienced fund manager (C1) argued that “short-selling is essentially parasitical.” This lack of acceptance amongst stakeholders is partly related to the ‘trading not investing’ barrier discussed earlier, but is also related to an understanding amongst

stakeholders, such as trustees and consultants, of the unique risks in short-selling (including, for example, unlimited loss potential). It is further related to knowledge of historical market abuses involving short-selling, leading to an air of suspicion and unacceptability around short-selling. Short-selling becomes marginalized, despite its academic credentials. However, interviewees argued that the lack of stakeholder acceptance for short-selling had been diminishing in importance, lessening an important indirect constraint. This is consistent with increased short-selling over several years.

Dechow *et al.* (2001) suggest two possible explanations for the gradual growth in short-selling over the previous thirty years: deregulation and the growth of the hedge fund industry. I investigated this question through my interviews. Interviewees cited a series of possible explanations for the growth in short-selling in recent years, including the attraction of high fees for managers of long-short funds, increasing acceptance by clients and investment consultants, deregulation, improved technology and systems, greater availability of derivative instruments that can be used to implement short-positions, improving knowledge of short-selling and more developed (i.e. more marketable) track records. Some of these possible explanations relate to reduced direct constraints (e.g. deregulation), others to reduced indirect constraints (e.g. reduction in the 'lack of acceptance' and 'lack of knowledge' barriers). As an example of the impact of deregulation, one long-only investment manager comments:

G1: " The UCITS III legislation will prove quite a powerful force in providing more tools in the tool kit for running funds and this may change the way firms like ours look at short-selling."

The 'attraction of high fees' is a business-driven, supply-side arguments for the growth in short-selling – high fees are also regarded by some as a *barrier* to short-selling. The development of more marketable track records could be regarded as a supply side argument, or could alternatively be perceived as evidence of some investment managers' knowledge, experience and skill in short-selling (and thus the

diminishment of two indirect short-sale constraints – 'lack of knowledge' and 'lack of skill'). The ability of short-selling to generate positive returns in falling markets is seen by some (I1, U1) as an attractive feature both for clients wishing to manage risk, and for businesses seeking to diversify their revenue streams and offset declining fees at certain stages of the market cycle.

4.8 Conclusions

There exist many constraints on short-selling. In this study, I categorize five direct constraints and twenty-eight indirect constraints. The indirect constraints can be grouped into five broad themes: risk, distribution of returns, institutional constraints, social constraints and personal constraints. There are links between these different themes. There are also connections between constraints that fall within the same themes and relationships between some direct constraints and indirect constraints.

I find that market practitioners with different functional roles believe that different factors account for the short-sale reluctance puzzle. Indirect constraints are sometimes more important than direct constraints in explaining why some firms that invest or advise on investment are reluctant to practice short-selling.

Diether *et al.* (2008) suggest that it could be considered 'un-American' to short-sell. If this is a reference to patriotism, I find that this cannot be generalized globally. Patriotic reasons are firmly rejected by all interviewees. In so far as it suggests that it is 'anti-capitalist' to short-sell, there is only limited evidence to back up this notion. There is also limited evidence at best to support D'Avolio's (2002) notion that 'fear of tracking error' is a key constraint to short-selling. Arguably, it is the setting of tracking error limits by risk managers or clients that has been a barrier to short-selling, rather than investment managers' fear of tracking error. The results from these interviews could be 'location specific' or 'group specific'. However, these results reveal at the very least that some suggestions made in the literature cannot be generalized globally – an important finding.

I identify two key social indirect constraints on short-selling: the 'trading not investing' constraint and the 'lack of stakeholder acceptance' constraint. Several interviewees argued that the latter had been diminishing and believed that this had contributed to the growth of short-selling in recent years. The distinction between investing and trading is an important finding from this research. There are two facets to this argument. First, there is a legal distinction between the two activities: investing confers ownership and voting rights and responsibilities; short-selling does neither. The second distinction concerns time horizon – investors are perceived to have long-term time horizons in the main, but speculators or traders are perceived to have shorter-term time horizons. Social and institutional constraints are rational in light of the specific roles and responsibilities that exist within the investment industry. For example, trust law requires trustees to invest in a 'prudent' manner. Investment consultants are hired to advise trustees amongst others. The social constraints of 'lack of acceptance' and 'trading not investing' are, in a sense, the collective wisdom of market participants built up over many years. This collective wisdom serves to guide or warn responsible members of society on how to behave (or how not to behave) in investment matters. In any legal dispute over prudent behaviour, the trustee who has observed social constraints is on safer ground. Personal constraints, such as 'lack of knowledge', however, lack this rationality. Academics have a role to play in solving this problem. I find that the works of Clarke *et al.* (2002, 2004, 2008) have had a profound impact to date on interest in short-selling. The acceptance of the 'short-extension' portfolio structure – one that 'solves' the negative expected return problem by maintaining a 100% net long position, suggests that the 'negative expected return problem' has been a significant barrier to short-selling. Additionally, interviewees highlighted a benchmarking problem, whereby returns from long-short portfolios are sometimes compared to those of traditional long-only portfolios. This indirect short-sale constraint is also solved by the short-extension portfolio structure. The success of the Clarke *et al.* work suggests that there are rewards for those able to design portfolio structures that overcome specific indirect short-sale constraints. Furthermore, such work assists in the gradual convergence of market practice towards the theoretical assumption of a stock market

with many arbitrageurs, constantly trading in such a manner as to drive stock prices towards fair value.

4.9 Further Research

Amongst the many indirect constraints on short-selling described by interviewees, the risk-related constraints remain under-researched and poorly understood. These constraints should lend themselves well to quantitative analysis and are of relevance to analysts, portfolio managers and risk managers involved in short-selling. In particular, two of these constraints: crowded exits and manipulative short squeezes, are related to liquidity problems. Geczy *et al.* (2002) argue that if short-selling problems explain the availability of factor portfolio returns to unskilled managers, then these short selling problems are not borrowing costs, but perhaps liquidity constraints. I contribute to the literature in Chapters 6 and 7 by studying these short-sale constraints from the perspective of liquidity problems and risk.

Whereas the maximum loss that a long-only investor can suffer is 100% of the amount invested, short-sellers are exposed to potentially unlimited losses. This can deter short-selling, according to several of my interviewees. Gamboa-Cavazos and Savor (2007) investigate short-covering and find that short-sellers close their positions in response to rising stock prices. In Chapter 8, I refine their techniques and examine the response of short-sellers to accounting losses.

To undertake this research into liquidity and risk-related indirect short-selling constraints, I create a new dataset by merging a commercial stock lending database from Data Explorers Ltd. with data on returns and other stock characteristics from Datastream. This new dataset comprises daily stock lending and stock return data for up to 681 of the largest companies listed on the London Stock Exchange from September 2003 until May 2007. I describe the dataset in Chapter 5.

5. DATA

5.1 Data Sources

I create a new dataset for the purposes of this thesis by merging data from two sources. The first of these is a commercial database of UK stock lending data from Index Explorers Ltd[10]. This contains daily information on stock lending starting on September 3rd 2003 when the database came into existence. At inception, this database included stocks from the 350 largest companies traded on the London Stock Exchange. The data is sourced from CREST - the organisation responsible for settlement of all trades on the London Stock Exchange. The amount of stock on loan is updated daily, but with a three day reporting lag (before December 12th, 2005 the lag was five days). Over time, the coverage of companies in the database increases through the addition of smaller capitalization stocks so that by the end date for this sample, May 31st 2007, there is stock lending data for 681 companies. The smallest of these companies have market capitalizations of approximately £25 million (approximately USD 40 million) as of 2007. A number of companies cease to exist at some point during the 45 months (979 trading days) studied. This could be as a result of a merger or acquisition, the lapsing of the company into administrative receivership, or a change to private ownership. Such companies are included in the database until the date of their de-listing, to prevent survivor bias. I make use of all stocks in the database and all dates in the sample for which stock lending data is available - public holidays and weekends are naturally excluded.

The Index Explorers database includes the following daily information for each stock:

- Date
- Name of company
- SEDOL (a unique company identifier code)

[10] Index Explorers data has also been used by Saffi and Sigurdsson (2007) and Mackenzie and Hendry (2008).

- Turnover (defined as the number of shares traded that day)
- Stock Price (defined as the previous day's closing stock price)
- Volume (defined as turnover multiplied by stock price)
- Market Capitalisation (defined as number of shares in issue multiplied by stock price)
- Shares on Loan (defined as the number of shares reported to CREST as being on loan[11])
- Volume on Loan (defined as shares on loan multiplied by stock price)
- Percentage of Market Capitalization on Loan (defined as the volume on loan divided by the market capitalization)
- Dividend Record Dates (the dates on which the recorded owners of shares on that day become entitled to receive the next dividend payment)
- Stock Utilisation Rate (the percentage of shares made available for borrowing by stock lenders that are actually borrowed)
- Weighted Mean Stock Lending Fees (the weighted average of the fees paid by stock borrowers to stock lenders on initiation of the stock loan, measured as a proportion of the value of shares borrowed).

I use Datastream to obtain the following data for all for all FTSE All Share Index constituents from September 1st, 2002 to May 31st 2007:

- Date
- Name of company
- SEDOL (a unique company identifier code)
- Daily stock returns (defined as the total return for a stock on that date)
- Book value per share (this value is generally updated annually for each UK company and is reported to the public via financial statements that are published up to six month in arrears. Datastream then 'backfills' the new book value to the end of the last financial year. To account for the possible delay in reporting book value per

[11] Mackenzie and Henry (2008) argue that the use of such industry-wide data removes the problem of substitution effects across lenders that might be present in studies, including D'Avolio (2002), Geczy *et al.*, (2002) and Cohen *et al.* (2007), that are based on a single stock lender.

share, I shift the 'book value per share series' back by six months for each company, thus reflecting what is 'knowable' to market participants at any time)

- Free float percentage of shares (defined as the percentage of the total number of shares in issue that are available to ordinary investors i.e. that are not held away from the market by government or close family interests).

To facilitate the estimation of abnormal stock returns using an asset pricing model, I collect daily stock returns for the year before the start of the Index Explorers database. This 'formation period' runs from September 1st 2002 to September 1st 2003 and the daily stock returns collected are used to estimate the beta of each stock in the study.

Using each company's SEDOL code as a unique identifier to reconcile stocks across the two databases, I merge the two databases, and construct a data set that includes stock return, trading, lending and fundamental information for up to 681 stocks listed on the London Stock Exchange, during the period from 3rd September 2003 to 31st May 2007. Overall, the dataset is an unbalanced panel of data for between 350 and 681 companies covering 979 trading days with 12 data items per firm day, plus a series of transformations such as the natural logarithms of daily stock returns. The dataset was compiled and rearranged in Microsoft Office Excel 2003 for import into Eviews 5.1. For the remainder of the study, EViews 5.1 was used. This new dataset is used to address the research questions posed in this thesis, but is also a key contribution in its own right, and can be made available to future researchers.

5.2 Stock Lending as a Proxy for Short-Selling

Direct data on short-selling is not publicly available in the UK. Instead, stock lending data is available, on a daily basis. Stock lending acts as a proxy for short-selling, as the process of short-selling generally requires stock to be borrowed to facilitate settlement of the trade. MacKenzie and Henry (2008) state that: "The use of securities lending data is a fairly new innovation in the literature and only a handful of papers have had access to this type of data, including D'Avolio (2002), Cohen *et*

al. (2007) and Saffi and Sigurdsson (2007)." However, there are a number of problems with using stock lending data as a proxy for short-selling.

First, shares do not need to be borrowed to undertake 'naked' short-selling (see Section 2.3). Naked short-selling for periods of one day or longer is unlikely to be common, however, as it involves failed settlement. 'Repeat offenders' would soon become known to the brokers for such trades, who would cease dealing with them. So (1998) reports that the Hong Kong Stock Exchange conducted 768 investigations and made 15 prosecutions in 1997 for breach of short-selling rules that included a prohibition of 'naked' short-selling. Intra-day short-selling, though, does not require the delivery of stock for settlement at the end of the day, and so would not be revealed by daily stock lending data. Jones (2004) finds that intra-day shorting represents about 5% of daily volume in the early 1930s.

Secondly, stock lending occurs for a number of reasons other than short-selling. In general, borrowing shares results in the temporary receipt of legal ownership of the securities and so the borrower is entitled to dividends, voting rights and so forth. Strategies exist to benefit from these arrangements. These include dividend tax arbitrage and vote-buying (see Sections 2.2.3 and 2.2.4). As an illustration, if the 'borrower' has a tax advantage over the 'lender', dividend tax arbitrage is feasible. Christoffersen et al. (2002, 2005) demonstrate increases in securities lending around dividend record dates. With regard to the exercise of the voting rights by the borrower, while being illegal in the US, it is merely regarded as unethical in the UK. Stock lenders are recommended to recall their shares, prior to record dates for voting (see Myners, 2005). As a result of these various practices, the dataset can become obfuscated. Christophe *et al.* (2005) discuss the problem of obfuscation in short-interest data arising from the aggregation of short positions from market participants with differing motivations (e.g. market makers, option-market arbitrageurs, traders expecting stock price declines). They provide evidence that some of the component parts that are aggregated in short interest data are negatively correlated with one another. With stock lending data, an even greater number of motivations can exist, including financing purposes and borrowing to exercise voting rights. One of the

crucial issues for this study concerns the time around the dividend dates, since dividend tax arbitrage is common (see Section 2.2.4) and may obfuscate the data. To minimize the risk that stock lending for dividend tax arbitrage is confounded with borrowing to facilitate short-selling, I remove data from three weeks before until three weeks after the dividend record date for each stock in this study of stock lending data. This is consistent with the method employed by Saffi & Sigurdsson (2007). In studies that use stock lending data, but that do not adjust for dividend tax arbitrage (e.g. Au *et al.*, 2007), results have not been fully consistent with those found in the core literature.

Thirdly, the extent to which market practitioners fail to fulfil their obligations to report stock lending to the market authorities is a further limitation on the use of stock lending data as a proxy for short-selling. Discussions with practitioners involved in stock lending suggest that this problem is rare, but unavoidable.

Finally, derivatives can be used to effect transactions that are economically equivalent to short-selling (see, for example, Ofek *et al.*, 2004). The extent to which the use of derivatives to facilitate short-selling is transmitted into the stock lending market influences the usefulness of stock lending data as a proxy for short-selling. Discussions with stock-lending practitioners suggests that the majority, but not all, short-sale-equivalent trades using derivatives are ultimately hedged by the counter-parties to those trades, through borrowing stock and selling short.

5.3 Advantages and Limitations of the Dataset

A number of studies into short-selling make use of monthly data (e.g. Senchack and Starks, 1993, Dechow *et al.*, 2001, and Gamboa-Cavazos and Savor, 2007). Christophe *et al.* (2007) criticise the use of monthly short-selling data, as it "represents only a snap-shot of total shorted shares on one day during the month." Cohen *et al.* (2007) find that almost half the securities lending contracts they study are closed out within two weeks, while the median contract length is 11 days. This

suggests that monthly data could be inadequate for understanding the trading practices of short-sellers. The dataset used for this study incorporates daily data on shares borrowed (a proxy for shares shorted). This higher frequency data allows for an appropriate degree of granularity for the proposed study of manipulative short squeezes, crowded exits and the use of stop losses.

Some studies obtain trade-by-trade (or 'flow') data on stock lending or short-selling. These same studies tend to investigate shorter time periods. There is a balance to be had, though: although flow data provides the highest degree of granularity, it would be arduous to study flow data for long periods of time. However, studies over longer periods could reveal trends and cycles not found in shorter periods. Christophe *et al.* (2007) take flow data for a ten month period and aggregate it into daily data. Similarly, Diether *et al.* (2008) obtain tick by tick short-sale data for over 3,800 stocks during 2005 and aggregate it for each stock to the daily level.

Due to differences in regulatory and institutional frameworks, evidence from studies of US data are not necessarily representative of behaviour outside the US markets. For example, in the United Kingdom, the Financial Services Authority does not ordinarily impose specific restrictions or controls on short-selling, unlike in the USA (see Section 2.3). Instead, short-sellers are subject to general market and regulatory arrangements, including market abuse principles. Furthermore, studying data from outside the USA can be used to counter the criticism that observed regularities in empirical studies are simply due to data mining. A limited number of studies investigate short-selling and its impact on stock prices outside the USA (e.g. Aitken *et al.*, 1998, Biais *et al.*, 1999, Poitras, 2002, Ackert and Athanassakos, 2005, and Au *et al.*, 2007). However, these studies do not involve an investigation of the indirect short-sale constraints that I propose to study in this thesis.

Geczy *et al.* (2002) examines shares available for borrowing (and thus available for shorting), based on a single lender of stock for a twelve month period. D'Avolio (2002) examines an eighteen month period of data from one stock lender. This thesis draws on a longer time period than either Geczy *et al.* or D'Avolio, and uses market-

wide data on stock lending, rather than just data from a single lender. As such, it makes a contribution to the empirical literature.

By observing the differences in returns between equally-weighted and value-weighted portfolios, Asquith *et al.* (2005) demonstrate that the level of short-selling is more informative as a negative sentiment indicator for smaller capitalization stocks than for larger stocks. Au *et al.* (2007) suggest that a study based on larger capitalization stocks will produce more conservative estimates for the relationship between short-selling and stock returns compared to a study that includes smaller, less liquid stocks. The smallest stocks in my dataset have a market capitalization of approximately £25 million. Thus, 'micro-cap' stocks are not included in my dataset, suggesting a degree of conservatism in any findings.

5.4 Descriptive Statistics

The dataset forms an 'unbalanced panel' dataset in which some cross-sectional units have some of the time periods missing. This form of panel is a result of the number of companies recorded in the Index Explorers database growing over time as smaller capitalization stocks are added. The resulting dataset contains 10,259,946 observations in the overall sample; 6,542,712 of which are non-blank, and represents an EViews file of approximately 400 Mb.

In Table 5.1, descriptive statistics are produced for three points in time: the first day of the sample time period for which all the variables existed (01/09/2003), the last day of the sample time period (31/05/2007) and the mid-point (15/07/2005). The mean percentage of market capitalization on loan is a low figure for each of the snapshot dates (less than 3.5%), but the distribution is positively skewed. From the Jarque-Bera probabilities, it can be seen that the first five variables are not Normally-distributed.

Table 5.1: Descriptive Statistics for the Raw Dataset

Descriptive statistics are provided for three points in time: the first day of the sample time period (01/09/2003), the mid-point (15/07/2005) of the sample time period and the final day of the sample time period (31/05/2007). The descriptive statistics are parameters that measure central tendency, dispersion, minimum/maximum values, number of observations, skewness, kurtosis and Jarque-Bera statistics for stock price, market capitalization, percentage of market capitalization on loan, shares on loan, book value per share* and free float number of shares (%).

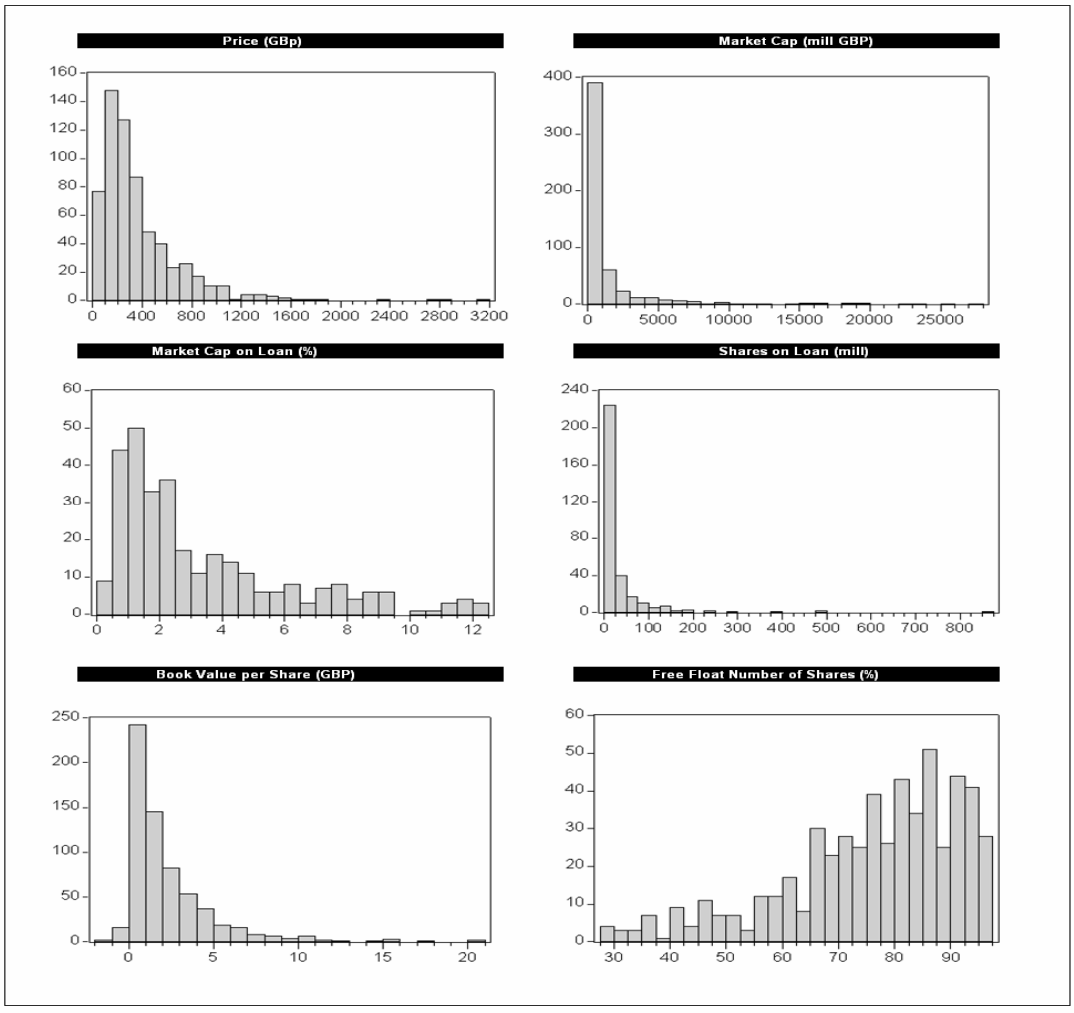
		Price (GBp)	*Market Cap (mill GBP)*	*Market Cap on Loan (%)*	*Shares on Loan (mill)*	*Book Value per Share (GBP)*	*Free float number of shares (%)*
01/09/2003	*Mean*	348.9678	2190.933	2.426836	28.13055	1.523835	56.71614
	Median	217.75	311	1.62	5.5	1.1105	57
	Maximum	20500	95755	15.63	1078.8	186.318	100
	Minimum	2.35	47	0.15	0.1	-422.447	9
	Std. Dev.	985.9779	8613.22	2.50429	79.08176	18.8214	17.15801
	Skewness	16.55132	8.035531	2.482568	9.250658	-16.40918	-0.182926
	Kurtosis	317.4105	75.15189	10.31674	116.0577	421.1521	2.843907
	Jarque-Bera	2440439	112015.6	895.895	150383.2	4662099	3.757554
	Probability	0.00	0.00	0.00	0.00	0.00	0.152777
	Observations	586	492	275	275	636	570
15/07/2005	*Mean*	423.317	2503.904	3.48463	32.44019	2.511012	78.57348
	Median	266	381	2.35	8.5	1.261	82
	Maximum	23650	130630	19.32	866.1	221.26	100
	Minimum	5.85	51	0.32	0.2	-76.755	11
	Std. Dev.	1030.296	9924.584	3.137033	75.87327	10.13917	17.03667
	Skewness	18.55561	8.7192	1.647085	6.389255	15.77574	-0.921704
	Kurtosis	409.2458	91.73508	5.882677	57.78028	348.8487	3.510788
	Jarque-Bera	4416875	184346	248.2996	41002.37	3256384	95.44044
	Probability	0.00	0.00	0.00	0.00	0.00	0.00
	Observations	637	541	311	311	648	626
31/05/2007	*Mean*	610.4427	3034.235	3.037874	25.2274	3.314581	74.67109
	Median	399	463	1.78	3.00	1.467	77
	Maximum	26725.01	109377	29.33	3793.2	264.7	100
	Minimum	5.85	20	0.01	0.00	-2.855	18
	Std. Dev.	1203.783	10065.52	3.60918	154.0299	13.12218	17.355
	Skewness	15.83103	6.728114	2.623158	22.11777	17.33452	-0.648486
	Kurtosis	330.5056	57.06653	12.92178	538.0428	337.5389	2.958836
	Jarque-Bera	3071946	82650.91	3506.041	8022336	2229372	47.56819
	Probability	0.00	0.00	0.00	0.00	0.00	0.00
	Observations	681	639	668	668	473	678

** For the BV variable the snapshots presented are for the BV shifted.*

Histograms for each of six variables are presented in Table 5.2 below. For the purpose of visualization the histograms are constructed using the mid-point snapshots. In order to improve granularity of the histograms, any outliers further than three standard deviations from the mean are removed (this is done only for illustrative purposes with these histograms and does not affect the rest of the study).

Table 5.2: Histograms for the raw dataset

Histograms for six variables (stock price, market capitalization, percentage of market capitalization on loan, shares on loan, book value per share and free float number of shares (%)) are constructed. For the purpose of visualization the histograms are produced using the mid-date snapshot (15th July, 2005). In order to improve the granularity of the histograms, outliers of greater than three standard deviations from the mean are removed (this is done for the illustrative purposes only).



Tables 5.3 and 5.4 present descriptive statistics for the logarithms of the six variables considered earlier.

Table 5.3: Descriptive Statistics for the logarithmic dataset

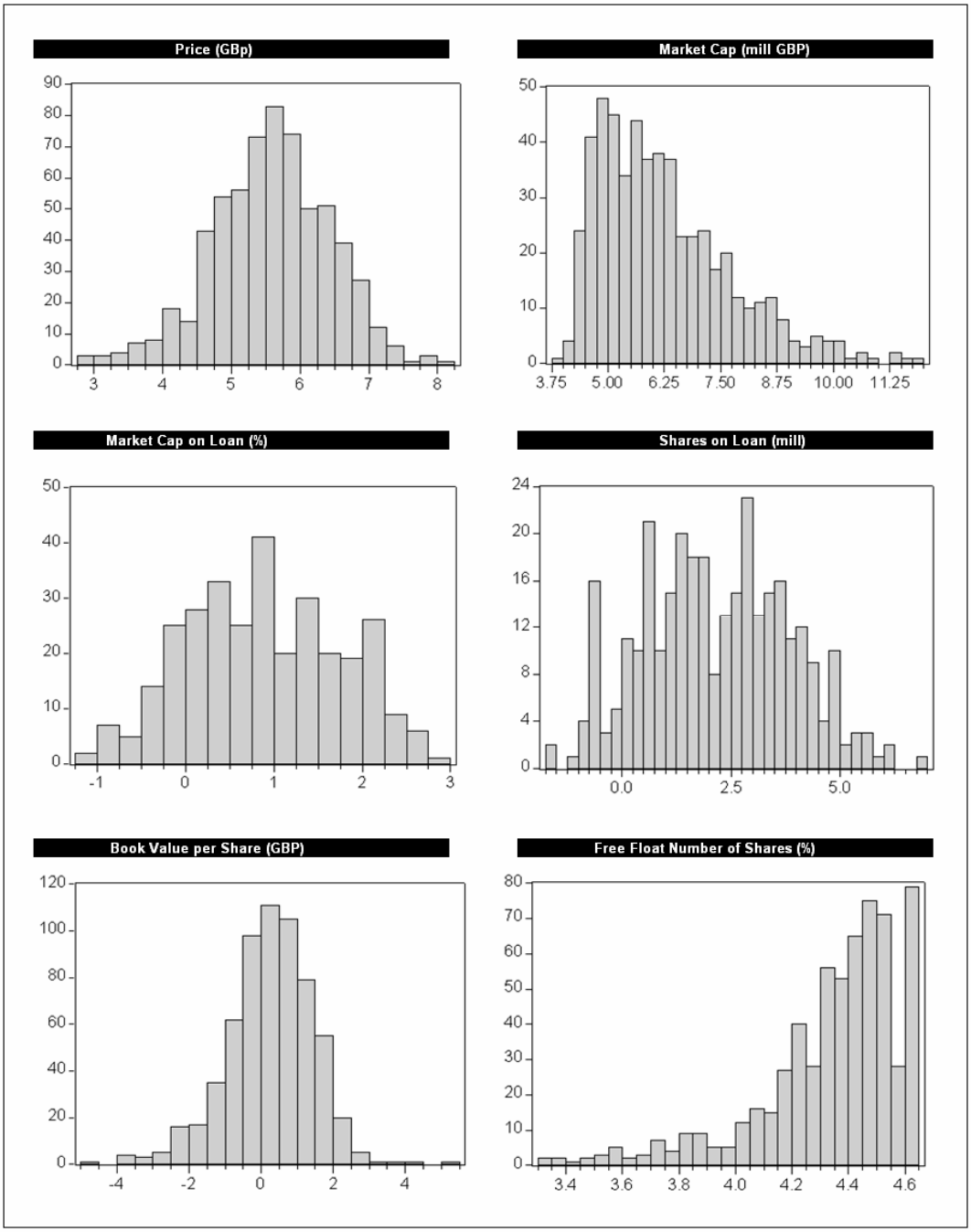
Descriptive statistics are provided for three points in time: the first day of the sample time period (01/09/2003), the mid-point (15/07/2005) of the sample time period and the final day of the sample time period (31/05/2007). The descriptive statistics are parameters that measure central tendency, dispersion, minimum/maximum values, number of observations, skewness, kurtosis and Jarque-Bera statistics for six variables: stock price, market capitalization, percentage of market capitalization on loan, shares on loan, book value per share* and free float number of shares (%).

		Price (GBp)	Market Cap (mill GBP)	Market Cap on Loan (%)	Shares on Loan (mill)	Book Value per Share (GBP)	Free float number of shares (%)
01/09/2003	Mean	5.316258	6.046764	0.487787	1.834715	0.058888	3.981826
	Median	5.383342	5.739793	0.482426	1.704748	0.188966	4.043051
	Maximum	9.92818	11.46955	2.749192	6.983604	5.227455	4.60517
	Minimum	0.854415	3.850147	-1.89712	-2.302585	-5.521461	2.197225
	Std. Dev.	0.968889	1.50577	0.894732	1.773594	1.258237	0.359823
	Skewness	-0.272131	0.993897	0.055387	0.180727	-0.629466	-1.253193
	Kurtosis	5.221265	3.76551	2.824535	2.377743	5.023834	5.077885
	Jarque-Bera	127.7051	93.01533	0.493385	5.93E+00	142.2571	251.7399
	Probability	0.00	0.00	0.78	0.05	0.00	0.00
	Observations	586	492	275	275	601	570
15/07/2005	Mean	5.567265	6.24073	0.880144	2.194331	0.252293	4.333748
	Median	5.583496	5.9428	0.854415	2.140066	0.293037	4.406719
	Maximum	10.07112	11.78012	2.961141	6.764	5.399338	4.60517
	Minimum	1.766442	3.931826	-1.139434	-1.609438	-4.710531	2.397895
	Std. Dev.	0.930843	1.460353	0.873153	1.655141	1.204421	0.266321
	Skewness	-0.215372	1.047292	0.055395	0.071518	-0.387375	-1.963846
	Kurtosis	4.853598	3.923735	2.261525	2.446984	4.299419	9.156942
	Jarque-Bera	96.11709	118.1313	7.225814	4.23E+00	59.12548	1391.147
	Probability	0.00	0.00	0.03	0.12	0.00	0.00
	Observations	637	541	311	311	620	626
31/05/2007	Mean	5.899454	6.474853	0.415943	1.239666	0.420813	4.279769
	Median	5.988961	6.137727	0.576613	1.193923	0.439221	4.343805
	Maximum	10.19336	11.60256	3.378611	8.240965	5.578597	4.60517
	Minimum	1.766442	2.995732	-4.60517	-2.302585	-3.963316	2.890372
	Std. Dev.	1.01162	1.495919	1.345159	2.045757	1.20275	0.275389
	Skewness	-0.276713	0.932306	-0.619932	0.144035	-0.147303	-1.485895
	Kurtosis	4.001597	3.59038	3.190487	2.387284	4.254811	5.865685
	Jarque-Bera	37.15639	101.8494	43.7971	1.22E+01	31.15017	481.4841
	Probability	0.00	0.00	0.00	0.00	0.00	0.00
	Observations	681	639	668	638	450	678

** For the BV variable the snapshots presented are for the BV shifted.*

Table 5.4: Histograms for the Logarithmic Dataset

Histograms for six variables (stock price, market capitalization, percentage of market capitalization on loan, shares on loan, book value per share and free float number of shares (%)) are constructed. For the purpose of visualization the histograms are produced using the mid-date snapshot (15th July, 2005). In order to improve the granularity of the histograms, outliers of greater than three standard deviations from the mean are removed (this is done for the illustrative purposes only).



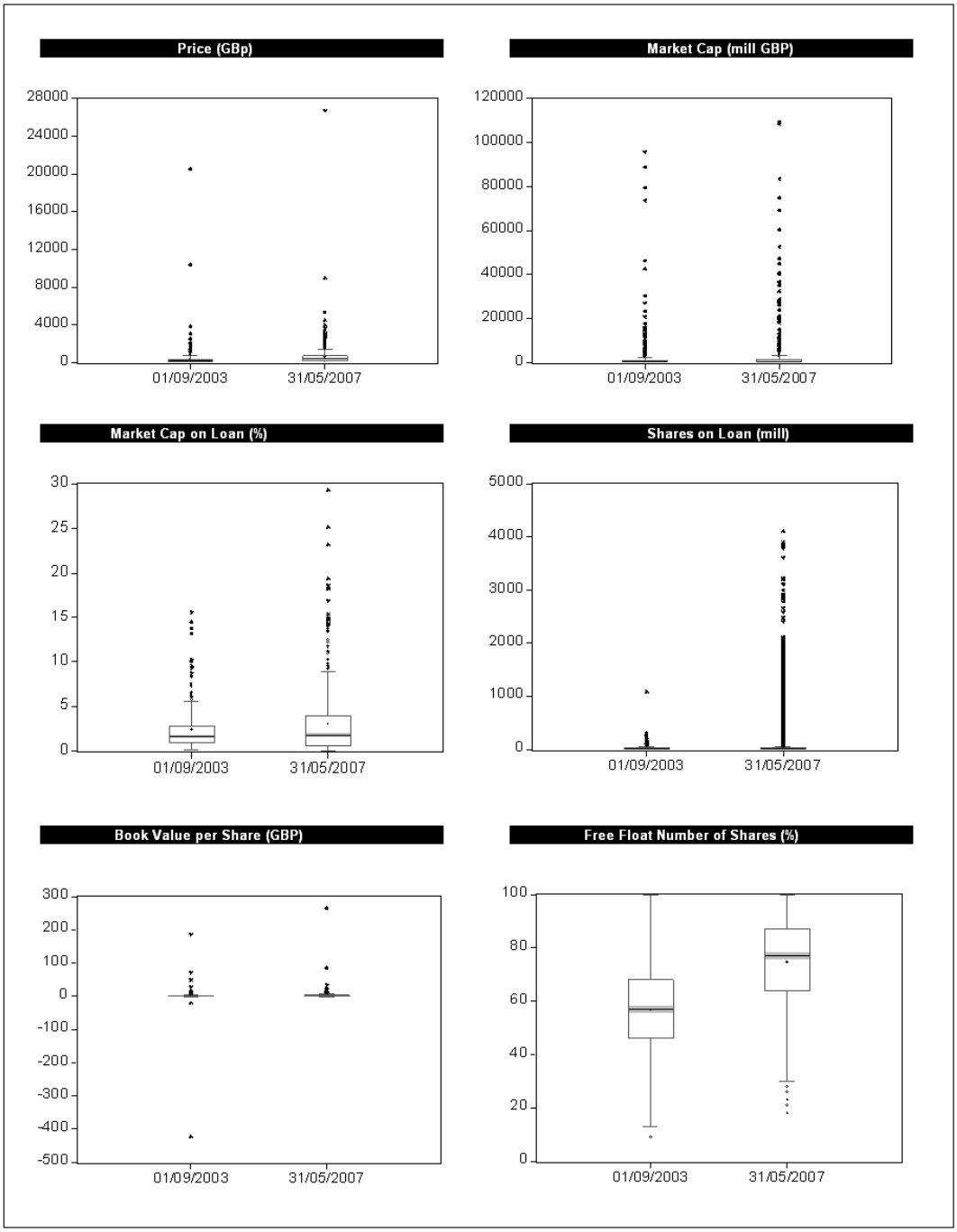
An analysis of the time series of percentage of market capitalization on loan series for each stock shows that this can be a highly volatile series. Dividend-paying stocks often experience large increases in shares on loan around divided record dates, indicating a dividend capture effect that is consistent with dividend tax arbitrage. Nevertheless, some cross-sections experience a consistently high level through the observed period. During some dates in the sample the maximum value for this series exceeds 100% for some companies, signifying that borrowed shares have been re-lent.

5.5 Outliers

For the first and last snap-shot dates (01/09/2003 and 31/05/2007), I construct box-plots for each of the six variables considered in Section 5.4, to provide a visual summary of outliers in the dataset. These are shown in Table 5.5 below:

Table 5.5: Box-plots

Box-plots are constructed for each of the six variables in the dataset for the first (01/09/2003) and for the last (31/05/2007) snap-shot dates. They intend to provide a visual summary of the outliers in the dataset. For most of the variables there are more outliers in the last snapshot of data than in the first one, which is consistent with the notion of a growing panel.



For each variable, I identify outliers in the study sample using two techniques. First, I observe data points that lie more than three standard deviations from the mean for each variable. Secondly, I observe daily changes in each variable that are more than three standard deviations from the mean daily change. Table 5.6 below reports the frequency of these outliers by variable.

Table 5.6: Outliers

The top panel of the table shows for each of the six variables the number of observations greater than three standard deviations from the mean as well as its equivalent presented as a percentage of the total number of observations. The bottom panel of the table presents the number of occasions (and its percentage equivalent) each variable has changed in one day by more than three standard deviations from the mean daily change. Both measures aim to capture 'exceptional' data points.

		Price (GBp)	*Market Cap (mill GBP)*	*Market Cap on Loan (%)*	*Shares on Loan (mill)*	*Book Value per Share (GBP)*	*Free float number of shares (%)*
> or < than	***Number of observations***	3443	942	3469	3849	21496	1300
($\mu \pm 3\sigma$)	***% of sample***	0.3386%	0.17%	0.83%	0.9150%	2.2378%	0.1608%
> or < than	***Number of observations***	810	1167	3834	6929	NA*	8207
($i_{,t} \pm 3\sigma$)	***% of sample***	0.0797%	0.21%	0.92%	1.6472%	NA*	1.0151%

***the information is not applicable as BV changes once a year**

In studying manipulative short squeezes and crowded exits in the next sections of this thesis, I am concerned with exceptional situations for short-sellers. As such, 'outliers' in each variable are likely to be important and so are not removed from the dataset.

5.6 Asset Pricing Model for Estimating Abnormal Returns

In choosing an asset pricing model for the purposes of calculating abnormal returns, I note that Asquith and Moelbroek (1996) establish that the negative relation between

excess returns and short positions is robust to a variety of techniques for calculating excess returns. Dechow *et al.* (2001) measure excess returns by adjusting each firm's return by the equal weighted return for all NYSE and AMEX shares over the same time period. They make no adjustment for risk across firms and cite previous research in this field that has been robust to changes in the asset pricing model used. Figlewski (1981) and Figlewski & Webb (1993) make use of the CAPM model. Asquith *et al.* (2005) and Boehmer *et al.* (2008) use several asset pricing models to estimate abnormal returns for short-sellers and find no significant difference in the results. Cavazos and Savor (2007) apply both benchmark-adjusted returns approach and Fama-French three factors regression to study the relationship between short selling activities and subsequent abnormal returns, and obtain similar results for both. In fact, results in this research area have been uniformly robust to changes in asset pricing model. I note this phenomenon, and in this research, I choose to use the CAPM model for its simplicity. Abnormal returns are calculated as:

$$AR_{i,t} = R_{i,t} - \left[R_{f,t} + \beta_i \left(R_{m,t} - R_{f,t}\right)\right] \quad (1)$$

Where $R_{i,t}$ is the return of stock *i* on day *t*, and $R_{f,t}$ is the risk-free rate on day *t*. $R_{m,t}$ is the market return on day *t*, which is calculated from the total return index for the FTSE All Share index. β_i represents the correlation between the returns on stock *i* and the market return premium, which is estimated using CAPM over the period from 2nd September 2002 to 31st August 2003, which is a one-year period that precedes my stock lending sample data period. I use 3-month LIBOR as the risk free rate. LIBOR is commonly used as a risk-free proxy. I note that this series was 'well-behaved' during the period of study, but became unusually dislocated during the 2007-2009 US and UK banking crisis. In a study that uses UK stock lending data from CREST, Au *et al.* (2007) use weekly one-month LIBOR rates as their measure of the risk-free rate and estimate one-month cumulative abnormal returns relative to FTSE 350 index returns.

6. *CAVEAT VENDITOR* – CROWDED EXITS![*]

6.1 Introduction

Geczy *et al.* (2002) argue that if short-selling problems explain the availability of factor portfolio returns to unskilled managers, then these short selling problems are not borrowing costs, but perhaps liquidity constraints. In this chapter, I consider *crowded exits,* a liquidity problem that is unique to short-sellers. Crowded exits have yet to be examined in the literature, and this study fills this gap. Crowded exits arise in stocks where short-sellers hold large positions relative to normal trading volume, and when a catalyst prompts short-sellers to cover their positions rapidly and simultaneously. Catalysts include, but are not limited to, public news releases by companies. The temporary excess of demand for stock relative to normal trading volume leads to upward pressure on the stock price and these events are associated with losses to short-sellers that are economically and statistically significant. As such, the risk of a crowded exit represents an indirect constraint on short-selling. My strategy of enquiry is to explore the database described in Chapter 5 to develop an understanding of how liquidity constraints can impact on short-sellers.

As part of any description of crowded exits, it is helpful to explain how a short position might become 'crowded' in the first instance. One possible scenario is outlined below. Initially, one or more traders with negative information about a company short-sells stock in that company. This represents informed trading and leads to an increase in the number of shares shorted. In the interest of transparency, most developed stock markets require the publication of data on short-selling or stock lending, and so the above increase in short-interest is made public. Note that a substantial body of empirical research shows that heavily shorted stocks perform poorly (see, for example, Dechow *et al.* (2001), Angel *et al.* (2003), Gopalan (2003),

[*] This chapter forms the basis of a University of Edinburgh Working Paper entitled "*Caveat Venditor* – Crowded Exits!" by James Clunie, Peter Moles and Yuan Gao. The paper was presented at the Midwest Finance Association conference in Chicago in March, 2009 and has been accepted for presentation at the European Financial Management conference in Nantes in April, 2009.

Ackert and Athanassakos (2005), Diether *et al.*, 2008 and Boehmer *et al.*, 2008). Market participants who are aware of this literature can simply short-sell stocks that are seen to be heavily shorted, in an attempt to benefit from the short-sellers' information. This is an 'imitation strategy', other examples of which are described in Fligstein (1996, 2001), White (1981, 2001) and MacKenzie (2006). In so far as this imitation strategy occurs in markets, it follows that heavily shorted stock positions contain both informed traders and noise traders. Imitation strategies, however, contain the seeds of their own destruction. In this illustration, imitation leads to an increase in the size of the short position relative to the liquidity of the stock. A crowded position thus develops, based on a mix of informed short-selling and 'rational imitation'.

I refer to short positions that are large relative to normal trading volume as 'crowded positions'. With a catalyst, rapid and simultaneous short-covering can commence and the crowded position becomes a 'crowded exit'. The idea is akin to the audience in a crowded theatre rushing to a narrow exit door once the fire alarm sounds…only so many can leave the building in any given interval of time. A variety of catalysts for a crowded exit are possible: a company could release new, positive information to the market; a sell-side analyst could upgrade his earnings forecast or trading recommendation on a stock; or informed short-sellers could receive new, private information and start to cover their positions, to be followed by imitators. Another catalyst could be that short-sellers become unable to hold their short positions (because of client redemptions, stock loan recall, margin calls or risk control mechanisms) and are forced to cover their positions; as this is revealed to the market via public stock-lending data, it could be misconstrued as informed buying and act as a catalyst for short covering by imitators. Finally, manipulators buying shares in a company could prompt short covering amongst traders who misinterpret the manipulative trades as informed buying. From interviews with practitioners, I find that short-sellers perceive crowded exits to be risky: it could become difficult to cover a short position when desired, or the short-seller could suffer losses due to 'market impact' for demanding liquidity to cover a short position quickly.

I examine crowded exits in detail by using the comprehensive dataset described in Chapter 5. This dataset contains stock lending data for up to 681 stocks listed on the London Stock Exchange from 1st Sep 2003 to 31st May 2007. The main findings of this research are as follows: crowded exits are associated with positive abnormal returns (i.e. losses to short-sellers) of up to 27% over a period of 60 days, and this result is both statistically and economically significant. I infer that short-sellers thus face an important indirect constraint on short-selling in the form of crowded exits. New, long-only investors would generally be unable to exploit this finding by buying into crowded exits, as by definition these are illiquid positions; however, incumbent short-sellers, unable to readily cover their positions, suffer losses.

6.2 Methodology

6.2.1 Definitions of Variables

In this chapter, I standardize shares on loan first by the number of shares outstanding and, second, by the free float number of shares. Each of these measures serves as a proxy for short interest.

The proportion of market capitalisation on loan (MCOL) of a stock on any given day is calculated as:

$$MCOL_{i,t} = \frac{\text{Shares on loan}_{i,t}}{\text{Outstanding Shares}_{i,t}} \qquad (6.1)$$

This measure represents the proportion of a company *i*'s outstanding shares that are on loan on day *t*. By dividing by outstanding shares, this ensures that the measure of short interest is not dominated by larger firms.

I introduce the proportion of free float on loan (FFOL) as a second measure of short-interest that is better attuned to the liquidity of a stock. It is calculated as:

$$FFOL_{i,t} = \frac{\text{Shares on Loan}_{i,t}}{\text{Size of Free Float}_{i,t}} \qquad (6.2)$$

The 'size of free float' is the total number of shares in issue that are available to ordinary investors (i.e. excluding shares held by government or long-term family interests).

I also measure the shares on loan relative to the normal trading volume for each firm day. I calculate the 'Days to Cover Ratio' (DCR) as a key factor for identifying 'crowded positions'. This ratio is calculated as:

$$\text{Days to Cover Ratio}_{i,t}\ (\text{DCR}) = \frac{\text{Shares on Loan}_{i,t}}{\text{Average Daily Trading Volume}_{i,t}} \qquad (6.3)$$

$\text{Shares on Loan}_{i,t}$ is the closing number of shares on loan for stock *i* on day *t*.

$\text{Average Daily Trading Volume}_{i,t}$ is the moving average of the trading volume for stock *i* from days (*t*-61) to (*t*-1). I choose 60 days of trading volume as a compromise between the risk of including out-dated information on trading volume and the risk of one or more exceptional days influencing the moving average figure.

6.2.2 Constructing Portfolios

The primary goal of this chapter is to measure the abnormal returns of stocks experiencing crowded exits. A portfolio approach is applied as it allows the researcher to replicate gross and risk-adjusted returns for a potential trading strategy; and it captures certain non-linearities that might characterize the patterns of subsequent returns (Pan and Poteshman, 2006). For each day, I sort the data to construct equal-weighted portfolios containing stocks identified as going through crowded exits. I study the characteristics of the securities included in the crowded exit portfolios, and estimate the abnormal portfolio returns for subsequent time periods.

I use two approaches to select portfolios of stocks. The first approach is a 'simple sort', identifying stocks on each day based on their Days to Cover Ratio (DCR) ranking relative to other stocks. The DCR is a liquidity ratio: the higher the ratio, the more difficult it should be for short-sellers to liquidate their positions without having market impact. This simple sort thus creates portfolios that differ by the 'crowdedness of short positions'. The second approach is a 'double sort'. In addition to sorting by DCR, I also divide portfolios according to whether or not each stock is experiencing exceptional short covering.

Simple Sorts

For each day, I rank all stocks by DCR. I then construct three portfolios containing the 99^{th}, 95^{th}, and 90^{th} percentile of stocks by DCR. These higher percentiles represent the most 'crowded' short positions. A prerequisite of a crowded exit is that the stock should have a high level of short interest relative to its liquidity, and this simple sort captures that condition.

Double Sorts

I carry out simultaneous sorts, creating portfolios based on a ranking of stocks by DCR and also whether or not they meet the test of showing an 'exceptional' decrease in shares on loan. Instead of sorting stocks into independent percentiles twice, I sort stocks into 99^{th}, 95^{th}, and 90^{th} percentiles based on DCR, and narrow down the portfolios by controlling for 'exceptional' changes in short interest on the previous day. I define the resultant portfolios as portfolios of stocks experiencing crowded exits: these portfolios include stocks with high DCRs and showing 'exceptional' changes in short interest on the previous day. To define an 'exceptional' reduction in short interest level, I use two criteria. First, I filter the data to include only stocks with decreasing shares on loan. See equation (4) below:

Change in shares on loan (*t*) = shares on loan (*t*) – shares on loan (*t-1*) (6.4)

A negative number indicates that short-sellers are covering their positions on day *t*.

Only publicly-traded stocks are generally loaned and so it important in any study of liquidity problems to consider each firm's free-float rather than total shares outstanding. I use the proportion of free float on loan in defining an exceptional decrease in short interest level. I first calculate the change in the free float on loan (CFFL) from day *t-1* to day *t*. The average change across all stocks for day *t* is defined as the cross sectional mean on day *t*, according to the equation below:

$$\text{Average market change } (CFFL_{m,t}) = \frac{\sum_{i=1}^{n} CFFL_{i,t}}{n} \quad (6.5)$$

Where *n* is the total number of stocks in the universe on day *t*. I adjust the daily change in free float on loan for stock *i* ($CFFL_{i,t}$) for the market average change, and obtain the adjusted daily change in free float on loan relative to the market average change, as shown in the equation below:

$$\text{Relative daily change for stock } i \ (RCFFL_{i,t}) = \frac{CFFL_{i,t}}{CFFL_{m,t}} \quad (6.6)$$

Next, I test whether or not each $RCFFL_{i,t}$ is 'exceptional'. For each firm day, I calculate $RCFFL_{i,t}$ for each day from day (*t-21*) to day (*t-1*) and measure the mean and standard deviation of this series. If $RCFFL_{i,t}$ exceeds ± 2 standard deviations, I determine this to be an 'exceptional' change. If this exceptional change is accompanied by fewer shares on loan and a lower CFFL, it is defined as an exceptional decrease in the level of short interest. Using this technique and having already undertaken a simple sort, I proceed to separate each of the DCR groups into two smaller portfolios: a 'Crowded Exit Portfolio' (where each stock experiences an exceptional decrease in short interest) and a 'Not Crowded Exit Portfolio' (the stocks do not experience an exceptional decrease in short interest).

I study the characteristics of securities found in the 'Crowded Exit Portfolios' and compare to those for the 'Not Crowded Exit Portfolios'. These characteristics include the short interest ratios defined in Section 6.2.1; and liquidity factors (daily trading volume and percentage of outstanding shares that are free floating). I also measure fundamental factors, including market capitalization, market-to-book, volatility of returns, and past returns. The 'past return' is the raw return for a portfolio of stocks over the previous 20 trading days.

6.2.3. Abnormal Returns around Crowded Exits

Portfolio abnormal returns are estimated from the CAPM model, as described in Chapter 5. I calculate equal-weighted portfolio abnormal returns for each portfolio resulting from a sort. In measuring abnormal returns following crowded exits, for each portfolio I skip one day and hold the portfolios over *N* trading days. I start the holding period on day (*t+2*) to reduce the risk that stock prices are disproportionately at either 'bid' or 'ask' (see, for example, Kaul and Nimalendran, 1990, for a discussion of the 'bid-ask bounce problem'). I calculate Cumulative Abnormal Returns (CAR) over a series of holding periods (1, 5, 10, 20 and 60 days) to investigate the aggregate losses to short-sellers who cannot or do not cover their positions.

Cumulative abnormal returns for periods of up to 60 days are estimated for each day, and thus there is a problem of 'overlapping' data to address. Estimates based on overlapping periods could capture autocorrelation and heteroskedasticity in a firm's excess returns, thus biasing the results. Senchack and Starks (1993) use monthly data and apply an event window covering 15 days before and after short interest announcement date to avoid the overlapping problem. Angel et al. (2003) study stocks returns by partitioning their study sample into non-overlapping four-day sub-samples. However, I am using daily data to obtain greater granularity in studying liquidity problems, and such techniques would not be suitable for this study. Since I rank by DCR daily and hold portfolios for a subsequent *N* days, I need to adjust for unknown autocorrelation and heteroskedasticity in returns. The Newey-West (1987) Heterockedasticity Autocorrelation Covariance (HAC) Matrix Estimator is widely used for such adjustment. Diether *et al.* (2008) sort stocks into quintiles based on the percentage of daily trading volume due to short selling, and study the day (*t+2*) to day (*t+5*) holding period. They use the Newey-West (1987) approach with lag 5 to adjust for autocorrelation over the overlapping holding period. However, Petersen (2008) notes that, although the Newey-West HAC matrix estimator is more efficient, its weighting scheme is not as optimal as clustered White (1980) standard errors. Also, if there is a requirement to adjust for autocorrelation, the test is mis-specified. To solve this problem whilst making full use of the daily data, I undertake a calendar-time approach to calculate average daily returns. This approach is used by Mitchell and Stafford (2000) and Boehmer *et al.* (2008) to address the overlap problem.

The daily abnormal return on portfolio *p*, $AR_{p,t}$, is given by:

$$AR_{p,t} = \frac{1}{I}\sum_{i=1}^{I} AR_{i,t} \qquad (6.7)$$

$AR_{i,t}$ is the abnormal return for the i^{th} stock assigned to portfolio *p* based on the daily ranking of DCR. *I* is the number of stocks contained in the portfolio.

I skip one day to avoid the bid-ask bounce problem and estimate the abnormal return from day (*t+2*). I establish the window for one day [*t+2*, *t+3*], 5 days [*t+2*, *t+6*], 10 days [*t+2*, *t+11*], 20 days [*t+2*, *t+21*], and 60 days [*t+2*, *t+61*]. The Cumulative Abnormal Return (CAR) is estimated based on the above windows.

6.3. Results

Table 6.1 below shows summary statistics for the entire sample period (1st September 2003-31st May 2007) and for three 'snapshots': the sample beginning date (1st September), the sample mid-date (15th July 2005), and the sample end date (31st May 2007). Panel A presents statistics for variables related to stock lending. Panel B presents statistics for stock characteristics. In Panel A, by comparing the mean to the median and the upper percentiles for shares on loan, it is clear that the distribution of shares on loan is skewed. Likewise, the Days to Cover Ratio (DCR) distribution is also skewed. Whereas Gamboa-Cavazos and Savor (2007) find increasing short interest for NASDAQ stocks between 1988 and 2001, there is no obvious increasing trend in short interest for London Stock Exchange stocks during the period 2003 to 2007.

Table 6.1 Summary Statistics

Panel A reports summary statistics for a series of short-selling measures. Shares on Loan is the number of shares borrowed over the period (01 Sep 2003 to 31 May 2007), which acts as a proxy for the number of shares shorted. Market Cap on Loan is the number of shares on loan divided by market capitalization over the sample period. Free Float on Loan is the number of shares on loan divided by the size of the free float, providing a liquidity-adjusted meaure of short interest. DCR (Days to Cover Ratio) is the number of shares on loan divided by average daily trading volume, which measures how many days of normal trading volume it would take for short-sellers to cover their positions. Panel B reports summary statistics for stock characteristics. Market Cap is used to measure the firm size, and B/M refers to lagged book-to-market ratio as defined in Fama and French (1993). Trading Volume is the number of shares traded in the market per day. Free Float shows the percentage of outstanding shares which are publicly traded. Each panel reports statistics for the whole sample period and also snapshots for the beginning sample date (01 Sep 2003), the mid-date (15 Jul 2005), and the final sample date (31 May 2007).

Panel A: Short Selling Summary Statistics

		Shares on loan (millions)	Market cap on loan (%)	Free float on loan (%)	DCR (days)
01 Sep 2003-31 May 2007	mean	23.39	2.90	4.68	7.88
	median	4.40	1.84	2.70	4.48
	Std.Dev	74.99	3.07	5.68	29.29
01 Sep 2003 (Snapshot 1)	mean	28.84	2.43	4.57	6.74
	median	5.50	1.64	2.79	3.51
	Std.Dev	81.60	2.43	5.18	19.01
15 Jul 2005 (Snapshot 2)	mean	33.38	3.55	4.55	7.94
	median	9.90	2.41	2.69	5.02
	Std.Dev	77.58	3.18	4.39	15.65
31 May 2007 (Snapshot 3)	mean	33.27	3.37	4.42	8.42
	median	4.35	2.18	2.53	4.30
	Std.Dev	191.39	3.66	5.49	28.49

Panel B: Stock Characteristics Summary Statistics

		Market Cap (millions)	Daily Trading Volume (millions)	B/M	Free Float (%)
01 Sep 2003-31 May 2007	mean	2293.7	3.24	0.67	66.54
	median	370.0	0.31	0.50	69.00
	Std.Dev	8485.1	15.74	1.51	21.64
01 Sep 2003 (Snapshot 1)	mean	1571.2	4.95	0.89	56.95
	median	272.0	1.19	0.65	57.00
	Std.Dev	7165.7	11.56	3.36	14.69
15 Jul 2005 (Snapshot 2)	mean	2495.5	6.14	0.69	82.07
	median	383.5	1.75	0.53	85.00
	Std.Dev	10011.4	12.76	1.19	15.66
31 May 2007 (Snapshot 3)	mean	2700.5	4.71	0.48	74.99
	median	459.5	0.84	0.36	78.00
	Std.Dev	7817.9	10.96	0.37	17.68

6.3.1 Simple Sorts

For each day, stocks are ranked according to DCR and portfolios containing the 99^{th}, 95^{th} and 90^{th} percentile of stocks by DCR are constructed. The portfolio characteristics resulting from these simple sorts are shown in Table 6.2 below:

Table 6.2 Portfolios based on Simple Sorts

This table reports the characteristics of portfolios sorted daily by Days to Cover Ratio (DCR) over the period 01 September 2003 to 31 May 2007. DCR is calculated as shares on loan divided by average daily trading volume. The first column shows variables for the entire sample, the following three columns show the 99th, 95th, and 90th percentiles by DCR respectively. Past Return is calculated as the raw percentage return of each portfolio over the previous 20 trading days.

		All	99th Percentile DCR>19.4	95th Percentile DCR>12.4	90th Percentile DCR>8.11
Panel A. Short Interest					
DCR (days)	Mean	7.88	147.26	52.87	34.71
	Median	4.48	62.68	25.76	19.36
	Std. Dev.	29.29	224.63	119.21	86.97
Shares on Loan	Mean	23.39	25.90	26.31	33.17
(in millions)	Median	4.40	14.10	7.80	9.40
	Std. Dev.	74.99	63.48	58.36	67.72
Mkt Cap on Loan (%)	Mean	2.90	5.60	6.22	6.20
	Median	1.84	3.54	4.66	4.90
	Std. Dev.	3.07	4.19	4.39	4.52
Free Float on Loan(%)	Mean	4.68	9.82	10.77	10.66
	Median	2.70	6.75	7.76	7.93
	Std. Dev.	5.68	7.93	9.05	9.04
Panel B. Stock Liquidity					
Turnover by shares	Mean	3.24	0.45	1.21	1.94
(in millions)	Median	0.31	0.10	0.16	0.26
	Std. Dev.	15.74	2.10	3.82	5.35
Free Float (%)	Mean	66.54	65.34	66.07	66.64
	Median	69.00	65.00	68.00	69.00
	Std. Dev.	21.64	21.64	20.00	20.42
Panel C. Other Stock Characteristics					
Volatility	Mean	0.24	0.25	0.24	0.25
	Median	0.22	0.22	0.22	0.23
	Std. Dev.	0.14	0.14	0.12	0.12
Mkt Cap	Mean	2294	697	983	1574
(in millions)	Median	370	444	443	499
	Std. Dev.	8485	3740	2980	5093
Book to Market ratio	Mean	0.67	6.21	1.86	1.21
	Median	0.48	0.47	0.55	0.49
	Std. Dev.	37.91	15.36	7.68	5.52
Past Return (%)	Mean	1.93	2.23	1.41	1.49
	Median	1.60	1.67	1.34	1.36
	Std. Dev.	8.37	8.72	7.81	7.60

Panel A reports the variables related to short interest. Unsurprisingly, the higher DCR percentiles have higher short-interest. Panel B presents statistics associated with liquidity factors: As expected, liquidity is generally poorer in portfolios with

higher DCRs. A high DCR thus typically results from the *combination* of high short interest and poor liquidity. Panel C presents statistics for other portfolio characteristics, including market capitalization, stock return volatility, book-to-market ratio and past returns. Boehmer *et al.* (2008) find that high shorting tends to occur in small stocks. In addition, small stocks are expected to have lower trading volume and poorer liquidity. Considering these two features, I expect the higher DCR percentiles to be dominated by smaller stocks. Panel C reveals that the higher DCR portfolios show a lower mean market capitalization than for the whole sample. In fact, mean market capitalization declines monotonically with the higher DCR portfolios. The mean portfolio book-to-market ratio rises with DCR ratio and each of the higher DCR portfolios has above average book to market ratio. Based on medians, however, no clear relationship exists. This suggests that a small number of 'value' stocks dominate the mean figures. Boehmer *et al.* (2008) point out although short-sellers are able to identify over-valued stocks, high levels of short-selling are neither necessarily nor sufficiently related to a low book-to-market ratio. Financial distress risk is likely to be present with extreme value stocks. There is no apparent relationship between volatility and DCR, or between past returns and DCR.

Table 6.3 below presents the abnormal returns and cumulative abnormal returns associated with higher DCR portfolios.

Table 6.3 Abnormal Returns and Cumulative Abnormal Returns based on Simple Sorts (%)

The Table reports abnormal returns and cumulative abnormal returns (CAR) for higher-percentile DCR portfolios from 01 Sep 2003 to 31 May 2007. Stocks are sorted into 99th, 95th, and 90th percentiles based on their Days to Cover Ratio (DCR). Portfolios are re-balanced daily. By skipping one day to avoid concerns about bid-ask bounce, daily abnormal returns, cumulative abnormal returns and t-statistics are calculated using a calendar-time approach with a holding period of 1, 5, 10, 20, and 60 trading days. All returns are quoted as percentages.

		99th Percentile	95th Percentile	90th Percentile
AR(+1)	Mean	0.034	0.020	0.027
	t-Stat	1.345	1.720 *	2.429
CAR(+5)	Mean	0.127	0.127	0.116
	t-Stat	1.188	2.710 ***	2.951 ***
CAR(+10)	Mean	0.291	0.307	0.263
	t-Stat	1.032	3.250 ***	3.423 ***
CAR(+20)	Mean	0.348	0.562	0.622
	t-Stat	1.742 *	2.989 ***	4.265 ***
CAR(+60)	Mean	2.027	1.203	1.463
	t-Stat	1.682 *	1.970 **	3.419 ***

Note: * indicates significance at 10% level, ** indicates significance at 5% level, and *** indicates significance at 1% level.

Table 6.3 reveals positive abnormal returns for each of the higher DCR portfolios over each time period considered. Statistical significance is generally stronger over the longer holding periods; and for the 90^{th} and 95^{th} percentiles compared to the 99^{th} percentile. This latter effect is due to the lower volatility of abnormal returns in the 90^{th} and 95^{th} percentile portfolios, such that statistical significance can be established at a lower abnormal return.

6.3.2 Double Sorts

Table 6.4 below shows portfolio characteristics for the higher percentile DCR portfolios, separated into 'Crowded Exits' portfolios and 'All' portfolios. This allows for a comparison between the characteristics of stock experiencing crowded exits, and all stocks that belong to higher percentile DCR portfolios.

Table 6.4 Portfolios based on Double Sorts

This table reports the characteristics of portfolios sorted according to both Days to Cover Ratio (DCR) and exceptional decreases in the percentage of free float on loan over the period 01 September 2003 to 31 May 2007. DCR is calculated as shares on loan divided by average daily trading volume. Exceptional decreases in free float on loan are identified as described in the Methodology section. For each percentile, the column 'All' shows variables for all stocks in that percentile group based on a simple sort; the Crowded Exits column reports portfolios which have a high DCR combined with exceptional falls in short interest, as defined in the Methodology section. Past Return is calculated as the raw percentage return of each portfolio over the previous 20 trading days.

First Sort (By DCR)		**99th Percentile**		**95th Percentile**		**90th Percentile**	
Second Sort (By Exceptional Change)		**All**	**Crowded Exits**	**All**	**Crowded Exits**	**All**	**Crowded Exits**
		Panel A. Short Interest					
DCR (days)	Mean	147.26	91.43	52.87	36.55	34.71	25.76
	Median	62.68	57.30	25.76	24.56	19.36	18.58
	Std. Dev.	224.63	94.80	119.21	48.08	86.97	34.74
Shares on Loan	Mean	25.90	27.70	26.31	33.41	33.17	45.37
(in millions)	Median	14.10	18.90	7.80	15.70	9.40	16.60
	Std. Dev.	63.48	24.54	58.36	57.53	67.72	84.69
Mkt Cap on Loan (%)	Mean	5.60	4.51	6.22	6.73	6.20	6.73
	Median	3.54	2.98	4.66	5.90	4.90	5.90
	Std. Dev.	4.19	3.87	4.39	4.58	4.52	4.53
Free Float on Loan(%)	Mean	9.82	7.89	10.77	12.02	10.66	12.11
	Median	6.75	3.63	7.76	9.91	7.93	9.90
	Std. Dev.	7.93	7.48	9.05	9.74	9.04	9.73
		Panel B. Stock Liquidity					
Turnover by shares	Mean	454.9	0.4	1206.1	1.7	1936.7	3.0
(in millions)	Median	103.2	0.1	161.9	0.3	260.7	0.5
	Std. Dev.	2096	899	3823	3908	5346	8116
Free Float (%)	Mean	65.34	67.21	66.07	64.56	66.64	64.64
	Median	65.00	71.00	68.00	66.00	69.00	67.00
	Std. Dev.	21.64	23.05	20.00	20.82	20.42	21.22
		Panel C. Other Stock Characteristics					
Volatility	Mean	0.25	0.27	0.24	0.25	0.25	0.25
	Median	0.22	0.21	0.22	0.22	0.23	0.23
	Std. Dev.	0.14	0.19	0.12	0.14	0.12	0.12
Mkt Cap	Mean	696.8	642.7	982.8	1257.5	1573.8	1953.6
	Median	444.0	497.0	443.0	503.0	499.0	587.0
	Std. Dev.	3740	692	2980	2224	5093	6234
B/M	Mean	6.21	0.11	1.86	0.49	1.21	0.49
	Median	0.47	0.15	0.55	0.46	0.49	0.43
	Std. Dev.	15.36	0.86	7.68	0.59	5.52	0.51
Past Return	Mean	0.022	0.02	0.014	0.02	0.015	0.02
	Median	0.017	0.02	0.013	0.02	0.014	0.02
	Std. Dev.	0.087	0.08	0.078	0.07	0.076	0.07

From Panel B, it can be seen that mean and median turnover by shares is dramatically lower for the 'Crowded Exits' portfolios compared to the 'All' portfolios, suggesting that lower trading volume is an important factor in explaining

crowded exits. Panel C reveals that the Book-to-Market ratio is lower for 'Crowded Exits' portfolios than for the 'All' portfolios.

I examine each of the stocks appearing in the 'Crowded Exits' portfolios to identify if there are regulatory news releases around the time of the crowded exit. In approximately half the cases, there are regulatory news announcements in the period from 7 days before the start of exceptional short covering. This suggests that public, company-specific news could be the catalyst for a crowded exit in some, but not all, cases. Stocks typically stay in the crowded exit portfolio for a limited number of days (a mean of 3.35 days for the 99th percentile portfolios, 3.55 days for the 95th percentile portfolios and 4.45 days for the 90th percentile portfolios).

For the crowded exits portfolios, I calculate equal-weighted portfolio returns using the calendar-time approach over holding periods of 1, 5, 10, 20, and 60 trading days. As before, I skip one day to counter the bid-ask bounce problem. This approach is repeated every day. I expect stocks experiencing crowded exits to show higher positive AR and CARs than stocks that do not experience crowded exits. Results are shown in Table 6.5 below:

Table 6.5 Abnormal Returns and Cumulative Abnormal Returns based on Double Sorts (in %)

The Table reports mean abnormal returns and cumulative abnormal returns (CAR) for crowded exit portfolios from 01 Sep 2003 to 31 May 2007. For each day, stocks are first sorted into 99th, 95th, and 90th percentiles based on their Days to Cover Ratio (DCR). Within each percentile, stocks showing exceptional decreases in short interest (as defined int he Methodology section) are studied - these stocks are said to experience a 'crowded exit'. For each percentile, the first column reports the abnormal returns for stocks experiencing a crowded exit. The second column reports the difference in mean returns between portfolios of stocks experiencing crowded exits and those that do not experience crowded exits. By skipping one day to avoid concerns about bid-ask bounce, daily abnormal returns, cumulative abnormal returns and t-statistics are calculated using a calendar-time approach with a holding period of 1, 5, 10, 20, and 60 trading days. All numbers are quoted as percentages.

		99th Percentile		95th Percentile		90th Percentile	
		Crowded Exits	Difference	Crowded Exits	Difference	Crowded Exits	Difference
AR(+1)	Mean	0.518	0.233	0.158	0.026	0.151	0.105
	t-Stat	0.915	0.641	2.161 **	0.256	1.332	1.512 *
CAR(+5)	Mean	1.833	0.647	0.404	-0.050	0.402	0.320
	t-Stat	0.862	0.523	1.409	-0.133	0.873	1.157
CAR(+10)	Mean	4.916	4.125	1.005	1.065	1.051	0.986
	t-Stat	2.191 **	1.949 **	2.344 **	0.834	1.773 *	1.611 *
CAR(+20)	Mean	5.254	5.858	3.403	1.869	3.610	1.986
	t-Stat	1.831 *	1.506 *	4.413 ***	1.426 *	2.994 ***	2.012 **
CAR(+60)	Mean	18.930	14.446	5.033	3.022	6.370	3.640
	t-Stat	2.065 **	1.298 *	1.964 **	0.758	1.703 *	1.324 *

Note: * indicates significance at 10% level, ** indicates significance at 5% level, and *** indicates significance at 1%

For each percentile, the 'Crowded Exits' column reports the AR and CARs for portfolios of stocks that have high Days to Cover Ratios but that also show exceptional decreases in short interest – each of these stocks is said to experience a 'crowded exit'. The 'Difference' column shows the difference between stocks experiencing crowded exits and those do not, within each percentile group. 'Crowded Exit' portfolios have positive AR and CARs, most of which are statistically significant. Comparing to the simple sorts, these AR and CARs are also all higher. For example, the highest CAR is observed in the 99th percentile over the holding period of 60 trading days, with 18.93%, which is statistically significant at the 5% level, while the CAR(+60) for the 99th percentile based on a simple sort is only 2.03%, significant at the 10% level. The mean CAR(+60) for the 99th percentile Crowded Exit portfolios, at 18.93%, is also economically significant. This indicates potentially large losses for short-sellers during crowded exits. Noting from Table 6.4 that stocks in the 99th percentile portfolio have an average DCR of over 147 days, it is unsurprising that such stocks could remain crowded after 60 days. Although the

positive CARs are not statistically significant over shorter periods, they are all statistically significant over periods of 10 days or greater.

The results are consistent with the hypothesis that crowded exits are a risk to short-sellers. For longer holding periods, results are both statistically and economically significant. The greatest CARs are in the highest DCR portfolios. As a robustness check, I consider stocks that have high Days to Cover Ratios and that also exhibit any decrease in shares on loan over a 5 day period (as opposed to exhibiting 'exceptional' decreases in shares on loan as defined in Section 6.2.2.). I find that the abnormal returns for each category are generally no longer positive, and that none is statistically significantly different from 0. This reveals that it is the 'exceptional' nature of short-covering associated with crowded exits that leads to losses for short-sellers.

6.3.3 Adjustment for Arbitrage

Not all short-sales are motivated by negative opinions on a stock. For example, short-sellers might short stocks to conduct convertibles arbitrage and so take advantage of relative mispricing between a stock and a convertible bond issued by the same company. Where a short-seller is arbitrage-motivated, he will be partially hedged against movements in the stock price. The presence of such arbitrageurs could thus obfuscate our results and weaken the power of the tests. I use Thomson One Banker to identify firms with convertible bonds as part of their capital structure and re-estimate abnormal returns and CARs for the Double Sorts, separating firms with convertible bonds from those without. Gamboa-Cavazos and Savor (2007) separate firms with convertible securities outstanding in excess of $10M, from those firms below this threshold. In this study, I separate firms with any convertible bonds in issue from those without convertible bonds, to completely remove any obfuscation due to convertible bond arbitrage. Approximately one fifth of stocks in the panel have convertibles within their capital structure. Table 6.6 shows the results from my double sorts, adjusted for arbitrage-motivated short-selling.

Table 6.6 Double Sort Results Adjusted For Arbitrage

The Table reports mean abnormal returns and cumulative abnormal returns (CAR) for crowded exit portfolios from 01 Sep 2003 to 31 May 2007. First, stocks that are experiencing crowded exits are identified based on double sorts. Any company with a convertible bond in its capital structure is identified as being exposed to arbitrage-motivated short-selling. Crowded exit stocks are then seperated into 'non-convertible' portfolios and 'convertible' portfolios. By skipping one day to avoid concerns about bid-ask bounce, daily abnormal returns, cumulative abnormal returns and t-statistics are calculated using a calendar-time approach with a holding period of 1, 5, 10, 20, and 60 trading days. All numbers are quoted as percentages.

		99th Percentile		95th Percentile		90th Percentile	
		non-convertible	convertible	non-convertible	convertible	non-convertible	convertible
AR(+1)	Mean	0.728	-0.451	0.190	0.040	0.167	0.076
	t-Stat	1.117	-1.408	1.295	0.332	1.895 *	1.079
CAR(+5)	Mean	2.350	-0.545	0.494	0.142	0.466	0.108
	t-Stat	0.096	-0.476	0.825	0.285	1.443	0.194
CAR(+10)	Mean	6.106	-0.559	1.327	0.338	1.095	0.721
	t-Stat	2.279 **	-0.319	1.815 *	0.286	2.120 *	1.054
CAR(+20)	Mean	8.083	-7.759	3.763	3.173	3.569	3.197
	t-Stat	2.235 **	-1.831	2.571 **	1.570	3.974 ***	1.920 *
CAR(+60)	Mean	26.981	-18.103	8.312	0.815	5.514	3.526
	t-Stat	2.508 **	-1.423	1.949 *	0.105	1.967 *	0.594

Note: * indicates significant at the 10% level, ** indicates significant at the 5% level, *** indicates significant at the 1% level.

I expect greater CARs for the non-convertible portfolios compared to the convertible portfolios, as short positions in the non-convertible portfolios are not hedged by long positions in convertible bonds. In all cases I find greater ARs and CARs for the non-convertible portfolios, as expected. For the arbitrage-motivated 'Convertible' portfolios, all but one of the AR and CARs are insignificant at any level. This is consistent with the findings of Diether *et al* (2008) and Gamboa-Cavazos and Savor (2007) on arbitrage-motivated short-selling.

6.4 Conclusions

It is rational for investors to take account of published evidence on stock market anomalies. In particular, a number of quantitative analysts incorporate empirical evidence on stock market anomalies into their investment processes, in their search for out-performance. Lev and Nissim (2004) study short-selling and the 'accrual

anomaly' and find that in recent years institutions have altered their portfolio positions more actively in response to accrual disclosures, suggesting that the publication of academic research influences investor behaviour. Wu (2008) argues that "short sellers appear to exploit the [post earnings announcement] drift by increasing (decreasing) shorting immediately following negative (positive) earnings surprises." There exists a substantial body of literature showing that heavily shorted stocks perform poorly. Furthermore, Cohen *et al.* (2007) show that increasing borrowing demand for a stock is followed by poor performance. These studies suggest a potential trading strategy for short-sellers: identify heavily shorted stocks (or stocks with increasing borrowing demand) and build short positions in those stocks. This is an imitation strategy, similar to those described by Fligstein (1996, 2001), White (1981, 2001) and MacKenzie (2006). However, the act of imitation changes the market dynamics and can lead to unexpected consequences (see Surowiecki, 2004). With imitation, short-positions become more crowded, and the risk of 'crowded exits' increases. This could lead to examples of 'counter-performativity', as described by MacKenzie (2006), whereby the widespread and plentiful practice of short-selling, as assumed in economic models such as Arbitrage Pricing Theory, leads not necessarily to a more efficient market, but to an increasing number of occasions on which stock prices move temporarily away from fair value. Indeed, Irvine (2005) finds that stocks with higher short interest in any given month also have greater return skewness the next month.

Crowded exits are a liquidity problem unique to short-sellers. They have yet to be examined in the literature, and this study fills this gap. Crowded exits arise in stocks where short-sellers hold large positions relative to normal trading volume, and when a catalysts prompts short-sellers to cover their positions rapidly and simultaneously. Catalysts include, but are not limited to, public news releases by companies. I find that crowded exists are associated with losses to short-sellers that are economically and statistically significant. As such, the risk of a crowded exit represents an indirect constraint on short-selling.

I show that stocks with higher short interest, smaller sizes and poorer liquidity are more likely to have crowded exits. This research makes a contribution to the literature by furthering our knowledge of indirect short-sale constraints. It also makes a practical contribution, as my findings suggest practical steps that short-sellers can take to mitigate crowded exit risk. First, short-sellers should be risk-aware when short-selling smaller, less liquid stocks with high days-to-cover ratios. Secondly, given the prolonged nature of crowded exits, short-sellers should cover their short positions immediately upon observing exceptional levels of covering by other short-sellers in crowded positions. However, such short-covering will in itself exacerbate the crowded exit effect for others.

7. MANIPULATING THE SHORTS[*]

7.1 Introduction

My interviews revealed that some practising (and prospective) short-sellers fear becoming victims of stock manipulation. This fear can serve to limit the extent of short-selling, and so acts as an indirect constraint on short-selling. Of course, long-investors can also become victims of stock manipulation but short-sellers are particularly vulnerable due to the possibility of stock loan recall. If a stock loan is recalled and cannot be replaced, the short-seller must cover his position by buying stock in the market. A stock loan recall thus has the potential to create 'forced trading', making manipulation more effective. It is the recall mechanism that distinguishes manipulation against short-sellers from manipulation against long-investors.

Since at least the Great Depression, there has been suspicion amongst some politicians, media commentators and firms that short-sellers could be the *instigators* of stock manipulation (see sections 2.3 and 3.3.3 for examples of this phenomenon). A recent example of this, from 2008, was the widely-reported claim that short-sellers were manipulating the price of shares in Halifax Bank of Scotland plc (HBOS), using false rumours and short-selling to drive the price lower. This led to a formal investigation by the Financial Services Authority, involving a series of interviews with market participants and the examination of phone conversations and trading records. Ultimately, the regulator found no evidence of manipulative behaviour. Much less comment is given, however, to manipulation *against* short-sellers. A recent exception to this is provided by comment surrounding activity in the shares in Volkswagen AG, a German-based automobile manufacturer, during October 2008[12]. At the time of writing, this case is the subject of an investigation by BaFin, the

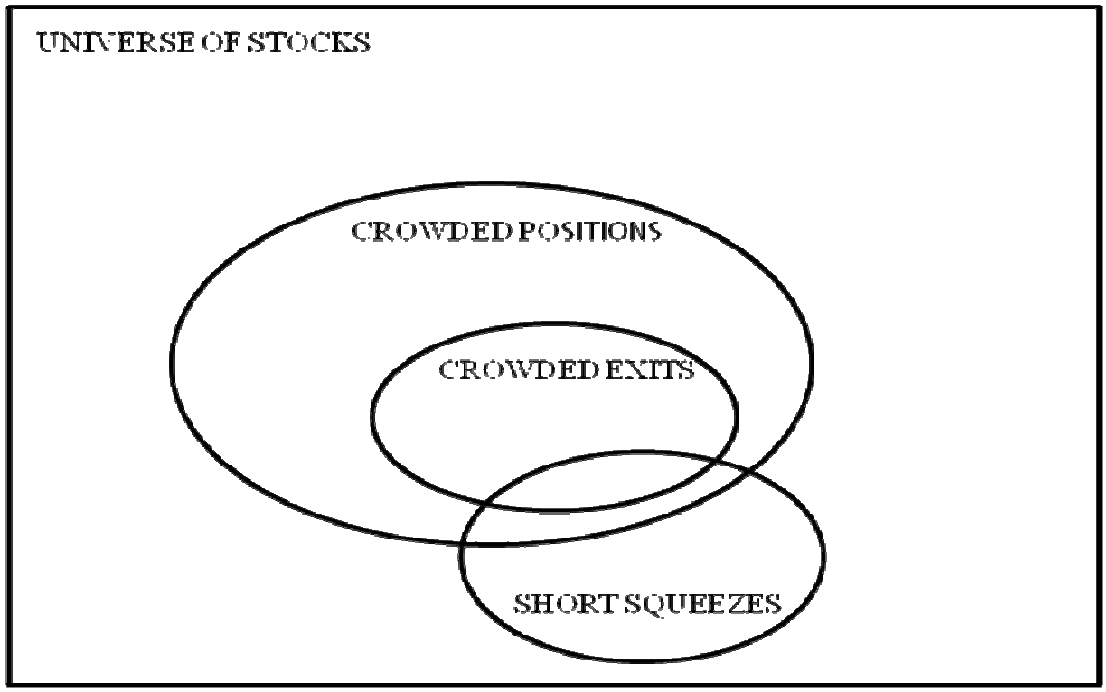
[*] This chapter forms the basis of a University of Edinburgh Working Paper entitled "Manipulating the Shorts" by James Clunie, Peter Moles and Nelly Terekhova.

[12] See for example, Financial Times: 28th October, November 5th and 25th, 2008.

German financial regulator. In section 7.3 I undertake a case study, examining stock lending data for Volkswagen AG around the time of the alleged manipulation.

A short squeeze is described by Dechow *et al.* (2001) as a situation where a stock loan is recalled and the stock borrower is unable to find an alternative lender. The stock borrower must then purchase shares in the open market to repay the stock loan and to close the position.[13] Figure 7.1 shows the relationship between crowded positions, crowded exits (see chapter 6) and short squeezes (as described in the literature).

Figure 7.1. Venn Diagram showing a Universe of Stocks, those Stocks with Crowded Positions, those experiencing Crowded Exits and those experiencing Short Squeezes



Crowded exits and short squeezes can be seen to be distinct, but potentially over-lapping, phenomena. Where a short-squeeze occurs in a highly liquid stock, the

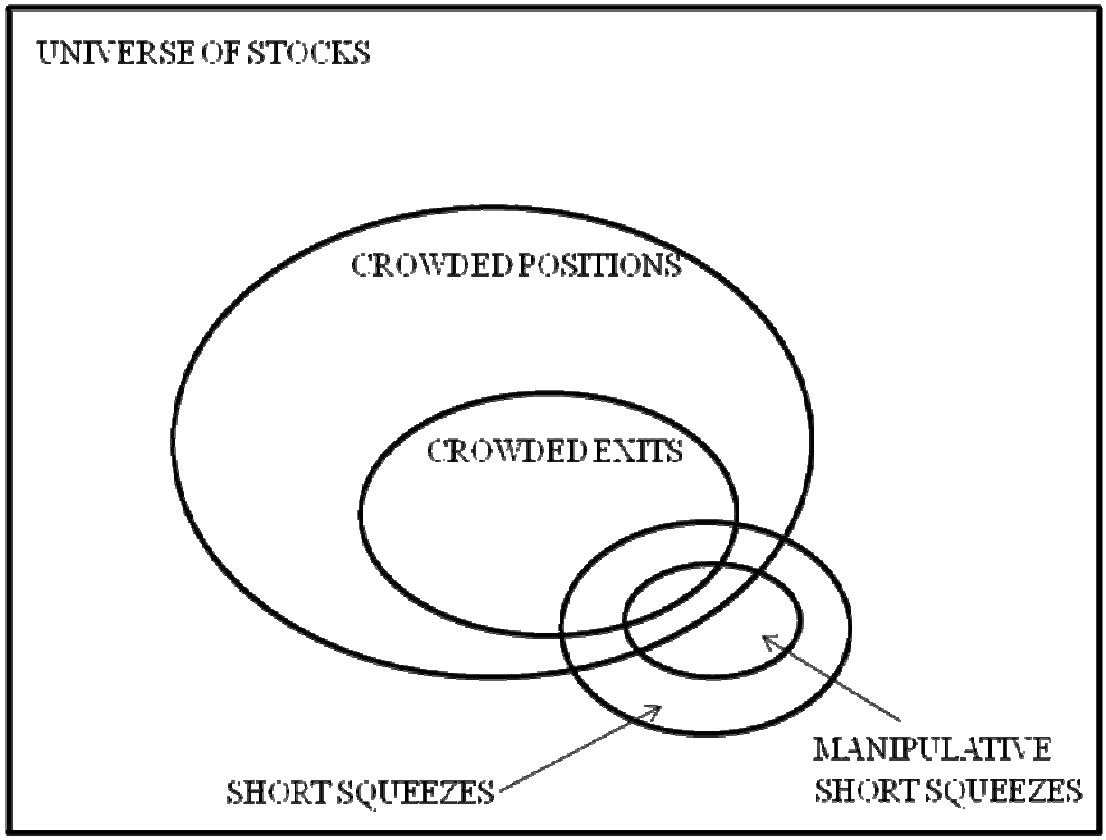
[13] A similar definition is offered by Duffie *et al.* (2002): "The lender may opt out of a continuing lending arrangement by issuing a recall notice, in which case the borrower must return the stock." …"In some cases, called 'short squeezes', the borrower (or its broker) is unable to locate lendable shares and is 'bought in', that is, must buy the stock outright. If the borrower fails to deliver the security in standard settlement time, the lender itself may buy it, using the cash collateral."

short-seller simply buys stock in the market to cover his position, and these purchases would have little market impact. The short-seller bears trading costs and would also suffer an opportunity cost if the stock price fell subsequent to the short covering. By contrast, consider a short squeeze where a stock's liquidity was 'poor' in the context of the scale of the recall. Short covering would have market impact, imposing losses on the short-seller. In an extreme case, a crowded exit could ensue as other short-sellers begin to cover their positions. Thus, a short squeeze can result in a crowded exit if the market impact of the initial short covering is large, or if the squeeze precipitates much additional short covering relative to the stock's liquidity.

It is possible to divide a short squeeze into two types: 'manipulative' and 'non-manipulative' short squeezes. A non-manipulative short squeeze occurs naturally when a stock lender recalls his stock (say, to settle a stock sale) and the short-seller is unable to replace his stock loan, due to limited supply. By contrast, a manipulative short squeeze is associated with deliberate recall by the stock lender as part of a broader manipulation strategy. Consider the situation where a manipulator owns shares in a company and those shares are on loan to a short-seller. The manipulator wishes to 'pump up' the share price and so buys *additional* shares in the company, demanding liquidity from the market. Simultaneously, he recalls the stock that is on loan. If unable to locate new stock to borrow, the short-seller must cover his position by buying stock in the open market. The market impact of these purchases places further upwards pressure on the stock price. The short-seller suffers a loss as he covers his position at a price above the initial, undisturbed share price. Finally, the manipulator 'dumps' his shares at the new, higher share price. In so doing, he secures a profit and completes the manipulation process.

Figure 7.2 below expands upon Figure 7.1 and illustrates the relationship between 'crowded positions', 'crowded exits', 'short squeezes' and 'manipulative short squeezes'.

Figure 7.2. Venn Diagram showing a Universe of Stocks, those Stocks with Crowded Positions, those experiencing Crowded Exits, those experiencing Short Squeezes and those experiencing Manipulative Short Squeezes



Manipulative short squeezes can be seen to be a subset of short squeezes. Furthermore, some manipulative short squeezes belong to the set of crowded exits. This chapter is concerned with manipulative short squeezes. In particular, I study situations where short-sellers become the victims of manipulative short squeezes. This topic is important because some market practitioners state that they fear manipulative short squeezes, and that this fear is a barrier to short-selling. My research questions are: "how frequent are manipulative short squeezes?"; "what type of stocks are associated with manipulative short squeezes?"; "what are the abnormal returns associated with manipulative short squeezes?" and "should short-sellers fear manipulative short squeezes?"

Stock loan recalls and short squeezes are frequently described in the literature, but are rarely researched further. One exception is D'Avolio (2002), who investigates

stock loan recalls and finds that it can be difficult to re-borrow stock after a recall. He finds that 2% of stocks on loan are recalled during an average month, and that it takes a mean of 23 days (and a median of 9 days) to replace a recalled stock loan. Under existing regulations (e.g. Regulation SHO), a short-seller would be unable to hold onto a short position for such extended periods of time without a stock loan. This suggests that the recall of a stock loan typically leads to the need to cover the short position. Accordingly, a manipulator can use a stock loan recall to induce short-covering, thus making manipulation more effective.

The motivation for engineering a manipulative short squeeze is provided by two strands of the finance literature: the emerging literature on predatory trading and the literature on manipulation.

Predatory Trading

Predatory trading is a form of trading whereby a market participant seeks to exploit his knowledge of the positions and strategies of one or more other investors, by benefiting from the market impact of forced transactions by those investors (see also Section 3.3.6). Attari *et al.* (2005) show that strategic traders can use knowledge of the financial state of an arbitrageur so as "to benefit from the predictable price deviations caused by a financially constrained arbitrageur's trades." They state that: "for a healthier but still financially fragile arbitrageur, the trades of the sophisticated traders can be detrimental enough to tip the balance against recovery of the arbitrageur, forcing it into insolvency." When the arbitrageur experiences financial distress, the strategic traders provide liquidity by buying the sole asset as the arbitrageur liquidates. Strategic traders choose between inactivity when the arbitrageur is well capitalized, and predatory trading as financial distress nears.

Shleifer and Vishny (1992) explore a market equilibrium approach to forced asset sales and describe how liquidity can disappear, imposing costs on the liquidation seller of assets. When financial distress is experienced by several parties within an industry and a liquidation sale takes place, liquidity must come from outsiders who are likely to have lower valuations for the asset and thus bid lower. Coval and

Stafford (2007) study asset "fire sales" in equity markets. These are forced, immediate sales for which counter-parties can demand large liquidity premia. In particular, they find "considerable support for the notion that widespread selling by financially distressed mutual funds leads to fire sale prices". The price effects are long-lasting and the 'fire sale' effect increases with the number of sellers and the level of financial distress. They find example of limits to arbitrage in funds that are unleveraged and not subject to margin calls – the forced selling pressure comes about as a result of the collective actions of investors who have placed assets on call with the agent (mutual fund manager) and who choose to redeem simultaneously. Even funds initially unaffected by financial distress can later become distressed: the selling by distressed funds of commonly held securities hurts performance of non-distressed funds, leading to investors' redemptions and subsequent distress. The authors argue that as "mutual funds cannot easily co-ordinate with each other their contemporaneous selling of overlapping holdings, combined with an outsider's ability to predict which funds will be forced to transact gives rise to an incentive for predatory trading. This can create a situation where arbitrageurs have an incentive to destabilize prices relative to informationally-efficient values by exploiting firms that have chosen a capital structure and organizational form that relies on immediately demandable capital." They further state that "the asset fire sale story provides a mechanism for rational mispricing. The market is clearly somewhat inefficient, in that market prices are not perfectly reflective of all available information. However, the basis of this mispricing requires neither irrational investors nor managers. Prices eventually reflect available information, but sometimes with a significant delay."

In summary, 'forced trading' at a time of diminished liquidity, whether by virtue of a manipulative short squeeze or an asset fire sale, can result in losses to the forced trader.

Manipulation

Fischel and Ross (1991) assume that share prices react principally to the arrival of information, and argue that manipulating prices through trading, without the use of false statements or fictitious trades, cannot succeed. However, Mahoney (1999)

argues that “there are plausible conditions under which profitable trade-based manipulation can occur.” He suggests that other traders might interpret a large manipulative trade as being ‘information based’, thus prompting a revaluation of the stock and possible further buying. Rhee (2003) argues that “it is believed that highly liquid stocks are less vulnerable to manipulation and abuse than securities that are less liquid”. Khwaja and Mian (2005) examine brokers in an emerging market colluding and trading amongst themselves and find that manipulation is not confined to small stocks. Zhou and Mei (2003) use a model that assumes that a single trader is large enough to manipulate prices. They investigate how a trade-based manipulator can exploit biases in other investors’ behaviour, such as loss aversion or trend-following. They show how trade-based manipulation can move security prices away from fair value, and suggest that this poses a challenge to the EMH. Aggarwal and Wu (2006) describe how a single broker, acting as principal, can manipulate prices by using informational asymmetry relative to other investors. However, on examining SEC manipulation cases, they conclude that “most manipulation schemes are undertaken jointly by several parties.”

The activities of ‘stock pools’ in the USA in the 1920s – groups of investors who actively traded (and allegedly manipulated prices) in specified securities are, according to Jiang *et al.* (2005), “the main reason for the current anti-manipulation laws in the United States.” Mahoney (1999) suggests that “the regulatory concern that prompted [the Securities Exchange Act of 1934] was the prevention of manipulation, uninformed trading that influences stock prices.” This Act brought US stock exchanges under federal regulation, and created the Securities and Exchange Commission. Jiang *et al.* (2005) state: “The SEC brings enforcement actions against alleged manipulators, primarily in small and illiquid stocks. During the internet boom in particular, the SEC took action against “pump and dump” schemes in which a trader makes large purchases (sometimes coupled with the release of false information) and then sells after a price increase.” Jiang *et al.* (2005) find no evidence that the 1920s stock pools’ trades drove share prices to artificially high levels. As a result, they argue that Congress’ investigations into uncovering evidence of manipulation on the New York Stock Exchange during the late 1920s were

unsuccessful. Nevertheless, the Senate Banking and Currency Committee (1932 to 1934) concluded that stock pools represented attempts to manipulate the prices of the targeted stocks. Jiang *et al.* (2005) find that the size, liquidity and disclosure standards in that market "may have been sufficient to protect investors against manipulation." and suggest that enforcement resources should be targeted on discrete segments of the securities markets, such as futures markets for commodities or financial instruments that must be delivered (and where the supply of this deliverable can be 'cornered'), or in relatively small and illiquid markets.

For manipulators, information about the stock positions and capital strength of short-sellers' can be valuable. Such information would allow the manipulator to understand better the 'ecology' of the stock market (see Lo, 2004). By knowing the price at which a short-seller established his short position, the manipulator also knows at what stock price the short-seller would experience a loss; by knowing the capital strength of the short-seller, the manipulator better understands the short-seller's ability to meet margin calls and thus to maintain losing positions. Such information allows the manipulator to gain a better understanding of when manipulation is likely to succeed. Manipulators can infer much valuable 'ecological' information from publicly disclosed data on stock lending, trading volume, stock returns and share holdings. However, market participants with access to 'proprietary' client trade flows hold a further advantage, as they can obtain more timely data with greater granularity. Such proprietary information would be very valuable to a manipulator, and firms with access to this type of data normally establish policies to disallow its use for manipulative purposes. Nevertheless, De Long *et al.* (1990) suggest that such information is commonly used by traders within investment banks.[14] The Social Studies in Finance literature shows that trading and risk arbitrage are social phenomena, performed amongst a community of traders largely known to one another. The social aspects of trading and information flows are discussed by MacKenzie (2004) and Zaloom (2006), and in more general terms by Granovetter (1973, 1985). 'Well-connected' traders, who receive rumours or information about

[14] De Long *et al.* (1990) state: "Another, perhaps more common example of destabilizing rational speculation would be front-running by investment banks. Investment banks and brokers familiar with the customer order flow have perhaps the best information about future levels of demand."

the activities of other traders, are at an advantage to those without such information. Legal and ethical considerations apart, it is a 'rational' strategy for traders to obtain and use this information, given the theoretical foundations for generating abnormal returns via manipulation and predatory trading.

Characteristics of a Manipulative Short Squeeze

The literature on security price manipulation also offers insights into the characteristics of a manipulative short squeeze. There are three classes of manipulation, according to Allen and Gale (1992). Manipulation can be 'information-based' (spreading false rumours or using false accounting); 'action-based' (e.g. launching a take-over bid); or 'trade-based' (e.g. 'pump and dump' trading). In the latter case, a manipulator 'pumps up' the share price with buying. Unable to distinguish between informed buying and manipulative buying, positive feedback traders are attracted to the rising share price and buy shares in the company, leading to further stock price increases. The manipulator then 'dumps' his stock at the higher price, securing a profit. The literature contains empirical evidence that 'pump and dump' manipulation can secure profits for manipulators: Khwaja and Mian (2005) study a 32 month period of data for the Karachi Stock Exchange (KSE) from December 1998 to August 2001. Their dataset contains aggregated daily trades for each broker and for each stock on the KSE. They find evidence of trade-based "pump and dump" price manipulation: "When prices are low, colluding brokers trade amongst themselves to artificially raise prices and attract positive-feedback traders. Once prices have risen, the former exit leaving the latter to suffer the ensuing price fall." The authors argue that several factors, crucial to successful price manipulation, favour brokers over other market participants. First, brokers have lower transaction costs in conducting frequent trading; secondly, they have superior information on prices, trade volumes and traders' expectations; thirdly, they "possess a natural advantage in spreading rumours or false information in the market." Easterbrook (1986) and Pirrong (1995) examine commodity markets and argue that a sharp rise in the price of a commodity, followed by a fall of similar size, is characteristic of manipulation. Aggarwal and Wu (2006) study US SEC actions in stock manipulation

cases and find that prices trend throughout the manipulation period and reverse in the post-manipulation period.

A ‘manipulative short squeeze’ follows this same general pattern of ‘pump’ and ‘dump’ but also involves the recall of a stock loan. A manipulative short squeeze thus combines two of the three classes of manipulation described by Allen and Gale (1992): trade-based manipulation (‘pump and dump’) and action-based manipulation (stock loan recall). I refer to the full manipulative short squeeze process as ‘pump, squeeze and dump’ and an understanding of this process informs my methodology in this chapter.

There are considerable practical challenges to researching this topic. Jiang *et al.* (2005) note that “it is difficult to reject a hypothesis of informed trading in favour of a hypothesis of trade-based manipulation, solely by examining short-run trading data.” Thus, it is difficult to use market data, such as the panel data described in Chapter 5, to distinguish between a ‘manipulative short squeeze’ and ‘informed trading’. In addition to this problem, note that stock lending markets are decentralized and there is no legal requirement to report a stock loan recall. That is to say, publicly available data does not explicitly identify stock loan recalls. Thus, it will not be possible to *affirmatively* identify a manipulative short squeeze from public data on stock lending or short-selling – it is only possible to *infer* stock loan recalls from patterns in the data. Even with private data that reveals stock loan recalls, the motivation behind a recall will remain unknown. Mahoney (1999) argues that it is difficult to test for profitable manipulation in actual trading, as manipulation is deemed illegal in the United States of America, and so is likely to be disguised. Fischel and Ross (1991) argue that trade based manipulation is often confounded by false statements and fictitious trades, making it difficult to affirmatively identify manipulation from direct questioning of market participants. In light of the practical difficulties in identifying manipulative short squeezes, it is little surprise that this topic is under-researched and poorly understood.

To overcome these problems, I define a pattern of market data with respect to stock returns and total shares on loan that is *consistent* with a manipulative short squeeze. I call such an event an 'apparent manipulative short squeeze'. I describe a set of rules for identifying apparent manipulative short squeezes in the methodology section. It is, of course, possible that patterns in the stock and stock loan market that are consistent with manipulative short squeezes could simply be the result of noise. Consequently, my group of 'apparent manipulative short squeezes' should mark the *upper count* on the actual occurrence of manipulative short squeezes. Although this appears to be a limitation of the research, one of the purposes of this research is to examine the frequency of manipulative short squeezes. If I find that 'apparent manipulative short squeezes' are rare, this finding would be consistent with the assertion that manipulative short squeezes are rare.

Jacobs and Levy (2007) assert that the *fear* of short squeezes deters some short-sellers, but that this fear is largely unfounded as short squeezes are rare events and confined to illiquid stocks. The authors do not, however, provide any evidence to back up this claim. Empirical evidence that manipulative short squeezes are rare and confined to illiquid securities could assist in reducing fear amongst short-sellers. By reducing fear, we reduce an indirect short-sale constraint and so promote market efficiency. The aim of this research is to examine the frequency and nature of manipulative short squeezes, the losses that short-sellers suffer and the type of stocks affected. I use the panel of data described in Chapter 5. From this dataset, I find that manipulative short squeezes are rare for larger, more liquid companies. If they occur at all, it tends to be in smaller, less liquid stocks. In the early stages of events identified as 'apparent manipulative short squeezes', stocks experience statistically significant positive abnormal returns. Short-sellers would experience losses and short-covering (because of loan recall) would lead to the crystallization of these losses.

My practitioner interviews reveal an awareness of manipulative short squeezes and a fear of the type of predatory trading described by Brunnermeier and Pederson (2005) and Attari *et al.* (2005). The contribution of this research is that my results should

assist in replacing the *fear* of manipulative short squeezes with a more *evidence-based* perspective. The empirical evidence presented in this study suggests that the fear of manipulative short squeezes is, in the main, unjustified for larger, more liquid stocks. This evidence should serve to reduce an indirect constraint on short-selling, thus promoting market efficiency. The remainder of the paper is as follows. In the next section I describe my methodology. I then present the results of my tests. In Section 7.4 I study the case of Volkswagen AG in autumn 2008. In the last section I offer some conclusions.

7.2 Methodology

The literature proposes several ways of testing for manipulation. Mahoney (1999) and Jiang *et al.* (2005) focus on the 'stock pools' of the 1920s. Each pool represented a group of investors who came together to trade in the shares of a specific company. Stock pools were suspected of price manipulation, and thus the creation of a stock pool provides an *a priori* view as to which stock will be targeted for manipulation and when that manipulation will start. To test for manipulation in a specified stock at a specified time, one can use nonparametric runs tests and event studies (in the latter case, comparing the performance of a control portfolio, matched in terms of industry classification and market capitalisation, to that of stocks targeted by stock pools). However, stock pools do not openly operate in the UK stock market at the time of this study, and so without any such *a priori* views, an alternative approach is required. To this effect, I draw upon Mahoney's (1999) suggestion that a large abnormal return in the absence of a news announcement, followed by a reversal of similar magnitude (as investors learn that the trading was not information-based) is indicative of manipulation. Furthermore, as I am interested in cases where borrowed stock is recalled and cannot be replaced, I expect to observe a decline in the total shares on loan during the manipulation process.

Definition of an 'Apparent Manipulative Short Squeeze'

I identify a pattern of stock returns and changes to shares on loan that is *consistent* with a manipulative short squeeze. I call this an 'apparent manipulative short squeeze' and define it as any situation in which all of the following occur: the stock price rises 'exceptionally' over some limited time period (the 'pump' phase), followed by a fall in the number of shares on loan (the 'squeeze' phase); subsequently, the stock price reverts towards the original, undisturbed level (the 'dump' phase). Furthermore, these events should not coincide with any regulatory news announcements - these might include trading statements, corporate results, announcement of share buybacks, change of directors etc. This latter requirement avoids the confounding of a manipulative short squeeze with reaction to new, public, company-specific information. By requiring that an exceptional price rise is followed by a price reversal, I am able to separate a manipulative short squeeze from 'informed' trading upon private information (a price reversal would not be expected in the latter case). The remaining difficulty is in separating an apparent manipulative short squeeze from noise trading. Noise trading could also lead to a rise in share price followed by a reversal. I attempt to separate the two phenomena as follows: first, by requiring that the initial share price rise is 'exceptional'. Noise treading is associated with trading by uninformed market participants. Traditional asset pricing theories generally consider the actions of noise traders to be uncorrelated amongst one another. Under such a framework, their market impact is less likely to be large, and so any stock price reaction to noise trading is likely to be limited and thus excluded by this criterion. Secondly, I require that shares on loan fall after the stock price rise. Whereas loan recalls mechanically create pressure for a reduction in shares on loan, there is no similar mechanical link between price changes due to noise and shares on loan. Nevertheless, it is not possible to fully disentangle the two phenomena and this becomes a limitation of the work that follows.

Next, I must define an 'exceptional' rise in stock price. I choose to define an exceptional rise in stock price as one that is large relative to the volatility of returns for that stock. Furthermore, I measure price changes over a three day period. A three

day period is chosen because, in the UK, stock loan recalls are settled in the same way as stock purchases, meaning that borrowers have three working days to return the stock (Faulkner, 2006)[15]. In particular, once a stock loan is recalled, a borrower who has shorted stock has three options: first, he could successfully find replacement stock; secondly, if unable to successfully find replacement stock, he could delay the return of the stock loan for up to three days in the hope of finding an alternative source of borrowing in this time; thirdly, he could cover his short position immediately and return the stock loan. Thus, even where the 'pump phase' coincides with a stock loan recall, it could take up to three days before the short-seller covers his position. For this reason, I measure the pump phase over three days. For each firm day, I measure the standard deviation of returns for the preceding sixty days. Sixty days is sufficiently long to allow for a meaningful estimate of stock return volatility, but also short enough to be 'current'. By measuring return volatility in this way for each firm day, I take account of the fact that volatility varies over time. I regard an exceptional stock price increase to be one where the stock price rises over any three-day period by at least 2.5 times the standard deviation of daily returns for that stock. Assuming an approximately Normal distribution of stock returns, this method would generally isolate situations that fall within the top percentile of stock price changes. By setting this specific definition, I establish an upper limit to the frequency of 'apparent manipulative short squeezes'. I later undertake robustness tests using different thresholds.

After receiving an order to return a stock loan, I expect a short-seller will search for alternative sources of borrowing. If a replacement loan is found, the short position need not be covered. However, the UK lending market is decentralised and thus finding replacement shares can take time. D'Avolio (2002) observes for his sample of US stocks that when loans are recalled, there is usually no immediate replacement available. Since in the UK it takes three days to deliver purchased stock under standard settlement arrangements, some short-sellers might be expected to cover

[15] A typical stock lending agreement in the UK requires the return of stock within three days of recall. Failure to return recalled stock within this time entitles the lender to claim costs from the borrower, and to serve a written notice of 'Event of Default', which can have repercussions for the borrower with respect to other counter-parties.

immediately upon loan recall. However, there is another group of borrowers who may prefer to delay covering their positions and look for replacement loans in subsequent days. If unsuccessful and eventually forced to cover, they will have to pay a premium for the delivery of stock to be made in one or two, rather than three days. Moreover, uninformed traders might start taking long positions around the same time, believing that the buyers they observe are informed market participants (see Hong and Stein, 2003). On the whole, there is likely to be a lot of noise in the stock price on the days immediately after the recall, but it is realistic to expect that the initial stock price rise will start to reverse by the third day after the stock loan recall. I define the event date (day 0) as the first day following the exceptional rise in share price on which the number of shares on loan falls. I ensure that there are no Regulatory News Service announcements from five days prior to the event date until ten days after the event date. Thus, the observed patterns are not the result of reactions to new, public information.

It is not clear over what time period the stock price reversal should take place. Most theoretical models of predatory trading or price manipulation assume complete price reversal, but use 'notional' time periods (see, for example, Brunnermeier and Pedersen, 2005, and Aggarwal and Wu, 2006). Thus, I expect complete price reversal over some unknown time period. If I over-estimate the time period, I should expect to observe complete price reversal, but am more likely to introduce confounding influences such as a change in company or economic fundamentals. By under-estimating the time period, I would expect to see partial price reversal only. Without a good theory on the time taken for a stock price to revert fully to its fair value, I prefer to identify partial reversal over a limited time period, as this reduces the risk of confounding factors contaminating the study. I report cases with a price reversal of at least 70% over a ten day period following the event date.

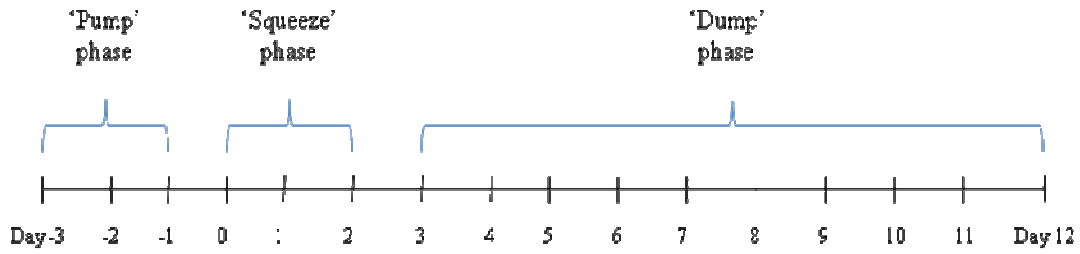
Estimating Abnormal Returns around Apparent Manipulative Short Squeezes

Having identified a number of 'apparent manipulative short-squeezes', I then estimate abnormal returns for the stocks involved. As described in Chapter 5, I use

the CAPM model to estimate abnormal returns and employ a one-year formation period to estimate betas. Due to the small number of observations in each sample and the presence of some large-cap stocks, I prefer to use equally-weighted returns when aggregating the results. However, Canina *et al.* (1998) warn that using equally-weighted returns can result in large biases and consequently, I also weight by market-capitalization.

I estimate abnormal returns for each of the three phases associated with an 'apparent manipulative short squeeze'. "Phase 1" (the 'pump' phase) lasts for three days, from day -3 to -1; "Phase 2" (the 'squeeze' phase) also lasts for three days, from day 0 to day 2; and "Phase 3" (the 'dump' phase) lasts for ten days, from day 3 to day 12 Figure 7.3 illustrates these three phases in the form of a timeline.

Figure 7.3 Timeline Representing the Three Phases of an 'Apparent Manipulative Short Squeeze'



The final step is to calculate how much short-sellers lose as a result of the manipulation. I calculate average cumulative abnormal returns from the start of the 'pump' phase to the end of the 'squeeze' phase (i.e. from day -3 to day 2). By this time, short covering is expected to have been completed and the short-seller should no longer be exposed to stock price movements. However, during the 'pump' phase (i.e. day -3 to day -1) short-sellers are highly likely to have experienced negative abnormal returns, because stock prices were increasing by definition. Including this interval in the analysis might result in a biased outcome. As a solution to this problem, I adopt an alternative approach that starts to measure cumulative abnormal

returns from event day (day zero) until the end of the squeeze phase (day 2). I then test if these returns are statistically significantly different from zero, by comparing to the relevant 2.5% t-test statistic with degrees of freedom equal to the number of companies in the sample minus one.

Characteristics of Stocks around Apparent Manipulative Short Squeezes

I also examine the characteristics of stocks around the time of 'apparent manipulative short squeezes'. In the literature, manipulation is associated with the following characteristics:

1. Smaller size

Jiang *et al.* (2005) argue that "successful trade-based manipulation is difficult for all but the smallest and most illiquid companies." I compare the market capitalisation of the stocks affected by apparent manipulative short squeezes with the average market capitalisation of all the stocks in the dataset on that day.

2. Lower liquidity

Brunnermeier and Pederson (2005) show in their model that predatory trading against other traders has the effect of reducing the liquidity of that stock in the market. Aggarwal and Wu (2006) find that price manipulators target stocks that are illiquid. I obtain two proxies for liquidity in those stocks subject to 'apparent manipulative short squeezes'. First, the free float value of shares and second, the number of days of normal trading volume that it would take a short-seller to cover his position. This latter is called the 'Days to Cover Ratio' (DCR) and is defined as:

$$\text{Days to Cover Ratio}_{i,t}\ (\text{DCR}) = \frac{\text{Shares on Loan}_{i,t}}{\text{Average Daily Trading Volume}_{i,t}} \qquad (7.1)$$

Where:

$\text{Days to Cover Ratio}_{i,t}$ is the 'days to cover ratio' for stock *i* on day *t*.

$\text{Shares on Loan}_{i,t}$ is the closing number of shares on loan for stock *i* on day *t*.

$\text{Average Daily Trading Volume}_{i,t}$ is the moving average of the trading volume for stock *i* from days (*t*-61) to (*t*-1). I choose 60 days of trading volume as a compromise between the risk of including out-of-date information on trading volume and the risk of one or more exceptional days influencing the moving average figure.

A stock with a high days to cover ratio is deemed to be less liquid (from a short-seller's perspective) than a comparable stock with a lower days to cover ratio. For each day during the manipulation period, I compare the DCR of a stock with its average value over the three preceding months. This allows me to observe any trend in this liquidity ratio during the apparent manipulative short squeeze. I also compare the free float number of shares for each stock with that of the average stock on the event day.

3. Elevated volatility of stock returns

Mahoney (1999) and Aggarwal and Wu (2006) argue that the stock price volatility of a manipulated stock would be greater than that of a similar 'un-manipulated' stock. I measure the volatility of stock returns for each company that is subject to an apparent manipulative short squeeze, from 20 days prior to the event date through to 10 days after the event date. For each of these days volatility is calculated as the standard deviation of returns for the twenty preceding days.[16] For each firm day, I compare the stock volatility measure to the year's average for that firm.

4. Elevated trading volume

Zhou and Mei (2003) argue that "excessive trading volume and price movements without news on fundamentals" can assist in distinguishing manipulative trading from other forms of trading. Aggarwal and Wu (2006) state that stocks investigated

[16] The number of days needs to be as small as possible to grasp the changes in volatility that we expect to see around the manipulative short squeeze. Nevertheless, this number still has to be sufficient to calculate reliable standard deviations. I choose 20 days as a compromise between these two requirements.

in US SEC actions in stock manipulations cases exhibit elevated trading volumes. For each stock subject to an 'apparent manipulative short squeeze', I record trading volume for the five days preceding the start of the manipulation process and compare this to the three month average trading volume for the stock.

7.3 Results

I observe thirty-six incidences where a stock price rises exceptionally, then shares on loan decreases, followed by a stock price reversal, in accordance with my definition from section 7.2 above. Of these thirty-six, some could represent 'noise' rather than manipulation. To consider how many might be due to noise, I run a 'mirror-image test' on the full dataset to identify the number of times the *opposite* pattern in market prices and shares on loan occurs (i.e. significant decreases in share price, followed by a rise in the number of shares on loan, followed by a reversal in share price). This mirror-image pattern would not be associated with manipulation against short-sellers, but would be expected to be subject to a similar degree of noise. If manipulative short squeezes do not occur in the market at all, one would expect the mirror image test to produce approximately the same number of observations as the 'apparent manipulative short squeeze' test. I observe twenty-five 'mirror-image test events', compared to thirty-six 'apparent manipulative short squeezes'. This lower number of 'mirror image test events' is consistent with the notion that some but not all 'apparent manipulative short squeezes' are simply the result of noise.

Of the thirty-six 'apparent manipulative short squeezes' identified above, sixteen are associated with regulatory news announcements. I eliminate these, as it is not possible to distinguish between a reaction to a news release and a manipulative short squeeze. This leaves twenty incidences matching my definition of an apparent manipulative short squeeze and free from the confounding effects of any regulatory news releases. This is a small number of incidences to observe over 979 days for between 350 and 681 stocks. Thus, an 'apparent manipulative short squeeze' as defined is a rare event.

I examine the abnormal returns for stocks involved in 'apparent manipulative short squeezes' for each day during the manipulation process (days -3 to 12). I group the companies into portfolios and test the null hypothesis of daily returns being equal to zero. Results are reported in Table 7.1. Panel A shows the equally-weighted portfolios: returns for these portfolios are significantly different from zero for eight of the 16 days. Panel B shows the market cap-weighted portfolios: only two of the 16 days exhibit returns that are significantly different from zero. The greatest magnitudes for the daily abnormal returns are observed during the pump phase and on the event day. The difference in results between the equally-weighted and market-cap weighted portfolios is consistent with the notion that abnormal returns are greater in smaller stocks.

Table 7.1 Abnormal Returns around Apparent Manipulative Short Squeezes

Panel A: Equally-Weighted Portfolio Abnormal Returns

Day	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
Average	-0.35%	1.47%	2.33%	2.25%	0.21%	-0.21%	-0.94%	-0.90%	-0.62%	-0.83%	-0.80%	-0.37%	-0.95%	-1.03%	-0.28%	-0.18%
Std. Deviation	1.42%	1.20%	1.49%	2.13%	2.34%	1.24%	1.51%	2.23%	1.59%	1.28%	1.44%	1.21%	1.95%	1.17%	1.90%	1.78%
t-stat. (abs.)	1.09	5.47	7.00	4.74	0.40	0.75	2.79	1.80	1.75	2.90	2.50	1.38	2.19	3.94	0.66	0.46
Prob. 2 tails	0.29	0.00	0.00	0.00	0.69	0.46	0.01	0.09	0.10	0.01	0.02	0.18	0.04	0.00	0.52	0.65
Prob. 1 tail	0.15	0.00	0.00	0.00	0.35	0.23	0.01	0.04	0.05	0.00	0.01	0.09	0.02	0.00	0.26	0.32

Panel B: Market Cap-Weighted Portfolio Abnormal Returns

Day	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
Average	-0.01%	0.08%	0.06%	0.05%	0.00%	0.04%	-0.02%	-0.05%	-0.01%	-0.07%	-0.01%	0.01%	-0.02%	-0.04%	0.00%	-0.01%
Std. Deviation	0.03%	0.23%	0.11%	0.09%	0.03%	0.19%	0.07%	0.17%	0.06%	0.19%	0.06%	0.11%	0.09%	0.11%	0.09%	0.03%
t-stat. (abs.)	1.47	1.55	2.61	2.62	0.65	0.93	1.03	1.29	0.72	1.57	0.60	0.55	0.91	1.64	0.21	0.68
Prob. 2 tails	0.16	0.14	0.02	0.02	0.52	0.36	0.32	0.21	0.48	0.13	0.56	0.59	0.37	0.12	0.84	0.50
Prob. 1 tail	0.08	0.07	0.01	0.01	0.26	0.18	0.16	0.11	0.24	0.07	0.28	0.29	0.19	0.06	0.42	0.25

To consider the potential losses to short-sellers, I estimate the cumulative abnormal returns for each phase of the 'apparent manipulative short squeezes'. Table 7.2 presents the results: Panel A shows cumulative abnormal returns by phase for the equal-weighted portfolios and Panel B shows cumulative abnormal returns by phase for the market-cap-weighted portfolios.

Table 7.2 Cumulative Abnormal Returns

Panel A. Equally-Weighted Portfolio Cumulative Abnormal Returns

Phase	1	2	3a	3b
Average	3.45%	2.26%	-4.09%	-6.91%
Std. Dev.	2.63%	3.43%	4.28%	5.17%
t-stat. (abs.)	5.86	2.95	4.27	5.98
Prob. 2 tails	0.00	0.01	0.00	0.00
Prob. 1 tail	0.00	0.00	0.00	0.00

Panel B. Market Cap-Weighted Portfolio Cumulative Abnormal Returns

Phase	1	2	3a	3b
Average	0.13%	0.10%	-0.15%	-0.21%
Std. Dev.	0.31%	0.24%	0.32%	0.36%
t-stat. (abs.)	1.92	1.74	2.12	2.60
Prob. 2 tails	0.07	0.10	0.05	0.02
Prob. 1 tail	0.03	0.05	0.02	0.01

Phase 3 has been shown in two ways: as sub-period 3a (days 3 to 7) and full period 3b (days 3 to 12) to provide greater granularity.

From Panel A, I can reject the hypothesis of zero abnormal returns for the equally-weighted portfolio for each phase. I observe significant positive abnormal returns of 3.45% in the first phase (days -3 to -1) and significant positive abnormal returns of 2.26% in the second phase (days 0 to 2). These positive abnormal returns are followed by significant reversals in the third phase. In Panel B I observe much lower abnormal returns, as a small number of large-cap stock observations have lower abnormal returns but large weights in the portfolio. The positive abnormal returns in phase one and phase two are significant at the 5% level using a one-tailed test. The above results indicate significant losses for short-sellers around 'apparent manipulative short squeezes'

Table 7.3 below shows cumulative abnormal returns for portfolios by day, rather than by phase, up until the start of the expected price reversal. Panel A shows equally-weighted portfolio cumulative abnormal returns by day. Cumulative abnormal returns peak at 5.91% by day 1 and start to reverse thereafter. I also show the upper and lower thresholds to the 95% confidence intervals for these cumulative abnormal returns. Recall that during days -3 to -1 (the 'pump' phase) short-sellers are highly likely to have experienced negative abnormal returns, because stock prices were increasing by definition. Including this interval in the analysis might result in a biased outcome. Consequently, I adopt an alternative approach in Panel B, and start

to measure cumulative abnormal returns from event day (day zero). Cumulative abnormal returns peak at 2.47% on day 1. In Panel C and Panel D, I show the corresponding results for market-cap weighted portfolios. Cumulative abnormal returns peak at day 2, at much smaller magnitudes than with the equally-weighted portfolios.

Table 7.3 Cumulative Abnormal Returns by Day

Panel A: Equally-Weighted Portfolios (starting from day -3)

Day	-3	-2	-1	0	1	2	3
Average	-0.35%	1.12%	3.45%	5.70%	5.91%	5.71%	4.77%
Std. Deviation	1.42%	1.81%	2.63%	2.89%	4.53%	4.39%	4.50%
Std. Error	0.32%	0.40%	0.59%	0.65%	1.01%	0.98%	1.01%
Conf. Int.: Higher Value	0.32%	1.97%	4.68%	7.05%	8.03%	7.76%	6.87%
Conf. Int.: Lower Value	-1.01%	0.27%	2.22%	4.35%	3.79%	3.65%	2.66%

Panel B: Equally-Weighted Portfolios (starting from day 0)

Day	0	1	2	3
Average	2.25%	2.47%	2.26%	1.32%
Std. Deviation	2.13%	3.57%	3.43%	3.61%
Std. Error	0.48%	0.80%	0.77%	0.81%
Conf. Int.: Higher Value	3.25%	4.14%	3.86%	3.01%
Conf. Int.: Lower Value	1.26%	0.79%	0.65%	-0.37%

Panel C: Market-Cap Weighted Portfolios (starting from day -3)

Day	-3	-2	-1	0	1	2	3
Average	-0.01%	0.07%	0.13%	0.19%	0.19%	0.23%	0.21%
Std. Deviation	0.03%	0.21%	0.31%	0.38%	0.38%	0.55%	0.57%
Std. Error	0.01%	0.05%	0.07%	0.09%	0.08%	0.12%	0.13%
Conf. Int.: Higher Value	0.00%	0.17%	0.28%	0.37%	0.37%	0.49%	0.48%
Conf. Int.: Lower Value	-0.02%	-0.03%	-0.01%	0.01%	0.02%	-0.03%	-0.05%

Panel D: Market-Cap Weighted Portfolios (starting from day 0)

Day	0	1	2	3
Average	0.05%	0.06%	0.10%	0.08%
Std. Deviation	0.09%	0.08%	0.25%	0.26%
Std. Error	0.02%	0.02%	0.05%	0.06%
Conf. Int.: Higher Value	0.09%	0.09%	0.21%	0.20%
Conf. Int.: Lower Value	0.01%	0.02%	-0.02%	-0.04%

The tables above reveal averages for a portfolio of stocks subject to 'apparent manipulative short squeezes'. By examining the underlying data I observe that the maximum loss a short-seller would have suffered from any individual stock was 8.16% in phase one and 13.74% in Phase two. Note that a trader or long-short fund

manager would normally hold a number of short positions at any time. Stocks subject to manipulative short squeezes are likely to form a subset of these short positions. When considered in this broader context, the abnormal returns observed above, while statistically significant, are likely to be of moderate economic significance.

Robustness Checks

As a robustness check, I filter for 'phase one' stock price rises that represent two (and three) standard deviation changes in stock price, as opposed to the original 2.5 standard deviations. I also filter for 'phase three' stock price reversals that are both greater and lower than the criterion of a 70% reversal. Unsurprisingly, I obtain a greater number of 'apparent manipulative short squeezes' when I test using looser criteria (and a smaller number of observations with the stricter criteria). I find that the magnitude of the mean abnormal returns varies inversely with the number of 'apparent manipulative short squeezes' that pass through the defining filter. By using looser criteria, I am likely to be collecting more observations that are simply the result of noise. Accordingly, I have lower confidence that the greater number of observations represents true manipulative short squeezes. When filtering using stricter criteria, I am likely to be excluding a greater number of true manipulative short squeezes (or at least those that have been less effective in generating large stock price movements). The mirror-image test (described earlier in this section) provides a means of estimating the amount of noise in the observations.

I also consider an entirely different means of detecting a manipulative short squeeze. The manipulation process comprises the recall of a stock loan, the removal of the recalled stock from the pool of stock available to borrow, and an attempt by the original stock borrower to replace the recalled stock. As such, a manipulative short squeeze should be associated with a reduction in shares on loan for the stock concerned. There should also be a rise (or at least no reduction) in stock lending fee, as demand for borrowing stock is unchanged but the supply of stock available for borrowing has fallen. The stock loan utilisation rate (i.e. the proportion of shares available for borrowing that are actually borrowed) should increase as the victim of

the recall seeks to replace his loan from the remaining pool of stock available for borrowing. To take account of the time taken for a stock loan recall to be reflected in the stock lending data, I use a five day period for the measurement of these three variables (shares on loan, stock lending fee and stock utilisation rate). For each stock *i* and day *t*, I model these three variables as dummy variables in the following least squares regression equations:

$$\textit{(Cumulative Abnormal Return)}_{i,\,t=-3,0} = \alpha + \beta(D1_{i,\,t} * D2_{i,t} * D3_{i,t}) + u_{i,t} \quad (7.2)$$

$$\textit{(Cumulative Abnormal Return)}_{i,\,t=0,3} = \alpha + \beta(D1_{i,t} * D2_{i,t} * D3_{i,t}) + u_{i,t} \quad (7.3)$$

where dummy variable $D1_{i,t}$ is set to 1 if shares on loan falls during the five day period prior to day *t*, or 0 otherwise; dummy variable $D2_{i,t}$ is set to 1 if the stock lending fee has not fallen during the five day period prior to day *t*, or 0 otherwise; and dummy variable $D3_{i,t}$ is set to 1 if the loan utilisation rate increases during the five day period prior to day *t*, or 0 otherwise. In Equation 7.2, the dependent variable is the cumulative abnormal return of stock *i* from three days before the three dummy variables are all '1', to the day they are all '1'. In Equation 7.3, the dependent variable is the cumulative abnormal return of stock *i* from the day the three dummy variables are all '1', to three days after.

Stock loan utilisation data is available from November, 2004 (the start of collection of such data by Data Explorers Ltd) and my results are based on the period from 8/11/2004 to 28/5/2008 (taking account of the five working days required for measuring the dummy variables and the four working days required for estimating the abnormal returns). Results are shown in Table 7.4 below.

Table 7.4 Robustness Check with Three Dummy Variables

Panel A: Cumulative Abnormal Returns (day -3 to day 0)

Dependent Variable: ABN_CUM_MINUS3
Method: Panel Least Squares
Sample (adjusted): 8/11/2004 5/31/2007
Cross-sections included: 624
Total panel (unbalanced) observations: 199024

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.38E-04	7.14E-05	13.137663	2.08E-39
D1*D2*D3	1.79E-08	1.15E-08	1.5468436	0.1219026

R-squared	1.20E-05	Mean dependent var	9.38E-04
Adjusted R-squared	7.00E-06	S.D. dependent var	0.0318513
S.E. of regression	0.03185118	Akaike info criterion	-4.0554746
Sum squared resid	201.9073536	Schwarz criterion	-4.0553721
Log likelihood	403570.3872	F-statistic	2.3927251
Durbin-Watson stat	0.566594047	Prob(F-statistic)	0.1219026

Panel B: Cumulative Abnormal Returns (day 0 to day 3)

Dependent Variable: ABN_CUM_PLUS3
Method: Panel Least Squares
Sample (adjusted): 8/11/2004 5/28/2007
Cross-sections included: 624
Total panel (unbalanced) observations: 197711

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.21E-03	7.15E-05	16.870364	8.24E-64
D1*D2*D3	1.07E-08	1.15E-08	0.9247395	0.3551026

R-squared	4.33E-06	Mean dependent var	1.21E-03
Adjusted R-squared	-7.33E-07	S.D. dependent var	0.0318051
S.E. of regression	0.031805157	Akaike info criterion	-4.0583665
Sum squared resid	199.9961	Schwarz criterion	-4.0582634
Log likelihood	401193.8479	F-statistic	0.8551431
Durbin-Watson stat	0.570749774	Prob(F-statistic)	0.3551026

The β-coefficient is not significantly different from zero for either measurement period. The adjusted R-squared for each analysis is also vanishingly small (less than 0.01% in each case). This pattern is consistent with the notion that there are many false positive signals in such an analysis. Discussions with stock lending agents and

prime brokers suggests that the true number of recalls that are passed onto clients (i.e. where the recalled stock cannot be replaced quickly) over any given twelve month period is likely to be in single digits, consistent with my original definition of a manipulative short squeeze.

I refine the above analysis to include a fourth dummy variable, $D4_{i,t}$, which equals 1 if the stock loan utilisation rate is in the top 5% of all such observations, or 0 otherwise[17]. Manipulative short squeezes are more likely to occur in stocks with high utilisation rates, as a stock lending agent is more likely to pass a recall on to the stock borrower when the utilisation rate is high (i.e. the loan is harder to replace). By adding this fourth independent dummy variable to the regressions in Equations 7.2 and 7.3, I obtain the results shown in Table 7.5 below.

[17] Thanks to Will Duff-Gordon at Data Explorers Ltd. for this idea. Dummy variable $D4_{i,t}$ is partially correlated with dummy variable $D3_{i,t}$ and this is a limitation to this analysis.

Table 7.5 Robustness Check with Four Dummy Variables

Panel A: Cumulative Abnormal Returns (day -3 to day 0)

Dependent Variable: ABN_CUM_MINUS3
Method: Panel Least Squares
Sample (adjusted): 8/11/2004 5/31/2007
Cross-sections included: 624
Total panel (unbalanced) observations: 199024

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000946	7.15E-05	13.23244	0
D1*D2*D3*D4	-0.002691	0.001266	-2.125301	0.0336

R-squared	0.000023	Mean dependent var	0.000938
Adjusted R-squared	0.000018	S.D. dependent var	0.031851
S.E. of regression	0.031851	Akaike info criterion	-4.055485
Sum squared resid	201.9052	Schwarz criterion	-4.055383
Log likelihood	403571.4	F-statistic	4.516904
Durbin-Watson stat	0.566578	Prob(F-statistic)	0.033563

Panel B: Cumulative Abnormal Returns (day 0 to day 3)

Dependent Variable: ABN_CUM_PLUS3
Method: Panel Least Squares
Sample (adjusted): 8/11/2004 5/28/2007
Cross-sections included: 624
Total panel (unbalanced) observations: 197711

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001209	7.16E-05	16.8744	0
D1*D2*D3*D4	-0.000754	0.001269	-0.594186	0.5524

R-squared	0.000002	Mean dependent var	0.001207
Adjusted R-squared	-0.000003	S.D. dependent var	0.031805
S.E. of regression	0.031805	Akaike info criterion	-4.058364
Sum squared resid	199.9966	Schwarz criterion	-4.058261
Log likelihood	401193.6	F-statistic	0.353057
Durbin-Watson stat	0.570745	Prob(F-statistic)	0.552388

Panel A of Table 7.5 shows that the β-coefficient for the period from day -3 to day 0 is statistically significantly different from zero at the 5% level. However, it is very small in magnitude. The adjusted R-squared for this analysis is again vanishingly

small. Clearly, if each of these incidences reflects an attempted manipulative short squeeze, they are of limited economic significance to short-sellers. The β-coefficient in Panel B is not significantly different from zero.

Characteristics of Stock Subject to Apparent Manipulative Short Squeezes

Table 7.6 summarizes the key characteristics (size, volatility, trading volume, liquidity and utilisation rate) for each stock and for the portfolio of stocks involved in 'apparent manipulative short squeezes'.

Table 7.6 Characteristics of Stocks subject to Apparent Manipulative Short Squeezes

Event №	Mkt Cap (at day 0 as % of market average)	Stock Volatility (at day 0 as % of Year Average)	Mean Trading Volume, days -3 to 0 (% of 3m Average)	Free Float (at day 0 as % of Mkt Average)	Mean DCR (days -3 to 0)	DCR (at day 0 as % of 3m Average)	Shares on Loan (at day 0 as % of 3m Average)	Mean Stock Lending Fee (days -3 to 0)	Mean Stock Lending Fee (at day 0 as % of 3m Average)	Mean % Stock Utilisation Rate (days -3 to 0)	Mean Stock Utilisation Rate (at day 0 as % of 3m Average)
1	133.2%	194.8%	176.9%	132.4%	2.5	57.7%	61.2%	10.0	96.9%	6.6	45.3%
2	64.5%	73.1%	87.5%	34.4%	5.7	85.8%	85.9%	15.4	93.2%	11.9	87.9%
3	12.0%	79.3%	337.3%	11.5%	2.5	57.0%	74.2%	59.2	37.4%	3.4	142.4%
4	5.1%	96.9%	3.8%	3.2%	31.9	158.1%	101.8%	61.6	97.2%	37.7	85.1%
5	13.7%	79.2%	26.9%	12.7%	10.2	98.5%	106.5%	59.5	78.7%	3.0	95.6%
6	15.2%	79.8%	28.5%	16.1%	2.0	218.2%	102.0%	28.3	46.0%	0.3	37.2%
7	16.2%	70.0%	290.8%	16.3%	1.2	82.1%	84.7%	222.1	81.2%	1.0	107.1%
8	5.6%	243.6%	40.5%	5.7%	24.6	106.1%	127.2%	-	-	-	-
9	73.9%	124.8%	112.9%	69.3%	1.3	52.4%	66.4%	35.8	239.3%	2.3	51.7%
10	31.6%	81.8%	77.6%	23.6%	2.7	110.2%	111.7%	-	-	-	-
11	82.6%	70.9%	97.4%	81.0%	3.0	122.8%	118.9%	19.7	87.8%	10.6	96.8%
12	11.3%	90.2%	76.6%	9.3%	11.1	122.6%	110.5%	-	-	-	-
13	22.5%	101.8%	282.7%	18.7%	9.2	159.3%	109.1%	21.6	133.0%	19.6	113.5%
14	18.5%	147.0%	98.5%	18.4%	3.9	83.4%	100.2%	-	-	-	-
15	13.8%	66.5%	112.6%	10.3%	1.5	82.8%	54.1%	-	-	-	-
16	444.8%	114.7%	80.8%	513.7%	5.6	76.9%	68.3%	10.0	111.2%	6.3	71.8%
17	11.1%	103.6%	101.4%	8.4%	4.2	-	-	-	-	-	-
18	76.5%	71.6%	126.0%	77.8%	12.2	94.9%	95.6%	10.5	76.3%	29.3	89.0%
19	1860.6%	112.5%	163.9%	2154.0%	3.8	91.9%	98.9%	13.6	-	0.1	-
20	27.9%	62.7%	150.4%	27.4%	5.0	-	-	-	-	-	-
Mean	147.0%	103.2%	123.6%	162.2%	7.2	103.4%	93.2%	43.6	98.2%	10.2	85.3%
St. Dev	414.9%	45.9%	89.8%	482.1%	8.0	41.6%	21.0%	57.1	51.3%	11.9	30.2%

The majority of stocks have market capitalisations of less than one-fifth the market average. This provides some support for the argument that smaller companies are

more vulnerable to manipulative short squeezes. However, a small number of large-cap stocks increase the portfolio mean market capitalisation, so that it is above the market average. There is some support for the notion that the volatility of returns of stocks is elevated ahead of a manipulative short squeeze – stock volatility as measured at day 0 during an 'apparent manipulative short squeeze' is slightly above its annual average (at 103.2% of annual average) but this result is not statistically significant. The mean trading volume is elevated prior to an 'apparent manipulative short squeeze' compared to its 3 month average, at 123.6% of its 3 month average, but again this result is not statistically significant. The majority of stocks have a free float value of shares less than one-fifth the market average. This supports the view that less liquid stocks are more vulnerable to manipulation. As an alternative measure of liquidity, I examine the number of days of normal trading volume that it takes investors to cover their short positions (The Days to Cover Ratio, or DCR). The portfolio mean DCR at day 0 is 103.4% of its three month average, but this result is not statistically significant. The percentage of shares on loan is not elevated for stocks subject to 'apparent manipulative short squeezes'. In conclusion, there is weak support for the notion that manipulative short squeezes are associated with stocks with smaller market capitalization and free float, elevated trading volume and reduced liquidity.

Using the above observations, I analyse all firms in the dataset to identify stocks that display similar qualities to those found in the set of 'apparent manipulative short squeezes'. Specifically, I identify instances where the market cap and free float value of a company are below the market average and where the stock's DCR and turnover are above their 60 day average. If a stock has more than one day when it satisfies these conditions, I treat every such occurrence as a separate event. I find 12,909 firm days satisfying the conditions described above. However, there is on average no price response around these occurrences. This suggests that it is difficult to predict a manipulative short squeeze based strictly on these size, trading volume and liquidity criteria, as many 'false positives' will emerge.

Jacobs and Levy (2007) argue that if a security does become subject to a short squeeze then a reduction in the supply of loanable stock is usually signalled by a decline in the rebate rate offered by prime brokers or by warnings from the prime brokers, so the position can be scaled back or covered in advance of any demand that borrowed stock be returned. According to this argument, short squeezes are rare and can largely be predicted. As such, they pose little threat to short-sellers. I test this argument on my sample of 'apparent manipulative short squeezes' by studying stock loan utilization rates (a measure of the proportion of available stock to borrow that is indeed borrowed) and stock loan fees (i.e. cash return – stock loan rebate rate) around the time of the apparent short squeezes. These data are shown in the final four columns of Table 7.6. I find no evidence that utilization rates and stock lending fees rise around the time of the apparent manipulative short squeezes. This is not consistent with the argument put forward by Jacobs and Levy (2007). I attribute this to the fact that my dataset considers the larger UK stocks (market capitalisations of £25 million and above) where the availability of stock to borrow is relatively high. For smaller stocks, loan availability is more likely to be problematic. My findings indicate that it is difficult to predict a manipulative short squeeze using publicly available information. It is perhaps this characteristic - that these are unpredictable events that can have economic impact - that has led to the fear of manipulative short squeezes amongst practitioners.

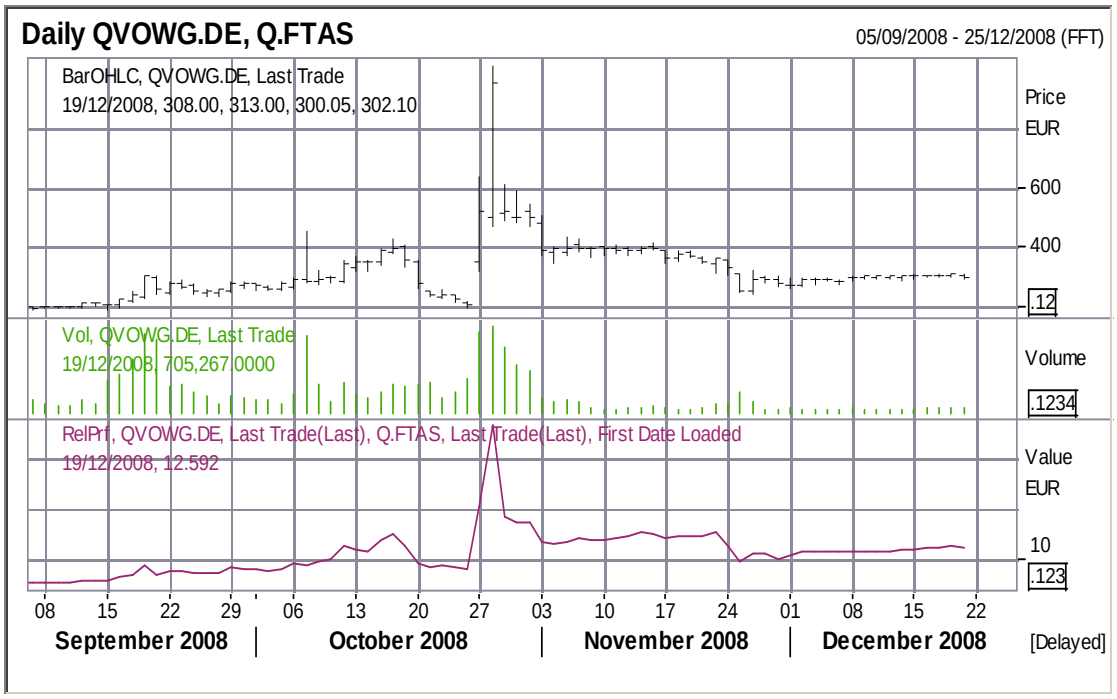
7.4 Case Study

"This is probably the biggest short squeeze in history"

The above quote is from Max Warburton, analyst at Sanford Bernstein, and is reported by Richard Milne of the London Financial Times (see Financial Times, 28th October, 2008). Mr Warburton was describing the events surrounding trading in the shares of Volkswagen AG during September and October of that year. Volkswagen was a large-cap company (one of Germany's largest companies by market capitalization) but had a limited free float. By September, 2008, rival car manufacturer Porsche AG had publicly declared a stake of 42.6% of the ordinary

shares in Volkswagen AG. A further 20.2% of the ordinary shares were owned by the Lower Saxony Land Government – a long-term stock-holder. Thus, the free float in Volkswagen ordinary shares was only 37.2% of the firm's market capitalisation. Over a period of time, the relationship between the price of the Volkswagen's ordinary shares and its preference shares had started to diverge from its long-term average, and risk-arbitrageurs had increased their short positions in the ordinary shares of the company. By 24th September 2008, 16.39% of Volkswagen stock was on loan. Unbeknownst to the risk-arbitrageurs, Porsche AG had purchased a cash-settled option position over a further 31.5% of the company. Porsche was not required to disclose its ownership of this option position under German financial regulations. If this cash-settled option could be converted into Volkswagen stock by agreement with the counterparties to the transaction, then Porsche would have effective control over 74.1% of the company. Thus, the effective free-float in Volkswagen shares was not 37.2% but instead 5.7% of market capitalization - less than the short-sellers' aggregate position. Short-sellers had effectively become 'cornered' - but were unaware of this! As Porsche released news of its option position to the market, short-sellers realised that they were vulnerable to recall risk and margin calls. The price of Volkswagen shares rose sharply (by approximately 400% in a matter of days). The exact cause(s) of this price rise have yet to be fully understood. Some possible reasons include pre-emptive short-covering, forced short-covering after stock loan recall and dynamic hedging by the counter-parties to Porsche's cash-settled options. Volkswagen briefly became the world's most valuable company by market capitalisation, despite deteriorating fundamentals for car manufacturers at the time. Figure 7.5 below shows the stock price, trading volume and relative stock performance for Volkswagen around this time (source: Reuters):

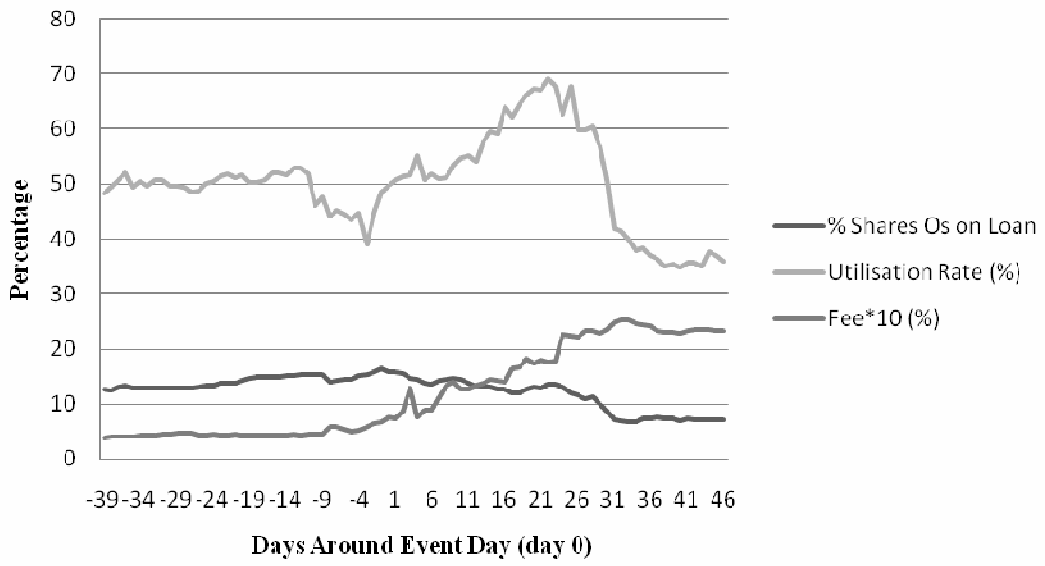
Figure 7.5 Market Data for Volkswagen AG Shares in autumn 2008



Porsche later announced that it would sell shares in Volkswagen to facilitate an orderly covering of short positions. By November, Porsche revealed that it had made a profit of EUR 6.8 billion through its trading of options in Volkswagen stock. A series of short-sellers announced large losses and the general suspicion arose that the short-sellers' had become the victims of stock manipulation. As a result of these suspicions, the German financial regulator initiated an investigation into trading in Volkswagen shares and options – this investigation remains ongoing at the time of writing.

Figure 7.6 below shows the percentage of shares on loan, the stock loan utilisation rate and the average stock loan fee for Volkswagen AG ordinary shares around the 'event day', day 0, defined as the first day on which shares on loan falls after an exceptional three day share price rise (25th September, 2008 in this case; well before the final and most prominent share price surge in late October).

Figure 7.6. Percentage of Shares on Loan, Stock Loan Utilisation Rate and Average Stock Loan Fee for Volkswagen AG Ordinary Shares around the Event Date (day 0)



By examining stock lending data around the time of the alleged manipulation, I observe that the ordinary shares experienced an exceptional price increase, followed by a reduction in shares on loan, and finally a gradual price reversal. This is consistent with the pattern of 'pump, squeeze and dump' that I use to define an 'apparent manipulative short squeeze'. In terms of stock characteristics, Volkswagen had a large market–capitalization, limited free float and a high 'days to cover ratio'. Trading volume was elevated and stock return volatility increased sharply in the days before the event day. As such, the stock's characteristics match those from my sample of 'apparent manipulative shot squeezes' in all but one respect – namely, that Volkswagen was a large-cap stock. The stock loan utilisation rate was high at 49.02% on the event day and rose in the days afterwards (to 55.96% by the fifth day after the event day). The stock loan fee also rose, from 0.68% on the event day to 0.76% by the fifth day afterwards and to 1.40% by the tenth day. Thus, the pattern observed is consistent with the pattern tested in Section 7.3 using four dummy variables as a robustness check.

In summary, the pattern of market data and stock lending data in Volkswagen ordinary shares is consistent with my definition of an 'apparent manipulative short

squeeze'. There is the added complication of trading in options as well as ordinary shares, and this makes the case study richer than the manipulation that I describe. The behaviour of Porsche AG would only be deemed to be manipulation if the firm's *intention* was to manipulate the ordinary shares of Volkswagen AG. This may never be known, and it is this feature that makes the study of alleged stock manipulation a challenging task.

7.5 Conclusions

By developing a definition for an 'apparent manipulative short squeeze', it becomes possible to identify patterns consistent with manipulative short squeezes and to investigate the abnormal returns around these events and the characteristics of the stocks subject to these events. My findings show that manipulative short squeezes are rare events. Out of a sample constituting nearly half a million firm days, I am able to identify only 20 events that satisfy my definition of an 'apparent manipulative short squeeze'. However, where squeezes do occur, short-sellers lose money. I find statistically significant abnormal returns around these events that are also economically significant with an average cumulative stock return of 3.45% in the 'pump' phase and 2.26% during the 'squeeze' phase. These are followed by a price reversal, but short-sellers who have covered their positions do not benefit from this effect. There is some (weak) support for the notion that trading volume and the volatility of stock returns is elevated before an 'apparent manipulative short squeeze'. Liquidity is poorer: it takes more days to cover a short position just before the squeeze than on average during the previous three months. However, it is difficult to forecast short squeezes from this data alone.

A short-seller who fears manipulative short squeezes can take practical steps to mitigate this risk. Dechow *et al.* (2001) explain that short-sellers can pay additional fees to borrow on a 'term basis' (i.e. for a fixed period of time) rather than on a call basis (i.e. with repayment of the loan on demand). However, term loans are not common, despite their ability to reduce the risk of a 'short squeeze'. Another means

of managing the risk of a short squeeze is the possibility of borrowing more shares than required for short-selling. Excess borrowing results in greater stock lending costs, but creates a 'buffer': if only a portion of the borrowed shares is recalled, the excess shares are delivered first to the lender, so that immediate short covering is not required. Both of these techniques incur a cost but reduce the risk of becoming the victim of a manipulative short squeeze.

An advantage of the dataset used for this study is that it involves daily data on stock lending, providing a level of granularity that is appropriate for studying manipulative short squeezes. A limitation of the dataset used is that it includes only the larger stocks listed on the London Stock Exchange. By showing that manipulative short squeezes are rare for larger, more liquid stocks, my results provide support for the Jacobs and Levy (2007) assertion that short squeezes generally only affect smaller, less liquid stocks. The Volkswagen case provides a rare, but economically significant, exception to this pattern. Volkswagen AG was a large-cap stock but with a limited free float. This suggests that where liquidity is constrained, even large stocks can exhibit patterns consistent with manipulative short squeezes. Whereas my interviews show that the *fear of manipulative short squeezes* acts as a constraint to short-selling, I show that this fear is largely unjustified for stocks that tend to be shorted by institutional investors (i.e. larger stocks with good liquidity). The contribution of this research is that my results should assist in replacing the *fear* of manipulative short squeezes with a more *evidence-based* perspective.

8. LOSSES AND SHORT COVERING[*]

8.1 Introduction

There is no upper limit to the price at which a stock can trade. Consequently, there is no limit, in theory, to the amount of money that a short-seller can lose. This contrasts with the experience of long-only investors, where losses are limited to the amount of capital invested. Exposure to unlimited liability can have catastrophic consequences, including personal bankruptcy, and is thus an important consideration in risk management. My interviews with practicing (and prospective) short-sellers reveal that they fear this risk and regard it as an indirect constraint on short-selling. Furthermore, they claim to mitigate this risk through the use of 'stop-losses', a mechanism whereby a trader attempts to close out a position once the loss rises above some pre-set threshold. In this chapter, I use the dataset described in Chapter 5 to examine the response of short-sellers to accounting losses. I find significant evidence that short-sellers cover their positions as accounting losses grow. This is consistent with short-sellers' use of stop losses as a risk control mechanism. I relate my findings to the literature on loss realization aversion and the 'disposition effect', an observed regularity in many studies of investor behavior. Evidence that short-sellers are not averse to realizing losses has important implications for asset pricing and market efficiency.

The literature on behavioral finance describes a number of investor biases, or apparent divergences from rational behavior. Amongst these is the tendency for investors to hold on to their losing stocks too long and sell their winners too early. Shefrin and Statman (1985) call this the 'disposition effect'. They seek to explain it by combining 'prospect theory' (Kahneman and Tversky, 1979) with the notion of 'mental accounting' (Thaler, 1985). Prospect theory modifies expected utility theory

[*] This chapter forms the basis of a University of Edinburgh Working Paper entitled "Short-Sellers, Losses and Short-Covering" by James Clunie, Peter Moles and Tatiana Pyatigorskaya. The paper was presented at the Midwest Finance Association conference in Chicago in March, 2009.

in two ways, leading to predictions consistent with investors being averse to realizing losses. First, individuals assess outcomes through the change they bring to their current situation (or other reference state) and not through their effect on overall wealth. Second, prospect theory assumes that utility functions are concave for gains and convex for losses (but steeper to attain overall risk aversion). Thus, losses (from a reference state) are perceived by individuals as larger than positive changes of the same magnitude. Mental accounting provides a framework for the way investors set reference points for the accounts that determine gains and losses. Where an investor creates separate 'mental accounts' for profits in each stock position and applies prospect theory to each account (ignoring interaction effects), a disposition effect would be observed. Whereas prospect theory suggests a pure preference-based explanation for the disposition effect, Shefrin and Statman (1985) suggest that psychological explanations also contribute to this phenomenon. An aversion to realizing losses is believed to have its roots in people's desire to avoid feelings of shame, regret and blame from others.

Early empirical studies into the disposition effect and loss aversion involved experiments on students. Christensen-Szalanski and Beach (1984) and Bonner and Pennington (1991) argue that student samples are not representative of the whole population and the majority of the later experimental studies were performed using different groups of market practitioners, including off-floor futures traders (Heisler, 1994), mutual fund managers (Brown et al, 1996), sellers in the housing market (Genesove and Mayer, 2001) and participants in the automobile market (Johnson *et al.*, 2006). Odean (1998) tests the 'disposition effect' using customer account data from a discount brokerage house. He finds that the propensity to sell a stock declines as losses increase, consistent with 'prospect theory'. He also observes selling of losing stocks in December by investors who presumably use the end of the tax year as a self-control mechanism.

Burns (1985) and Holt and Villamil (1986) argue that due to training, regulation and other factors, the behavior of financial professionals is expected to differ from that of 'ordinary individuals'. Locke and Mann (2000) find evidence to support the

existence of a disposition effect amongst professional floor futures traders: traders hold losing traders longer then winning trades and the average position size for losing trades is larger than that for winning trades. However, they also find that relative aversion to realizing losses is negatively related to contemporaneous and future relative trading success. Coval and Shumway (2001) find evidence of additional intra-day risk taking as a response to morning losses amongst professional market makers at the Chicago Board of Trade. Garvey and Murphy (2004) examine data on a US proprietary stock-trading team and find evidence that the traders hold on to losing positions too long and sell their winners too soon. Shapira and Venezia (2000) find that the disposition effect is pervasive amongst their sample of clients of an Israeli brokerage firm. However, it is less prevalent amongst professional investors than amongst amateurs. Brown *et al.* (2002) examine daily Australian Stock Exchange share data and find that the disposition effect is pervasive across investor classes but that it is less pronounced amongst traders instigating larger investments. This observation is "consistent with the notion that professional training and expertise reduces judgmental bias". Frino *et al.* (2004) compare the behavior of floor traders to that of off-floor traders and identify greater loss aversion amongst the former. Cici (2005) study 517 actively managed funds in the USA and find that 37% of the sample funds are affected by the 'disposition effect'. Furthermore, the 'disposition effect' has an economically and statistically significant negative effect on fund performance. Dhar and Zhu (2008) examine the trading records of a brokerage firm to identify individual differences in the disposition bias. They find empirical evidence that wealthier investors, and those in professional occupations, exhibit the disposition effect to a lesser extent. Furthermore, approximately one fifth of investors in their sample exhibit behavior opposite to the disposition effect. Although Shefrin (2002) argues that "Get-evenitis [i.e. aversion to realizing losses] afflicts both sophisticated and unsophisticated investors", there is evidence in the literature that the disposition effect can be moderated amongst larger, more experienced investors.

Widespread aversion to realizing losses can have important implications for asset pricing. Locke and Mann (2000) suggest that behavioral biases could affect asset

pricing through market microstructure. Accordingly, "evidence that professional traders also exhibit alternative behavioral tendencies would provide increased support for research on the systemic effects of behavioral financial models". Barberis *et al.* (2001) integrate 'loss aversion' into an asset pricing model and show that their enhanced model has superior predictive power to alternative models. Rabin and Thaler (2001) use 'loss aversion' to help explain some of the anomalies in expected utility theory. Grinblatt and Han (2004) develop a model of equilibrium asset prices driven by mental accounting and prospect theory, so as to generate outcomes consistent with the empirical evidence on the disposition effect. In the model, the differences between a stock's market price and its aggregate cost basis is positively related to the stock's expected future return. This creates a spread between a stock's fundamental value and its equilibrium price, and an under-reaction to information. They argue that fully rational arbitrageurs cannot eliminate the impact of the disposition effect on equilibrium prices for a variety of reasons, including noise trader risk and capital constraints. Thus, a pervasive disposition effect amongst investors can influence the pricing of assets.

Da Silva Rosa *et al.* (2005) state that: "the disposition effect…challenges precepts of rationality underpinning neo-classical theories of financial markets." However, a defence against such a challenge would emerge if it can be shown that the 'disposition effect' reflects only the behaviour of unsophisticated investors who are price followers rather than price setters. Accordingly, an examination into the behaviour of short-sellers with respect to loss realization is important. Short-sellers are widely regarded in the literature as sophisticated and 'well-informed' market participants (see, for example, Senchack and Starks, 1993; Dechow *et al.*, 2001; Ackert and Athanassakos, 2005; and Boehmer *et al.*, 2008). Short-selling is an integral component of arbitrage, a process that in neo-classical finance involves traders exploiting asset pricing anomalies and in so doing, helping to set asset prices and keep markets efficient. It is important to identify if short-sellers suffer from the disposition effect, as evidence of a systematic bias amongst short-sellers could have important implications for asset pricing and market efficiency. This study explores this niche in the literature.

Gamboa-Cavazos and Savor (2007) examine the behavior of short-sellers after changes in stock prices. Making use of monthly data (157 months) on short interest obtained from NASDAQ, the authors find that short-sellers cover their positions after stock prices rise (i.e. after negative returns for short-sellers). Gamboa-Cavazos and Savor use subsequent returns as a proxy for expected returns and argue that such short-covering cannot be explained by expected returns. The authors interpret their results as evidence that short-sellers cannot or will not maintain short positions after suffering losses, thus "making arbitrage less effective than envisioned by the efficient market hypothesis." They put forward two suggestions to explain their results: capital constraints (see Shleifer and Vishny, 1997) and 'myopic loss aversion' (see Benartzi and Thaler, 1995; Barberis and Huang, 2001; and Haigh and List, 2005). This study builds on the work of Gamboa-Cavazos and Savor (2007) by introducing higher frequency data and a methodology that examines short-covering as a response to accounting losses as well as to stock price increases. I incorporate a technique for estimating the volume weighted average price at which short positions are initiated and employ panel data regression analysis on daily data with cross-sectional dummies and clustered by time period standard errors. I find significant evidence that short-sellers cover their positions as accounting losses grow and not simply in response to rising stock prices. This is consistent with my interview findings that short-sellers employ stop-losses as a risk-control mechanism.

The rest of this chapter is organized as follows: Section 8.2 describes the methodology used. Section 8.3 contains results. Section 8.4 contains discussion and analysis. Section 8.5 concludes.

8.2 Methodology

A number of well-regarded papers use publicly available, monthly US data on short-interest (e.g., Figlewski and Webb, 1993; Dechow *et al.*, 2001; Gamboa-Cavazos and Savor, 2007). However, short-sellers are renowned for their short time horizons (see,

for example, Boehmer *et al.*, 2008) and monthly data fails to capture intra-month trading. I use the daily data described in Chapter 5. This provides greater granularity than monthly data, and so assists in better understanding the activities of short-sellers.

At its foundation, this research employs a method of regression analysis in the spirit of Gamboa-Cavazos and Savor (2007). However, this study differs in a number of ways. Gamboa-Cavazos and Savor (2007) use the following regression specification: their main independent variable is 'returns' (in different forms throughout the study) and their dependent variable is the change in short interest. They also include a set of control variables intended to act as a proxy for short-sale constraints in the market. This specification, therefore, shows the impact on the change in short interest as returns change, i.e. the coefficient for returns tells us about change in the change in short interest. Although of interest, this does not directly tell us the direction of the change in short interest. I include the Gamboa-Cavazos and Savor specification in this study but I first aim to establish the link between returns and short interest. To do this, I use the Percentage of Market Capitalization on Loan as the dependent variable - the coefficient for returns in this specification tells us about the magnitude and direction of the change in short interest. If the coefficient is negative and the difference from zero is statistically significant, this allows me to reject a null hypothesis that short-sellers do not close their positions in response to price changes. To mitigate the problem of positive skewness in the distribution of the market capitalization on loan series (see Section 5.4), I also run regressions using the natural logarithm of market capitalization on loan as the dependent variable.

I also note that using stock returns as an independent variable can result in confusion - in Gamboa-Cavazos and Savor (2007) an increase in returns essentially stands for the loss that short sellers face. Greater clarity is achieved by using stock price as the independent variable - it acts as a proxy for 'loss' in the same way as returns do (as they move in the same direction) and it is sufficient to establish the link between the loss-proxy and the short sellers' response. A more important reason for using price instead of returns as the independent variable in the first stage of the analysis,

however, is that it makes an easier link with the second stage of the analysis, where I introduce a superior proxy for loss that reveals whether short-sellers react solely to price changes or whether they are driven in their actions by accounting losses. To create this superior proxy for loss, I require an estimate of the cost basis for short-sellers' positions in each stock.

Estimating the cost-basis for short-sellers' positions

A limitation of the Gamboa-Cavazos and Savor paper is that the authors do not account for the price at which a short position is initiated (henceforth I refer to this as the 'cost basis' of a short position). The cost basis of a position is important because it is the difference between this and the market price of a security that determines if a position is at an accounting profit or loss. I build on the Gamboa-Cavazos and Savor study by incorporating a method for estimating the average cost basis of short-sellers into the regression analysis. I estimate the average cost basis of short-sellers using a procedure similar to the volume weighted average purchase price technique used by Brown *et al.* (2002) for long-only investors. I take stock prices and the number of shares on loan for the first company in the dataset and identify the first occasion in the series when the number of shares on loan increases. I assume that this increase in shares on loan represents shares borrowed for the purpose of short-selling and estimate the price at which this was done as the average of the opening and closing prices for the stock on that date. This becomes my initial estimate of the cost basis of all short positions for this stock. This estimate is updated on the next occasion when shares on loan increases (I ignore days when 'shares on loan' is unchanged or decreases, as there are no net new short positions established on these days). With each additional estimate of the price at which shares are shorted for a particular day, I refine my previous estimate of the cost basis of all short sellers. To do this, I calculate the weighted average cost basis at which the positions were established, weighted by the number of shares shorted on each occasion. This approach allows me to gradually build my estimate, based on published data. As the estimate is updated each day on which there is a rise in shares on loan, the estimate is expected to improve over time. Cohen *et al.* (2007) find that almost half of securities lending

contracts are closed out within two weeks and the median contract length is 11 days. Accordingly, the formation period for each stock in the sample should cover at least several weeks. As early estimates are likely to be poor, I choose a formation period of one year. The whole procedure is repeated for the next stock and so on. Regression analysis is undertaken using the period after the one-year formation period. However, the 'estimated cost basis' for each stock is updated every day beyond the formation period. The 'estimated cost basis' is incorporated into the regression analysis in the following manner. The difference between the 'estimated cost basis' and the share price is found for each occasion that a company's share price rises above the 'estimated cost basis' - this represents the short sellers' accounting loss. For ease of interpretation the absolute values of this series is taken. In the second stage of analysis this loss series enters the regressions along with the price variable. This is done to see whether short-sellers react to the price change or instead to the accounting loss, as price might have its own effect on the 'percentage of market capitalization on loan' series, independent of the accounting loss.

Throughout the study, I incorporate control variables into the regressions, in a similar fashion to Gamboa-Cavazos and Savor (2007). These control variables are market capitalization, market-to-book ratio and free float number of shares, where the latter is used as an alternative to institutional ownership as employed by Gamboa-Cavazos and Savor. I consider both institutional ownership and free float number of shares to be proxies for the same factor – availability of stock loans. Because Gamboa-Cavazos and Savor use monthly data, their control variables (and right hand-side variables in general) enter the regressions in lagged form (i.e., the last month's observations are control variables for this month). In contrast, as this study benefits from a daily dataset, the right-hand side variables are not in lagged form. To summarize, this study runs the following set of regressions. For the first stage of the analysis:

$$\textit{Market Capitalization on Loan (\%)}_t = \alpha + \beta(\ln \textit{Price}_t) + \gamma(\textit{Market Capitalization}_t) + \delta(\textit{Market-to-Book ratio}_t) + \lambda(\textit{Free Float number of Shares}_t) + u_t \quad (8.1)$$

and

$$ln(\text{Market Capitalization on Loan})_t = \alpha + \beta(\ln\text{Price}_t) + \gamma(\text{Market Capitalization}_t) + \delta(\text{Market-to-Book ratio}_t) + \lambda(\text{Free Float number of Shares}_t) + u_t \quad (8.2)$$

For the second stage:

$$\text{Market Capitalization on Loan (\%)}_t = \alpha + \theta(\ln\text{Loss}_t) + \beta(\ln\text{Price}_t) + \gamma(\text{Market Capitalization}_t) + \delta(\text{Market-to-Book ratio}_t) + \lambda(\text{Free Float number of Shares}_t) + u_t \quad (8.3)$$

and

$$ln(\text{Market Capitalization on Loan})_t = \alpha + \theta(\ln\text{Loss}_t) + \beta(\ln\text{Price}_t) + \gamma(\text{Market Capitalization}_t) + \delta(\text{Market-to-Book ratio}_t) + \lambda(\text{Free Float number of Shares}_t) + u_t \quad (8.4)$$

For the third stage, I introduce lagged forms of the loss series into the regressions to see if their effect diminishes with time. I also investigate the regression based solely on the top quintile of the loss series.

In the fourth stage of the analysis, I consider the change in short interest (i.e. change in the percentage of market capitalization on loan) as the dependent variable, similar to the work by Gamboa-Cavazos and Savor:

$$\Delta(\text{Market Capitalization on Loan}) = \alpha + \theta(\ln\text{Loss}_t) + \beta(\ln\text{Price}_t) + \gamma(\text{Market Capitalization}_t) + \varsigma(\text{Market Capitalization on Loan}_t) + \delta(\text{Market-to-Book ratio}_t) + \lambda(\text{Free Float number of Shares}_t) + u_t \quad (8.5)$$

where the series ‘market capitalization on loan’ on the right-hand side acts as an additional control variable.

For each regression, I take care of the firm effect parametrically by including firm dummies and use clustered by time period standard errors to eliminate the non-fixed time effect. This contrasts with Gamboa-Cavazos and Savor (2007), who employ the Fama-MacBeth (1973) procedure for their regression analysis. This latter procedure is designed to eliminate the time effect in panel data. However, panel data can also have a firm effect and if the Fama-MacBeth method is used in such a context, it would produce biased estimates. Gamboa-Cavazos and Savor do not correct the standard errors for potential autocorrelations of the cross-sectional regression estimates, arguing that their standard errors will be at most overstated by a factor of 1.2. Even where the Fama-MacBeth method is adjusted to take account of the firm effect, Petersen (2009) shows that it would still produce biased results. Petersen recommends starting with an analysis of the dataset to find out whether there is a time effect, firm effect, or both, and whether those effects are permanent or temporary. In the spirit of Petersen, I investigate the dataset to determine the most appropriate procedure. As a starting point, it is reasonable to assume that the dataset has some firm effect, i.e. the residuals for a particular company are correlated along the time period, and this is corroborated by an inspection of the correlograms. In other words, there are factors that are not explicitly included in our regressions that influence the dependent variable (percentage of market capitalization on loan) that are either constant or changing over time, but that differ from firm to firm. Such factors could, for example, be a firm's management capabilities or its competitive advantage. It is difficult to evaluate whether this factor stays constant over the entire sample period or, say, decays over time. Mauboussin and Johnson (1997) show that a firm's competitive advantage period generally varies between two and twenty years. This suggests that any qualitative judgment would be highly subjective.

Secondly, I consider that the dataset might have some time effect (this assumption is also corroborated by the findings of Gamboa-Cavazos and Savor). In other words, any market shock would affect all firms in the market to some extent. This is particularly relevant for my sample, where all the stocks are traded on one exchange. The question, however, remains as to whether or not all firms would be affected to the same extent by such a shock. It is reasonable to hypothesize that some firm

effects and time effects are present. Any effects will include a fixed part, because temporary effects can always be adjusted so as to incorporate a fixed component. On this basis, I include firm and time dummies in the regression to take care of the fixed components of the firm effects and time effects. I next employ quantitative analysis to check whether there is a temporary component of the firm and time effects. This is done by comparing (for each regression) the standard errors clustered by time period and the standard errors clustered by firm to the benchmark of the White standard errors. Because each type of standard error is already adjusted for the problem of heteroskedasticity, the difference between standard errors would be the result of temporary effects. As each regression also includes firm dummies and time dummies to take care of any fixed effects, if the standard errors clustered by firm, for example, are very different from White standard errors, then there is a firm effect in the data that has not been eliminated by the firm dummies. In other words, because firm dummies eliminate fixed firm effects, there must also be a temporary firm effect in the data.

For each of the six main types of regression equations (Equations 8.1 to 8.5 above plus the regression for the top quintile of the loss series), the regression analysis was run three times, each time with different types of standard error: White, clustered by firm and clustered by time period. Table 8.1 presents these three types of standard errors for each of the six main types of regressions.

Table 8.1 Comparison of Standard Errors

For each of the six main types of regression equation, the regression analysis was run three times, each time with different types of standard errors: White, clustered by firm and clustered by time period, respectively.

Panel A: Full Dataset
Dependent Variable: Market Cap on Loan (%)

		Log of Price	Market Cap	Market-to-Book ratio	Free float number of shares	Intercept
Coefficients		-1,057683	-0,000200	-1,30E-05	-0,008404	10,196580
Standard Errors	White	0,034029	4,30E-06	1,17E-06	0,000428	0,195139
	Clustered by cross section	0,032702	4,44E-06	1,02E-06	0,000296	0,190646
	Clustered by time period	0,467052	5,82E-05	5,32E-06	0,004010	2,684585

Panel B: Full Dataset
Dependent Variable: Market Cap on Loan (%)

		Log of Loss	Log of Price	Market Cap	Market-to-Book ratio	Free float number of shares	Intercept
Coefficients		-0,082161	0,164347	-0,000240	0,000104	-0,004147	3,679375
Standard Errors	White	0,007748	0,072314	6,57E-06	1,34E-05	0,000799	0,423813
	Clustered by cross section	0,008178	0,067731	6,99E-06	1,35E-05	0,000727	0,403896
	Clustered by time period	0,047724	0,732146	8,04E-05	2,38E-05	0,006704	4,196935

Panel C: Full Dataset
Dependent Variable: Change in Market Cap on Loan

		Log of Loss	Log of Price	Market Cap	Market Cap on Loan	Market-to-Book ratio	Free float number of shares	Intercept
Coefficients		0,005748	-0,031214	3,91E-06	0,008015	-1,07E-06	5,59E-05	0,123597
Standard Errors	White	0,001072	0,008723	6,68E-07	0,001086	3,97E-07	0,000103	0,052538
	Clustered by cross section	0,001123	0,009245	7,26E-07	0,001100	4,09E-07	0,000107	0,055427
	Clustered by time period	0,001373	0,010032	9,14E-07	0,001030	2,50E-07	0,000158	0,058164

Panel D: Full Dataset
Dependent Variable: Log of Market Cap on Loan

		Log of Price	Market Cap	Market-to-Book ratio	Free float number of shares	Intercept
Coefficients		-0,100119	-5,86E-05	-2,56E-06	-0,002174	1,449094
Standard Errors	White	0,007405	1,09E-06	2,21E-07	0,000135	0,042037
	Clustered by cross section	0,007026	1,16E-06	1,86E-07	0,000111	0,040456
	Clustered by time period	0,085322	1,41E-05	1,31E-06	0,001224	0,487976

Panel E: Full Dataset
Dependent Variable: Log of Market Cap on Loan

		Log of Loss	Log of Price	Market Cap	Market-to-Book ratio	Free float number of shares	Intercept
Coefficients		-0,030575	0,169538	-6,26E-05	2,13E-05	-0,000625	0,112698
Standard Errors	White	0,001929	0,016185	1,45E-06	2,77E-06	0,000214	0,094160
	Clustered by cross section	0,001922	0,013581	1,68E-06	2,76E-06	0,000185	0,082224
	Clustered by time period	0,011825	0,166299	1,44E-05	8,37E-06	0,001820	0,965527

Panel F: Loss € 80th
Dependent Variable: Log of Market Cap on Loan

		Log of Loss	Log of Price	Market Cap	Market-to-Book ratio	Free float number of shares	Intercept
Coefficients		-0,053061	0,546217	-6,31E-05	4,15E-05	0,001130	-2,522391
Standard Errors	White	0,004018	0,029530	1,84E-06	1,22E-06	0,000374	0,195995
	Clustered by cross section	0,004370	0,029060	1,97E-06	1,33E-06	0,000431	0,194725
	Clustered by time period	0,026886	0,324558	1,98E-05	5,94E-06	0,003161	2,113271

For each of the six panels in Table 8.1 above, it can be seen that the first two types of standard errors (White and clustered by firm) are very similar, while the third one is quite different. This suggests that my data has fixed firm effects and temporary time effects. In such a situation, Petersen recommends taking care of the firm effect parametrically (by including firm dummies) and using clustered by time period standard errors to eliminate the non-fixed time effect. Time dummies are also kept in the regressions for the reasons discussed above. The results of these regressions are reported in section 8.3 below.

Finally, if evidence emerges that short-sellers cover their positions in response to losses, it is natural to question if this short-covering has a cost to short-sellers, in the sense that stocks under-perform subsequent to short-covering. Having covered their positions, short-sellers would fail to benefit from any such under-performance and this would represent an opportunity cost. For each stock, I identify each occasion that the stock price rises above the estimated weighted-average cost basis for short-sellers, and where the number of shares on loan falls on that day and also on the following day, indicating short-covering. For each of these occasions, I calculate the cumulative abnormal stock return for 5, 10 and 30 days after the day on which the stock price rises above the short-sellers' cost basis. I form a portfolio of such stocks and test the hypotheses of zero cumulative abnormal returns for the 5, 10 and 30 day periods. The portfolio of stocks is equally-weighted, in order to prevent a small number of large-capitalization stocks from defining the results for the whole sample.

8.3 Results

Table 8.2 below presents the results of the regression analysis using 'percentage of market capitalization on loan' as the dependent variable.

Table 8.2 Regression Output with Percentage of Market Cap on Loan as Dependent Variable

Panel A considers the link between share price as a proxy for loss and the short sellers' response using the specification given in Equation 8.1. The accounting loss variable is introduced in Panel B, first using the specification given in Equation 8.3 and then making use of a lagged loss variable in the second and third regression specifications. Panel C uses a regression specification with only log of loss as an independent variable. Panel D uses the regression specification in Equation 8.5, where change in market capitalization on loan is the dependent variable.

Panel A: **Full Dataset**
Dependent Variable: Market Cap on Loan (%)

	Log of Price	*Market Cap*	*Market-to-Book ratio*	*Free float number of shares*	*Intercept*	R^2	*Adjusted* R^2
Coefficients	-1.057683	-0.000200	-1.30E-05	-0.008404	10.19658	0.637758	0.635701
t-stats	-2.264595	-3.431654	-2.438674	-2.095937	3.798195		
p-values	0.0235	0.0006	0.0147	0.0361	0.0001		

Panel B: **Full Dataset**
Dependent Variable: Market Cap on Loan (%)

	Log of Loss	*Log of Loss*$_{-1}$	*Log of Loss*$_{-2}$	*Log of Price*	*Market Cap*	*Market-to-Book ratio*	*Free float number of shares*	*Intercept*	R^2	*Adjusted* R^2
Coefficients	-0.082161			0.164347	-0.000240	0.000104	-0.004147	3.679375	0.663534	0.660172
t-stats	-1.721587			0.224473	-2.986002	4.382315	-0.618553	0.876681		
p-values	0.0851			0.8224	0.0028	0.0000	0.5362	0.3807		
Coefficients		-0.080479		0.155639	-0.000240	0.000104	-0.004257	3.730681	0.664698	0.661309
t-stats		-1.715214		0.213746	-2.966862	4.372520	-0.634466	0.893436		
p-values		0.0863		0.8307	0.0030	0.0000	0.5258	0.3716		
Coefficients			-0.076344	0.142150	-0.000239	0.000104	-0.004355	3.800637	0.665805	0.662389
t-stats			-1.641494	0.195739	-2.949351	4.408655	-0.649024	0.912359		
p-values			0.1007	0.8448	0.0032	0.0000	0.5163	0.3616		

Panel C: **Full Dataset**
Dependent Variable: Market Cap on Loan (%)

	Log of Loss	*Intercept*	R^2	*Adjusted* R^2
Coefficients	-0.104548	3.609868	0.649204	0.646189
t-stats	-2.513528	23.62255		
p-values	0.0120	0.0000		

Panel D: **Full Dataset**
Dependent Variable: Change in Market Cap on Loan

	Log of Loss	*Log of Price*	*Market Cap*	*Market Cap on Loan*	*Market-to-Book ratio*	*Free float number of shares*	*Intercept*	R^2	*Adjusted* R^2
Coefficients	0.005748	-0.031214	3.91E-06	0.008015	-1.07E-06	5.59E-05	0.123597	0.020448	0.010565
t-stats	4.185758	-3.111462	4.281544	7.782817	-4.279413	0.353477	2.124959		
p-values	0.0000	0.0019	0.0000	0.0000	0.0000	0.7237	0.0336		

Panel A in Table 8.2 shows that the coefficient for the price variable is negative and statistically significant (at the 5% significance level), providing evidence that as share price rises, short-sellers close their positions. Specifically, it implies that a 1% increase in share price results in approximately a 1.06% decrease in market capitalization on loan. Note that the coefficient for the 'market to book ratio' control variable is negative and statistically significant at the 5% significance level, suggesting short-sellers' preference for 'value' stocks. This appears surprising at first sight. A possible explanation for this lies in the specific characteristics of the sample. In particular, micro-capitalization stocks are not present in the database (the smallest stock has a market capitalization of around £25million, or USD 40 million), and amongst 'glamour' (i.e. not-value) stocks, it is micro-capitalization stocks that short-sellers might be expected to target, subject to stock loan availability (see Fama and French, 1993). The percentage of free float shares variable, a control variable for short sale constraints, is not significant at the 5% level on a two tailed test. A plausible explanation for this is that the majority of firms in the sample have a large free float, as noted in the descriptive statistics section. In fact, only 32 (out of 681) stocks have a mean percentage of free float shares below 40%. Thus, short sale constraints do not appear to significantly influence this sample of stocks.

In Panel B, the accounting loss variable is introduced to the analysis. The price variable is retained as it could have its own effect on the market capitalization on loan besides being a proxy for the loss. Results from the first regression in Panel B show that the coefficient for the accounting loss variable is negative and weakly significant (at the 10% significance level). The coefficient for the price variable is no longer statistically significant. This suggests that short sellers cover their positions in response to accounting losses and not simply in response to rising share prices. With regard to the control variables, a similar explanation applies as for the stage above. Benefiting from the daily dataset, I am also able to examine the relationship between short-interest and lagged accounting losses. In the second and third specifications of Panel B, the loss variable is replaced with a lagged loss variable (a one day and two day lag, respectively). The coefficient on the loss variable that is lagged by one day, although statistically significant, is smaller than the coefficient on the non-lagged

loss variable and the coefficient on the loss variable lagged by two days is smaller than the coefficient on the loss variable lagged by one day. This highlights the advantages of using daily data in understanding the actions of short-sellers. Indeed, these results suggest that many short sellers (but not all) react to a loss quickly (within one day). However, as short-sellers are not a homogenous group, some might react to losses only when, for example, accumulated losses lead to margin calls or amount to a certain percentage of capital. Furthermore, individual short-sellers will each have different cost bases.

It can also be noted that the explanatory power of the regression described above is high – the adjusted R^2 being 66%. I run a regression with only the loss variable on the right-hand side of the regression equation and present this in Panel C. The adjusted R^2 of this regression is around 65% - almost the same as the explanatory power of the previous regression.

Panel D presents the results of a regression where the dependent variable is the change in the market capitalization on loan (similar to the approach undertaken by Gamboa-Cavazos and Savor). The coefficients of the variables are much smaller than the coefficients of the previous regression specifications, although most are statistically highly significant. The explanatory power of this regression (R^2 is around 2% and adjusted R^2 is around 1%) is also far smaller than the explanatory powers of the previous regressions. This is, however, not surprising as coefficients here represent change in the change of the market capitalization on loan. Nevertheless, the magnitude of the coefficients and of the explanatory power is in line with those found by Gamboa-Cavazos and Savor. It is also important to mention the interpretation of these coefficients. The coefficient on the loss variable (positive and statistically significant at the 1% significance level) tells us that the greater the loss, the greater the change in the market capitalization on loan. In other words, large losses trigger a stronger reaction among short-sellers. This result has an intuitive appeal to it.

To mitigate the problem of positive skewness in the distribution of the market capitalization on loan series (see Section 5.4), I also run regressions using the natural logarithm of market capitalization on loan as the dependent variable. Results are shown in Table 8.3 below:

Table 8.3 Results using Log of Market Cap on Loan as Dependent Variable

Panel A considers the link between share price as a proxy for loss and the short sellers' response using the specification given in Equation 8.2. The accounting loss variable is introduced in Panel B, first using the specification given in Equation 8.4 and then making use of a lagged loss variable in the second and third regression specifications. Panel C uses a regression specification with only log of loss as an independent variable. Panel D considers solely the top quintile of accounting losses.

Panel A: **Full Dataset**
Dependent Variable: Log of Market Cap on Loan

	Log of Price	*Market Cap*	*Market-to-Book ratio*	*Free float number of shares*	*Intercept*	R^2	*Adjusted* R^2
Coefficients	-0.100119	-5.86E-05	-2.56E-06	-0.002174	1.449094	0.729511	0.727972
t-stats	-1.173430	-4.163498	-1.961313	-1.775744	2.969601		
p-values	0.2406	0.0000	0.0498	0.0758	0.0030		

Panel B: **Full Dataset**
Dependent Variable: Log of Market Cap on Loan

	Log of Loss	*Log of Loss*$_{-1}$	*Log of Loss*$_{-2}$	*Log of Price*	*Market Cap*	*Market-to-Book ratio*	*Free float number of shares*	*Intercept*	R^2	*Adjusted* R^2
Coefficients	-0.030575			0.169538	-6.26E-05	2.13E-05	-0.000625	0.112698	0.769303	0.766997
t-stats	-2.585630			1.019476	-4.344138	2.547764	-0.343474	0.116721		
p-values	0.0097			0.3080	0.0000	0.0108	0.7312	0.9071		
Coefficients		-0.029371		0.164603	-6.25E-05	2.13E-05	-0.000662	0.140896	0.769969	0.767643
t-stats		-2.519420		0.996132	-4.331280	2.540000	-0.365184	0.146710		
p-values		0.0118		0.3192	0.0000	0.0111	0.7150	0.8834		
Coefficients			-0.027788	0.158846	-6.24E-05	2.14E-05	-0.000684	0.171473	0.770723	0.768378
t-stats			-2.401133	0.964875	-4.321465	2.536860	-0.378198	0.179094		
p-values			0.0163	0.3346	0.0000	0.0112	0.7053	0.8579		

Panel C: **Full Dataset**
Dependent Variable: Log of Market Cap on Loan

	Log of Loss	*Intercept*	R^2	*Adjusted* R^2
Coefficients	-0.030329	0.865683	0.767981	0.765985
t-stats	-3.137918	24.37699		
p-values	0.0017	0.0000		

Panel D: **Loss € 80th**
Dependent Variable: Log of Market Cap on Loan

	Log of Loss	*Log of Price*	*Market Cap*	*Market-to-Book ratio*	*Free float number of shares*	*Intercept*	R^2	*Adjusted* R^2
Coefficients	-0.053061	0.546217	-6.31E-05	4.15E-05	0.001130	-2.522391	0.770770	0.765180
t-stats	-1.973600	1.682953	-3.195214	6.989878	0.357545	-1.193595		
p-values	0.0484	0.0924	0.0014	0.0000	0.7207	0.2326		

Although broadly similar, I observe a number of differences between the results in Tables 8.2 and 8.3. Specifically, in Panel A, the log of price variable is no longer statistically significant. In Panel B of Table 8.3, the coefficient on the accounting loss variable is negative and now statistically significant at the 1% level. At the same time, the coefficient on the price variable remains insignificant. This provides statistically significant evidence that short-sellers cover their positions in response to accounting losses, rather than simply to price increases. This is a key finding and a distinction from the findings of Gamboa-Cavazos and Savor.

I test the robustness of the main regression specification using a restricted sample of the top quintile of the loss series. This subset represents the 'large loss' series. Regression results are shown in Panel D of Table 8.3. The coefficient of the loss variable is negative and statistically significant (at the 5% significance level) with the stock price and free float number of shares variables being statistically insignificant. The explanatory power of this regression is also large, with the adjusted R^2 being around 77%. The coefficient of the loss variable from this regression is of greater magnitude than the equivalent coefficient from the regression on the non-restricted sample presented in the Panel B. This suggests that short-covering as a response to accounting losses is greater for larger losses.

Next, I test for short covering at different levels from simply the average cost basis of short-sellers. In particular, I examine when stock prices reach 2.5% and 5% above the cost basis. This is inspired by the belief (gained from interviews with short-sellers) that some short-sellers force themselves to sell positions once losses exceed a pre-defined threshold. Such mechanisms are generally known as 'stop-losses'. The methodology of this section is similar to that in the rest of the paper. The difference, however, lies in the fact that in order to examine short covering at 2.5% and 5% above the cost basis, the loss series is presented in relative or percentage terms (relative to price) and then only those data points that were above 2.5% (5%) were recorded (the loss series here is in absolute values). Then the logarithm of this series was taken before it entered the regression. The form of the regression is similar to that in the rest of the study. Table 8.4 shows that the coefficient on the loss variable

becomes more economically and statistically significant at higher levels above the cost basis.

Table 8.4 Dependent Variable: Market Capitalization on Loan

Regression	Independent Variables					Intercept
	Loss	*Price*	*Mkt Cap*	*Mkt-to-book*	*Free Float*	
Original	-0.0822	0.1643	-0.0002	0.0001	-0.0041	3.6794
	(0.0851)	(0.8224)	(0.0028)	(0.0000)	(0.5362)	(0.3807)
2.50%	-0.2226	0.4469	-0.0003	0.0001	-0.0044	2.2407
	(0.0209)	(0.5666)	(0.0027)	(0.0000)	0.5285)	(0.6176)
5%	-0.3476	0.7109	-0.0003	0.0001	-0.0055	1.0842
	(0.009)	(0.4004)	(0.0015)	(0.0000)	(0.4638)	(0.8239)

* p-values are in parentheses

It is natural to consider if there is a cost, in terms of investment performance, to short-sellers who make use of stop losses. Table 8.5 below presents the cumulative abnormal returns for stocks that have risen above the corresponding estimated weighted-average cost basis for short-sellers, and where short-covering has taken place.

Table 8.5 Cumulative Abnormal Returns after Short-Covering

The Table reports cumulative abnormal returns (CARs) calculated on an equal-weighted basis for all stocks from days on which two conditions are met: the stock rises above the estimated weighted-average cost basis for short-sellers of that stock; and the number of shares on loan falls that same day and the following day. CARs are calculated for 5,10 and 30 days after each day on which the two conditions are met.

	5 days	10 days	30 days
Mean	0.00106	0.00226	0.00844
Standard Deviation	0.0294	0.0427	0.0704
Degrees of Freedom	15760	15613	15069
t-stat	4.511	6.621	14.727
Probability (2-tails)	0.00001	0.00000	0.00000

Cumulative abnormal returns for 5, 10 and 30 days after the day on which the stock rises above the estimated short-sellers' cost basis are all positive and statistically significant. There is, however, an endogeneity problem associated with such

situations: the act of short covering could have market impact, leading in and of itself to stock price increases. It is thus difficult to interpret the above as evidence that short-covering in response to losses prevents further losses to a short-seller. Nevertheless, it can be argued that there is no evidence of an investment performance cost (other than transaction costs) to short-sellers from immediate short covering upon loss. From the perspective of a risk manager proposing the use of stop losses, this is an important finding.

8.4 Discussion and Analysis

I find significant evidence that short-sellers cover their positions in response to accounting losses. This finding is *inconsistent* with the notion that short-sellers are averse to realizing losses. This has important implications for asset pricing. Aversion to realizing losses is a bias observed in empirical studies of many types of market participants, including some professional investors. However, I show that this bias is not present amongst short-sellers, a sub-set of market participants that is particularly associated with arbitrage and price setting.

A possible interpretation is that short-sellers are naturally less prone to loss realization aversion than other investors. Alternatively, those short-sellers that are free from this bias could prove more successful and gain a greater share of capital, such that short-sellers in aggregate appear not to suffer from loss realization aversion. Locke and Mann (2000) show that "there is evidence that trading success is negatively related to the degree of loss realization aversion." Short-sellers aware of such evidence might respond by adapting their behavior so as to remove this bias. The literature provides examples of the use of trading rules to control against behavioral errors. Taffler (2001) notes that some market traders retreat from positions once losses exceed some pre-specified threshold (e.g. 10% of position size). In fact, Taffler, among others, recommends such rules to conquer psychological biases: "…we can overcome the operation of loss aversion to some extent by the use of rules to enforce self-control…" Shefrin (2002) describes the end

of December as an end of tax-year threshold that induces US investors to close their positions and to accept losses.

A further plausible explanation, however, is that short-sellers employ risk control mechanisms that have the effect of mitigating loss realization aversion. Although neither legal nor contractual constraints force short-sellers to close their positions at any particular level of loss, there are practical reasons to cover short positions in response to accounting losses. A key reason is that short-sellers face theoretically unlimited losses. By systematically crystallizing small losses through the use of stop losses, short-sellers are able to contain this risk. Moreover, popular risk control mechanisms such as dynamic hedging and the imposition of position limits are consistent with realizing losses in short positions. In my interviews, a number of short-sellers claim to use risk control mechanisms such as 'stop losses', whereby they would close any position that had either fallen to an accounting loss, fallen to a percentage loss greater than some pre-defined level, or made a negative contribution to portfolio returns that exceed some pre-defined threshold (e.g. a -0.5% contribution to portfolio returns). That is, short-sellers in practice employ stop-losses as a risk control mechanism and this has the side-effect of disciplining them against loss realization aversion.

The literature on stock price momentum effects also offers an explanation for short-sellers covering positions in response to losses. Jegadeesh and Titman (1993, 2001) show that momentum strategies ('buying winners and selling losers') based on prior performance can generate significantly positive returns for holding periods of 3 to 12 months. Short-sellers might believe that short positions that fall to a loss shall continue to experience losses in the future. Although subject to an endogeneity problem, Table 8.5 shows that there is a statistically significant (albeit economically modest) momentum effect for such stocks on a 5, 10 and 30 day horizon.

The desire to maintain portfolio diversification provides a further alternative explanation for short-covering. For long-investors, winning positions grow in size relative to losing positions. Lakonishok and Smidt (1986) argue that long- investors

could sell winners to restore portfolio diversification. However, short-sellers experience the opposite effect (see Section 4.6). As losing positions grow, it is credible to reduce or eliminate such positions to maintain portfolio diversification. Thus, the observed realization of losses amongst short-sellers is consistent with a desire to maintain portfolio diversification.

For taxable investors, there could be tax advantages associated with crystallizing losses. However, it is widely believed that short-selling is concentrated amongst funds that generally operate in tax-free, 'offshore' environments. Accordingly, tax reasons are a less likely explanation of the observed results.

Constrained capital provides another plausible explanation for the tendency of short-sellers to cover in response to accounting losses. Shleifer and Vishny (1997) argue that arbitrageurs in practice are generally agents working for owners of capital. Arbitrageurs face the risk that poorly-informed, disillusioned investors will withdraw their capital in response to accounting losses at the portfolio level, even though the underlying positions might be attractive. This gives arbitrageurs a strong incentive to avoid losses at the portfolio level. By systematically accepting small losses in individual stocks, this reduces the risk of large losses in individual stocks that might cause the overall portfolio to fall into loss. An additional consideration is that short positions that fall to an accounting loss could require the provision of further margin or collateral (to protect the stock lender or counter-party to a synthetic short position). This could lead to additional strain on the limited capital available to short-sellers. Such strain is mitigated by covering short positions that fall to a loss. Constrained capital is one of two suggestions put forward by Gamboa-Cavazos and Savor (2007) to explain their results.

Gamboa-Cavazos and Savor (2007) also suggest 'myopic loss aversion' as an explanation for their observation that short-sellers cover their positions after stock prices fall. They argue that short-sellers could be loss averse, with the degree of loss aversion depending on prior gains and losses. After experiencing losses, short-sellers would become more loss averse and so would cover their positions. Fellner and

Sutter (2008) conduct a series of experiments in a long-only environment to identify the causes of 'myopic loss aversion' and find that inappropriately short investment horizons and high feedback frequency contribute almost equally to this phenomenon. My interviews in Chapter 4 show that short-sellers are often characterized as 'traders and not investors' and so are likely to be associated with short investment horizons and high feedback frequency. However, under an efficient markets framework, a short position in a risky security has a negative expected return. Only with a mispricing story will the risky security have a positive expected return, and even then, only in the short-term because of the negative beta problem (Dyl, 1975). Myopic loss aversion - which manifests itself in a tendency to shun attractive long-term investments because of an aversion to short-term losses – should not apply to situations involving negative long-term expected returns. Indeed, given that a mispricing story is required to make un-hedged short-selling worthwhile, accepting losses appears rational for two reasons: first, if a short-seller believes that the market has mispriced a stock, but finds his short position falling to a loss, this suggests that his original mispricing thesis could be mistaken. Accepting the mistake (covering the short position) is rational in light of the negative expected long-term return. Second, it should be clear to the short-seller that as a position falls to a loss, synchronization risk (concerned with uncertainty about the market timing decisions of other rational arbitrageurs and thus the timing of the price correction) is heightened. Abreu and Brunermeier (2002) suggest 'delayed arbitrage' as a response to synchronization risk. This would entail short covering and returning to short the stock when other arbitrageurs have learned of the over-valuation.

My findings contribute to the literature on loss realization aversion and the 'disposition effect'. I show that a sophisticated group of traders, strongly associated with price setting, is not averse to realizing losses. In related work, Brown *et al.* (2002) examine the behavior of investors in Australian stocks across different levels of investor sophistication. They find that the disposition effect is observed for all categories of investor but that "traders instigating larger investments tend to be less, if not entirely unaffected by the disposition bias." Da Silva Rosa *et al.* (2005) observe that (long-only) UK managed funds do not exhibit the behavioral bias

associated with the disposition effect, once size (a proxy for liquidity) and market-to-book (a proxy for value) are taken into account. Thus, empirical evidence is emerging to show that larger and more sophisticated investors, who are most likely to set prices in markets, do not appear to suffer from the disposition effect.

There is, however, a potential problem for short-sellers arising from their response to accounting losses. The systematic crystallization of losses represents a form of predictable behavior. By knowing (or being able to estimate) the capital strength and cost basis of short-sellers, predators should be able to anticipate short-covering and so position themselves to benefit from the market impact of such trades. This is similar to the pattern described by Chen *et al.* (2006), whereby predators anticipate rebalancing by index funds and take advantage of the market impact of index fund investors. Furthermore, it could be possible for one or more manipulators to *induce* short-covering by placing buy orders when a stock price is close to the cost basis of short-sellers. Where the market impact of such trades pushes the stock price above the cost basis of short-sellers, short-covering ensues, placing further upwards pressure on the stock price when liquidity is constrained. The manipulator closes his long position by selling stock to a covering short-seller, 'earning' a profit in the process.

8.5 Conclusions

This study fills an important gap in the literature on loss-aversion with respect to a sophisticated sub-set of investors. It improves upon existing research in a number of ways. First, it benefits from the use of daily data, which is better suited than monthly data for studying short-selling activity. Secondly, it builds upon the extant methodology for this type of study by incorporating into the analysis an estimate of the average price at which short positions are initiated. This permits a study of short-sellers' responses to accounting losses.

I find that short-sellers close their positions in response to accounting losses and not simply in response to rising share prices. This is a key finding and a distinction from the findings of Gamboa-Cavazos and Savor (2007). Short-sellers do not exhibit an aversion to realizing accounting losses, but instead accept their losses or 'mistakes' systematically. Stocks subject to short-covering in this manner do not subsequently under-perform the market, and so there is no evidence of an investment performance cost (other than transaction costs) associated with immediately covering short positions that fall to an accounting loss. These findings should be of interest to researchers in behavioral finance and to market practitioners involved in short-selling and risk management. They not only shows that some biases can be controlled, but also that some of the techniques that assist in overcoming them are already in place amongst a sophisticated sub-set of investors, namely short-sellers.

9. SUMMARY AND CONCLUSIONS

9.1 Main Findings

I use interviews with senior market practitioners to investigate the short-sale reluctance puzzle. I identify and categorize five direct constraints and twenty-eight indirect constraints. These latter can be grouped into five broad, inter-related themes: 'risk', 'distribution of returns', 'institutional constraints', 'social constraints' and 'personal constraints'. I find that market practitioners with different functional roles believe that different factors account for the short-sale reluctance puzzle. Indirect constraints are sometimes more important than direct constraints in explaining why some firms that invest or advise on investment are reluctant to practice short-selling.

Diether *et al.* (2008) suggest that it could be considered 'un-American' to short-sell. If this is a reference to patriotism, I find that it cannot be generalized globally as patriotic reasons are firmly rejected by all interviewees. In so far as it suggests that it is 'anti-capitalist' to short-sell, there is only limited evidence to back up this notion. There is also limited evidence at best to support D'Avolio's (2002) notion that 'fear of tracking error' is a key constraint to short-selling. Arguably, it is the setting of tracking error limits by risk managers or clients that has been a barrier to short-selling, rather than investment managers' fear of tracking error. The results from my interviews could be 'location specific' or 'group specific'. However, they do reveal that some suggestions made in the literature cannot be generalized globally – an important finding in itself.

I identify two new social indirect constraints on short-selling: the 'trading not investing' constraint and the 'lack of stakeholder acceptance' constraint. Several interviewees argue that the latter is diminishing and believe that this helps to explain the growth of short-selling in recent years. The distinction between investing and trading is an important finding from this research. There are two facets to this argument. First, there is a legal distinction between the two activities: investing

confers ownership and voting rights and responsibilities; short-selling does neither. The second distinction concerns time horizon – investors are generally perceived to have longer time horizons than speculators. Social constraints such as 'lack of acceptance' and 'trading not investing' are, in a sense, the collective wisdom of market participants built up over many years. This collective wisdom serves to guide or warn responsible members of society on how to behave (or how not to behave) in investment matters. In any legal dispute over, say, prudent behaviour, the trustee who has observed social constraints is on safer ground. By contrast, some personal constraints, such as 'lack of knowledge', lack such rationality. Academics have a role to play in reducing the constraints around short-selling. I find that the works of Clarke *et al.* (2002, 2004, 2008) have had a profound impact on interest in short-selling, by addressing the 'negative expected return problem' and 'benchmarking constraints'. This suggests that there are rewards for those able to design portfolio structures that overcome specific indirect short-sale constraints. Furthermore, such work assists in the gradual convergence of market practice towards the theoretical assumption of a stock market with many arbitrageurs, constantly trading in such a manner as to drive stock prices towards fair value.

To build on the findings from the interviews, I obtain a comprehensive, commercial set of daily data on UK stock lending, from its inception on September 3rd, 2003 through to May 31st, 2007. As stock lending can serve as a proxy for short-selling, this data set allows for a quantitative analysis of indirect constraints on short-selling. I use the dataset to study crowded exits, manipulative short squeezes and the behaviour of short-sellers in response to accounting losses.

Crowded exits are a liquidity problem unique to short-sellers. They have yet to be examined in the literature, and this study fills this gap. I find that crowded exists are associated with losses to short-sellers that are economically and statistically significant. As such, the risk of a crowded exit represents an indirect constraint on short-selling. I show that stocks with higher short interest, smaller sizes and poorer liquidity are more likely to have crowded exits. Short-sellers can manage risk by limiting exposure to such stocks. Furthermore, given the prolonged nature of

crowded exits, short-sellers should cover their short positions immediately upon observing exceptional levels of covering by other shorts-sellers in crowded positions. However, such short-covering will in itself exacerbate the crowded exit effect. A further difficulty in this process is that data on stock lending and short-selling is often publicly available only with a time delay. Under such circumstances, private data on short-covering can become valuable.

It is rational for investors to take account of published evidence on stock market anomalies. A substantial body of literature shows that heavily shorted stocks (and stocks with increasing shorting demand) perform poorly. These studies suggest a potential trading strategy for short-sellers: identify heavily shorted stocks (or stocks with increasing shorting demand) and build short positions in those stocks. However, such imitation changes the market dynamics and can lead to unexpected consequences. Short-positions become more crowded with imitation, and the risk of 'crowded exits' increases. This could lead to examples of 'counter-performativity', as described by MacKenzie (2006), whereby the widespread and plentiful practice of short-selling, as assumed in economic models such as Arbitrage Pricing Theory, leads not necessarily to a more efficient market, but to an increasing number of occasions on which stock prices move temporarily away from fair value. Given the importance of the *path of stock returns* to investors employing leverage (who are liable to margin calls or subject to loan covenants) or to investment agents using open-ended fund structures (who are subject to the risk of redemption by clients), even temporary market imbalances can have important implications. Crowded exits can thus create path dependency problems for short-sellers.

By developing a definition for an 'apparent manipulative short squeeze', it becomes possible to identify and examine patterns consistent with manipulative short squeezes. I investigate the abnormal returns around these events and the characteristics of the stocks subject to these events. My findings show that manipulative short squeezes are rare events. Out of a sample constituting nearly half a million firm days, I am able to identify only 20 events that satisfy my definition of an 'apparent manipulative short squeeze'. However, where such squeezes do occur,

short-sellers lose money. I find statistically significant abnormal returns around these events that are also economically significant with an average cumulative stock return of 3.45% in the 'pump' phase and 2.26% during the 'squeeze' phase. These are followed by a price reversal, but short-sellers who have covered their positions do not benefit from this effect. There is some (weak) support for the notion that trading volume and the volatility of stock returns is elevated before an 'apparent manipulative short squeeze'. Liquidity is poorer: it takes more days to cover a short position just before the squeeze than on average during the previous three months. However, it is difficult to forecast manipulative short squeezes from knowledge of this pattern. The risk of becoming a victim of a manipulative short squeeze can be mitigated through the use of 'term' stock loans and excess borrowing to create a 'buffer' against loan recall; and by restricting shorting to the larger, more liquid stocks amongst which manipulative short squeezes are rare. However, each of these techniques incurs either a cost or an opportunity cost.

By showing that manipulative short squeezes are rare for larger, more liquid stocks, my results provide support for the Jacobs and Levy (2007) assertion that short squeezes generally only affect smaller, less liquid stocks. The Volkswagen case provides a rare, but economically significant, exception to this pattern. This case shows that where liquidity is constrained (e.g. by a limited free float), even large stocks can exhibit patterns consistent with manipulative short squeezes. The contribution of this research is that my results should assist in replacing the fear of manipulative short squeezes with a more evidence-based perspective.

Finally, I build upon the work of Gamboa-Cavazos and Savor (2007) and investigate the response of short-sellers to losses. I improve upon existing research in two ways. First, I use daily data, which is better suited than monthly data for examining short-selling activity. Secondly, I incorporate into the analysis an estimate of the weighted-average price at which short positions are initiated. This permits a study of short-sellers' responses to accounting losses.

I find that short-sellers close their positions in response to accounting losses and not simply in response to rising share prices. This is a key observation and a distinction from the findings of Gamboa-Cavazos and Savor (2007). Short-sellers do not exhibit an aversion to realizing accounting losses, but instead accept their losses or 'mistakes' systematically. Stocks subject to short-covering in this manner do not subsequently under-perform the market, and so there is no evidence of an investment performance cost (other than transaction costs) associated with immediately covering short positions that fall to an accounting loss. This behavior is consistent with short-sellers' use of risk management tools that are designed to crystallize small losses. These serve to limit the risk of potentially unlimited losses and to reduce short exposure to stocks at times of heightened synchronization risk. My findings contribute to the literature on loss realization aversion and the 'disposition effect'. I show that a sophisticated group of traders, strongly associated with price setting, are not averse to realizing losses. This has important implications for asset pricing.

A problem for short-sellers is that the predictable use of risk management tools such as stop losses can itself lead to a new risk – predation risk (see Brunnermeier and Pederson, 2005). To mitigate this second-order risk, short-sellers should be cautious about disseminating information on their capital strength and short sale positions. They might also consider making use of stop-losses based on a stock's impact on fund performance, rather than on accounting loss thresholds; alternatively, they could incorporate some degree of randomness into their behaviour.

Taken together, the qualitative and quantitative findings from this thesis should further our understanding of indirect constraints on short-selling. My hope is that this work assists in replacing fear and suspicion around short-selling with a more evidence-based approach.

9.2 Limitations

An important issue with the qualitative part of this thesis is the transferability, or 'generalizability', of the results from my interviews within the Scottish investment community. The results I obtain could be unique to this community, or biased by specific 'Scottish' factors. In fact, one interviewee argues that "Edinburgh is an investing city" (as opposed to a 'trading' city) suggesting at least one 'local' factor of importance to this study. However, by studying one investment community, I am able to test whether or not a series of constraints suggested in the literature can be generalized 'globally'. I find two examples of constraints, put forward in the literature, that are refuted by this community.

In Chapters 6 and 7, I study crowded exits and manipulative short squeezes. These two concepts have been described in the literature and are understood by many practitioners, but have yet to be formally defined. Where definitions have been attempted in the literature, they tend to be in the form of general descriptions or explanations that do not lend themselves to clear, formulaic definitions. It thus becomes difficult to undertake rigorous academic study of the concepts and their implications for investors. To tackle this problem, I establish clear, formulaic definitions and proceed to study the distribution of returns that follow from these definitions. I undertake robustness tests around the definitions, to better understand the implications of changing definitions. Although setting definitions allows study into areas that have been under-researched, it also serves as a limitation of this research, in that one can object to the subjectivity involved in setting the definitions. Nevertheless, this is something that must (and has been) done in many areas of social science research, from research into poverty (where a threshold must be set to define poverty) to research into emerging markets (where definitions must be created to establish the boundary between developed and emerging markets).

A further limitation of the dataset used is that it includes only the larger stocks listed on the London Stock Exchange. The lowest market capitalization of stocks in my dataset is around £25 million. This would be considered 'small-cap' but not 'micro-cap' in the context of the London Stock Exchange. However, I am able to provide support for the assertion that manipulative short squeezes, to the extent they take

place at all, largely only affect smaller, less liquid stocks by showing that they are rare for larger, more liquid stocks. By observing the differences in returns between equally-weighted and value-weighted portfolios, Asquith *et al.* (2005) demonstrate that the level of short-selling is more informative as a negative sentiment indicator for smaller capitalization stocks than for larger stocks. However, Au *et al.* (2007) suggest that a study based on larger capitalization stocks will produce more conservative estimates for the relationship between short-selling and stock returns compared to a study that includes smaller, less liquid stocks, thus suggesting a degree of conservatism in my findings.

Another limitation of this research is that it uses stock lending data as a proxy for short-selling. Direct data on short-selling is not publicly available in the UK. Instead, stock lending data is available, on a daily basis. The process of short-selling generally requires stock to be borrowed to facilitate settlement of the trade, and so stock lending data acts as a proxy for short-selling data. However, securities lending can take place for a variety of reasons (see Sections 2.2.3 and 2.2.4), and so stock lending does not solely reflect short-selling. There are other problems associated with using stock lending data as a proxy for short-selling. First, 'naked' short-selling and intra-day shorting do not require the delivery of stock for settlement at the end of the day, and so would not be revealed by daily stock lending data. The extent to which market practitioners fulfil their obligations to report stock lending to the market authorities is a further limitation on the use of stock lending data as a proxy for short-selling. Discussions with practitioners involved in stock lending suggest that this problem is rare, but unavoidable. Finally, derivatives can be used to effect transactions that are economically equivalent to short-selling (see, for example, Ofek *et al*., 2004). These trades are referred to as "synthetic short-sales". The extent to which the use of derivatives to facilitate short-selling is transmitted into the stock lending market influences the usefulness of stock lending data as a proxy for short-selling. Discussions with stock-lending practitioners suggest that the majority, but not all, synthetic short-sales are ultimately hedged by the counter-parties to those trades, through borrowing stock and selling short.

To examine the reaction of short-sellers to accounting losses, I incorporate a technique for estimating the cost basis of short positions. Specifically, for each stock, I observe the average stock price for days on which short positions are increased. I then build up over time an estimate of the short-sellers' cost basis in each stock using the volume weighted average price at which stock are sold short. Nevertheless, having an actual cost basis would enhance the research. Even if data on actual cost bases should remain unavailable, a longer series of data would allow for an increase in the formation period for the estimation of the cost bases, thus making such estimation more accurate.

A number of studies into short-selling make use of monthly data (e.g. Senchack and Starks, 1993 and Dechow *et al.*, 2001, Gamboa-Cavazos and Savor, 2007). However, Christophe *et al.* (2007) criticise the use of monthly short-selling data, as it "represents only a snap-shot of total shorted shares on one day during the month." Cohen *et al.* (2007) find that almost half the securities lending contracts they study are closed out within two weeks, while the median contract length is 11 days. This suggests that monthly data could be inadequate for understanding the trading practices of short-sellers. The dataset used for this study incorporates daily data on shares borrowed (a proxy for shares shorted). This higher frequency data allows for an appropriate degree of granularity for the study of manipulative short squeezes, crowded exits and the use of stop losses. Nevertheless, a limitation of the dataset is that it is unable to capture the activities of intra-day traders – those who open and close short-positions within one day.

Some studies obtain trade-by-trade (or 'flow') data on stock lending or short-selling. These same studies tend to investigate shorter time periods. There is a balance to be had, though: although flow data provides the highest degree of granularity, it would be arduous to study flow data for long periods of time. However, studies over longer periods could reveal trends and cycles not found in shorter periods. Christophe *et al.* (2007) take flow data for a ten month period and aggregate it into daily data. Similarly, Diether *et al.* (2008) obtain tick by tick short-sale data for over 3,800 stocks during 2005 and aggregate it for each stock to the daily level. This study uses

daily data over a 45 month period. It provides greater granularity than studies based on monthly data, but investigates a shorter time period than a number of these studies. However, I investigate a longer time period than most studies that use trade-by-trade data. This shows the nature of the compromise between granularity and time period studied.

9.3 Future Research

The interview-based qualitative analysis undertaken for this thesis was conducted in the United Kingdom. As institutional frameworks vary by country or region, further study outside of the United Kingdom would be helpful in testing whether or not the results can be generalized globally.

For the three empirical studies, I make use of a time period from the start of the UK stock lending database in September 2003, through until May 31st 2007. As with any empirical study, there are benefits to be derived from the study of a longer time period that encompasses different market conditions. For example, while in the writing-up phase of this thesis in July 2008, UK and US stock markets experienced a series of 'crowded exits', as heavily shorted financial and cyclical stocks recovered sharply and short-sellers suffered losses.

Whereas many studies of short-selling activity make use of monthly data on short-interest, this study uses daily data. This greater granularity allows me to capture the activities of short-sellers better, given their short-term trading horizons. Nevertheless, even daily data is unable to capture the activities of intra-day traders – those who open and close short-positions within one day. Thus, there is a case to be made for yet greater granularity and the use of intra-day or flow data in future studies.

The behaviour of stock market participants can change in response to new studies and empirical evidence. In particular, knowledge of the risks involved in crowded

exits could lead short-sellers to become more aware of crowded positions, or to react faster to any drop in short-interest in heavily shorted stocks. A study of changes in behavior over time with respect to 'crowded exit risk' would be of interest in understanding how a 'sophisticated' subset of practitioners reacts to new empirical evidence.

Another potential line of investigation relates to the predictable behavior of short-sellers in response to accounting losses. A logical step is to examine whether such predictable behavior can be exploited by other traders. For example, one or more large predatory traders, who know the cost basis of a short-seller, would be able to buy stock and exert upwards price pressure on the stock price. Where the stock price rises above the costs basis of the short-seller, this would prompt the short-seller to cover his position, in accordance with his stop loss process. The empirical literature on predatory trading would benefit greatly from such a study, as it would reveal whether or not short-sellers can become the victims of predatory trading. If so, then the use of stop losses - an apparently sensible risk-control mechanism designed to deal with the potential for unlimited losses - could in practice expose short-sellers to a new risk – 'predation risk'. Such a study could seek to measure the abnormal returns around such events, and to understand the risks involved for both predator and prey. Related to this would be an investigation into 'optimal strategies' for short-sellers in light of the need to balance the mitigation of unlimited loss potential (leading to the use of stop losses) with the minimization of predatory trading risk (which can follow from any form of predictable behavior).

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APPENDICES

Appendix A - Interview Questions for Investment Managers

Business Outline:

Please describe briefly your firm's business, investment philosophy and investment process.

Short Selling:

Short-selling generally represents a small proportion of market activity. Why do you believe that short-selling is so uncommon?

What is your, and your firm's, attitude towards short-selling?

What factors influence your view on short-selling?

How much of an influence on your attitude to short selling is attributable to:

- the costs of short selling (e.g. borrowing 'specials')
- constraints (legal, regulatory, institutional)
- risks of short-selling (e.g. unlimited loss potential; size of short position grows as price rises; 'blow-up' risk to reputation and brand, plus the management effort required to solve any such problem; synchronicity risk)
- the impact of short-selling on expected portfolio returns influence your decision not to be involved in short-selling? (If yes to the above, would you consider using index futures to counteract this effect?)
- a desire not to produce tracking error against a benchmark.
- cultural considerations (fear of vilification, fear of failure).

What are your clients' opinions on short selling?

Do you believe that short sellers have special skills relative to long-only managers?

Do you believe that hedge fund managers justify their fees in aggregate?

What proportion of your business do you envisage will involve short-selling in the long-term?

What reasons do you believe lie behind the growth in short selling over the past, say, twenty years?

Securities Lending:

What is your firm's attitude towards lending securities?

What factors influence your decision on securities lending?

Does your securities lending policy formally link in to your corporate/ proxy voting policy?

Predatory Trading:

Are you ever aware of the presence of short-sellers in companies whose shares you hold long?

Does knowledge about the presence of short-sellers ever influence your behaviour?
