Three Essays on Short Sales

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ABSTRACT

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This thesis consists of three essays. The first essay (thesis chapter two) examines the relationship between short sales and governance. A contribution is made to the literature on short sales by providing evidence that the level of shorting is reversely linked to the overall quality of the corporate governance of a firm and that sellers react contemporaneously to changes in such governance. Short traders may also be able to forecast changes in corporate governance and adjust their portfolios asymmetrically *prior* to the said changes, with a pronounced increase in short positions for actual and anticipated negative events and a more subdued repurchase of shorted stock for positive expectations.

The second essay (thesis chapter three) introduces a new taxonomy that classifies short-sales constraints into tangible and intangible categories. It includes the development of a theoretical framework relating overpricing and implementation drag to empirically estimate the four tangible constraints. The literature underestimates these constraints with taxes representing the largest drag on short-selling, followed by direct trading costs, the lending fee and dividend repayments. The commonly used lending fee is a poor proxy for short-selling constraints both in magnitude and variance. Overpricing generally exceeds the implementation drag from tangible short-sales constraints except during periods of rapid price contraction.

The third essay (thesis chapter four) extends the overvaluation model based on heterogeneous expectations and short-sales constraints. Seven intangible restrictions are identified and their effect is empirically assessed using two measures of mispricing; absolute and

relative. The recall risk, search frictions and investor sentiment increase mispricing while institutional ownership and the existence of options reduce it. Firm-based restrictive tactics initially increase overpricing but signal to the market that the stock is under selling pressure. Since such tactics are rarely effective, firm-bullying becomes negatively related to mispricing. Short-sellers should limit their holding period to a minimum as the monthly-equivalent short returns decline with longer trades and they would benefit by concentrating on firms that are smaller in size, relatively poorly managed with lower institutional ownership, higher systematic risk, no options, higher price-earnings multiples and lower market-to-book ratios.

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CHAPTER 1

INTRODUCTION

A short sale is the result of an investor selling an asset he does not own. To complete the transaction, four distinct steps are required: selling the securities, borrowing the shares in the lending market, repurchasing the asset at a later date to cover the short position, hopefully at a lower price, and then returning them to the lender. While the stock is under loan, the ownership and associated rights (voting, dividends, etc.) are transferred to the borrower. The act of borrowing shares (securities lending) is subject to fees and the borrower is also obliged to pay, partially or in full, any dividends received to the lender. The proceeds of a short sale are not available to the trader and are held in escrow. The Federal Reserve also requires that a further 50% of the dollar value of the shorted stock be added as collateral. If the share price increases, the seller must provide additional capital to the margin account to maintain a ratio of 150% at all times. In practice, this margin is usually posted using securities such as treasury bills or equivalent short-term money market instruments. Short selling is considered risky and expensive and is generally the domain of sophisticated or institutional investors.

Short sales have been the center of many debates in the finance industry. The central argument revolves around the potential negative impact of shorting on market efficiency and the resulting need for a regulatory framework. The general opinion of researchers, based on empirical and theoretical work, is that unrestricted shorting is actually beneficial to the market. As informed and resourceful investors, institutional short-sellers rapidly integrate previously overlooked information into stock valuation thus increasing price accuracy and liquidity.

Financial firms are generally well funded and, in their search for value and profits, actively scrutinize financial instruments for mispricing. It is rare to find a valuable stock that is not followed by one or more analysts. The literature on short sales also focuses on the abnormal returns generated by this activity but the specific techniques used to achieve these results are relatively unknown. The ability to detect or forecast financial misconduct, negative news or earnings restatements are among the capabilities attributed to short-sellers and these events are all closely related to the quality of firm management. While the relationship between long positions and corporate governance is extensively studied, the impact of short-sellers on the latter has thus far been ignored. The second chapter of this thesis aims to fill this void.

The price discovery process is a constant struggle between optimists, who drive the share price upwards by purchasing stock, and pessimists who depress it through sales. If one of these two protagonist groups is hindered, the stock price will drift accordingly. Long buyers enjoy relatively few restrictions with minimal transaction fees and a favorable tax treatment as profits can be considered capital gains. Short-sellers, on the other hand, face a number of restrictions. These restrictions are collectively referred to as constraints. If these constraints are sizable, traders with a negative view of a firm's prospects must wait for the share price to increase so they can recoup their cost and generate a profit. In the presence of heterogeneous expectations, the resulting effect is that stock prices rise above their fundamental value. This hindrance to market efficiency is well documented both theoretically and empirically and stocks are believed to be generally priced above their intrinsic value due to binding constraints. As share prices rise, the short investor must assess the intrinsic value of the stock as well as his fees to complete the trade. He understands that the stock is overvalued but cannot execute the sale until the market price reaches the sum of the expected future value plus the cost of completing the sale. Once the price crosses this threshold, the pessimistic investor can execute the sale and have a reasonable hope for monetary gains.

The literature is somewhat disorganized and incomplete on the subject of short-sales constraints. Most studies consider the lending fee as a unique or primary drag. Other proxies include use-of-proceeds restrictions, margin requirements, fundamental ratios, dividend yields, institutional ownership levels and the introduction of options. Whether by design or because of the difficulty in obtaining data, few papers rely on more than one or two measures to characterize constraints and fail to explain the magnitude of the overvaluation built into stock prices. Behavioral models for mispricing include representativeness heuristics where traders overplay popular news, feedback trading where only the latest events and price fluctuations are considered, self-attribution where investors ignore signals in favor of their beliefs or opinions and, finally, heterogeneous expectations under binding constraints due to the asymmetric restrictions imposed on short-sellers. The third chapter of this thesis aims to contribute to the literature by developing a theoretical framework relating mispricing and implementation drag with the objective of identifying, classifying and empirically estimating the constraints. Some of these, such as taxes, direct trading costs, dividend repayments and lending fees are tangible, can be readily assessed by the seller prior to the execution of the trade and should give rise to a quantifiable increase in mispricing if profits are to be expected. Chapter three also serves as a preliminary investigation of overpricing where it is defined as the difference between market price and the intrinsic value of a firm's stock.

While the tangible constraints account for some of the divergence between market and fundamental values, a portion of overpricing remains unexplained. Chapter four of this thesis explores excess overpricing defined as the surplus of the short-sales price over the sum of the intrinsic value of the stock and the tangible drag. Short-sellers are subject to a variety of factors that can have a positive or negative material impact on mispricing; the risk of a recall or short-squeeze, market opacity, market sentiment, the difficulty in locating lendable shares, the existence of options and the level of institutional ownership are included in this category. Firm managers also take a dim view of sellers and actively attempt to curb shorting by limiting the availability of lendable stock or threatening with lawsuits and belligerent announcements. Not to be outdone, regulatory bodies and governments increase short sales drag by introducing restrictions such as the uptick rule and, particularly during crisis periods, outright bans. The impact of these constraints is elusive and cannot be readily estimated by the trader. They act as an intangible drag to short sales, potentially providing an explanation to the excess overpricing conundrum. The purpose of the fourth chapter is twofold. The first objective is the identification and empirical assessment of the intangible constraints while the second is a study of the characteristics of overpriced shares. Mispricing varies across industries, macroeconomic conditions and firm-specific attributes such as market capitalization, fundamental ratios, systematic risk and ownership structure. Through a better understanding of overvaluation, chapter four also aims to examine the intangible determinants of share overvaluation.

The fifth chapter concludes the essay. It offers a summary of the findings for each of the three chapters dealing with short-sales constraints, overpricing and the conclusions that follow. Finally, possibilities for future research are discussed.

CHAPTER 2

GOVERNANCE AND SHORT SALES

2.1 INTRODUCTION

Short sales have been the subject of many debates in the academic literature and the finance industry. The bulk of the debate revolves around the potential impact of short-sellers on market efficiency and the resulting requirement for a regulatory framework (or lack thereof). The general opinion of researchers is that unrestricted short sales are actually beneficial to the market (Charoenrook and Daouk, 2005; Beber and Pagano, forthcoming; Boehmer *et al.,* 2013; Boulton and Braga-Alves, 2010). By rapidly integrating new information into stock valuation, price accuracy and liquidity naturally increase. In an effort to generate profits, short-sellers also engage in research activities, revealing new information that may have been previously overlooked, thereby improving market transparency and efficiency. Opponents to this point of view include politicians and corporate CEOs who claim that short sales can be used to manipulate share prices but there appears to be little support for this point of view in the more current literature.

Research on the topic of short selling also focuses on the profits generated by this activity. While the consensus is that short-sellers generate healthy abnormal returns, the methods or strategies used to achieve these higher yields are still relatively under researched. Superior analytical capabilities attributed to higher sophistication appear to be the norm among short-sellers who can sometimes pre-empt price downturns due to changes in fundamentals or other firm-specific events. The literature mentions ownership concentration, lower fundamental ratios, negative news, financial misconduct and earnings restatements as some of the drivers of short sales. These are all items directly or indirectly related to corporate governance or lack thereof. If a company is well managed, there should be less incentive to short its stock.

This chapter links corporate control and market finance to form a bridge between two distinct branches of the existing literature: governance and short sales. It contributes to the literature by providing a new insight into the decision-making process of short-sellers, using an extensive and comprehensive dataset that spans an entire market cycle. We accomplish this task by investigating the contemporaneous and temporal impact of governance ratings on the level of short sales. We also examine the determinants of short sales as previously established in the literature.

We find that there is a significant relationship between the utilization, a measure of the level of short sales defined as the ratio of borrowed shares over total lendable stock, and the CGQ (Corporate Governance Quotient) ratings of the same period, indicating that sellers adopt a short position commensurate with the current governance practices of a firm. Lower ratings are associated with a higher level of short sales. Furthermore, short-sellers adjust their stance when there is a material change in ratings, implying an active change in investment strategy as opposed to a simple monotonous short position. Utilization increases when governance weakens, and short sales decrease with a more subdued effect when the CGQ rating of a firm increases.

Lagged utilization is particularly informative when studying short interest. There is a high correlation for short sales from month to month but this pattern is broken when a governance event occurs. Our results show that short-sellers adopt a higher utilization level in the period *prior* to a change in CGQ ratings, indicating that they may be able to forecast such events and react accordingly. These findings shed light on the motivations of sellers and are consistent with the notion that short-sellers are informed investors. We also find that many of the determinants of short interest previously identified become insignificant when coupled with CGQ ratings. This is the case for fundamental ratios, market capitalization and the presence of options for a specific stock. Lagged utilization, shorting fee and institutional ownership remain as significant independent variables.

The remainder of this chapter is organized as follows. Section two consists of a literature review. Section three describes our sample and data. Section four discusses our hypotheses and the determinants of short interest. Section five presents our empirical methodology and results. Section six details our robustness tests. Section seven concludes the chapter.

2.2 LITERATURE REVIEW

A short sale is essentially the result of an investor selling an asset he does not own with the objective of repurchasing it at a later date and at a lower price to cover the short position. The process is completed when the seller borrows the asset in question from various market participants and delivers it to the buyer in exchange for payment. While the stock is under loan, the ownership of the security is transferred to the borrower along with all of the rights/responsibilities this ownership carries (dividends, voting rights, etc.). The act of borrowing, referred to as "securities lending", is subject to fees and costs and presents many potential dangers. The proceeds of the sale are not available to the seller since it is escrowed as collateral. The Federal Reserve requires that a further 50% of the dollar-equivalent of the trade be added to the collateral in question. Furthermore, short-sellers are subject to the threat of a "short squeeze" when the initial lender of the securities calls its loan with the intention of selling the shares on the open market, forcing the borrower to liquidate its position when no other lenders are available (Dechow *et al.*, 2001). For these reasons, short-sellers are believed to be mostly institutional investors.

Christophe *et al.* (2004) uncover a significant negative relationship between pre-earnings short sales and post-announcement prices. They conclude that "… a significant portion of the short-sellers are informed traders" (p. 1846).[1] Boehmer *et al.* (2008) estimate that approximately 98% of all short sales originate from institutions, proprietary traders and specialists while the remaining 2% is attributed to individuals. They show that short-sellers, as a group, are "extremely well informed" (p. 524) and that "short-sellers possess important information and that their trades are important contributors to more efficient stock prices." (p. 525). This conjecture is supported by the fact that short selling is considered risky and costly compared with long positions (Dechow *et al*, 2001).

With few exceptions, there is ample evidence in the academic literature that short-sellers generate abnormal positive returns (Senchack and Starks, 1993; Asquith and Meulbroek, 1996; Aitken *et al.*, 1998; Dechow *et al.*, 2001). Desai *et al.* (2002) also state that "heavily shorted firms experience negative abnormal returns of -0.76 to -1.13% monthly", or approximately 12% yearly. These findings are supported by Diether *et al.* (2008) who determine that "a trading strategy that buys stocks with low short-selling activity and sells short stocks with high short-selling activity generates an abnormal return of roughly 1.39% (1.41%) per month for the NYSE (Nasdaq)". Woolridge and Dickinson (1994) provide a dissenting opinion but their paper fails to differentiate between speculation-driven and arbitrage/hedging motivated short sales, thereby generating skewed results. The magnitude of short-interest positions (% shorted divided by outstanding shares) plays a determinant role in sorting the purpose of the short position.

[1] Christophe *et al*. (2004) further contend that pre-announcement trades, although partially explained by firm attributes, are more likely driven by specific information about the upcoming announcement.

Focusing on stocks with a short interest of 2.5% of shares outstanding or more provides better information on speculative forces and avoids the trap of including arbitrage and hedging transactions (Dechow *et al.*, 2001; Aitken *et al.*, 1998).

Once it is established that short-sellers do generate abnormal returns, the following question naturally comes to mind: "How do they do it?" Granted, they are mostly informed institutional investors with sizable resources at their disposal but market efficiencies should eliminate the possibility of abnormal returns. While it is a well-known fact that market frictions combined with behavioural factors may cause prices to temporarily deviate from fundamental value (Miller, 1977; Scheinkman and Xiong, 2003; DeBondt and Thaler, 1985; Daniel *et al.*, 1998, Hong and Stein, 1999), does it mean that short-sellers as a group are uncharacteristically astute and can take advantage of these imperfections? A number of papers have attempted to investigate the methods and strategies used by short-sellers to answer this question.

As a group, short-sellers actively target firms with low fundamental to market ratios. Dechow *et al.* (2001) determine that when market prices are high, short interest is also high for stocks with lower than normal cash flow/price, earnings/price and book/market ratios. A possible justification for this phenomenon is that short-sellers simply recognize that stocks are overvalued and act accordingly. Francis *et al.* (2005) agree with this conclusion but differ on the reasons. Their work shows that the increase in short interest is due to overestimated fundamentals and underestimated risk factors, leading to mistakenly high expected returns. In both cases, short-sellers act as a dampening force to realign stock prices. This is partially supported by Diether *et al.* (2008) who determine that short sales increase after a stock has shown a string of strong returns.

Announcements and news also have a marked impact on short sales; newly disclosed negative public information is normally followed by an increase in short interest (Christophe *et al.*, 2004; Desai *et al.*, 2006, Engelberg *et al.*, 2012). Fox *et al.* (2009) explain that short-sellers can actually predict negative news and pre-empt the market by short selling ahead of the news releases, earning abnormal returns in the process. In the same vein, Karpoff and Lou (2010) study the effect of financial misrepresentation on short sales and conclude that short-sellers' actions realign the stock prices with the correct fundamental value prior to the disclosure of misconduct, thereby providing uninformed investors with valuable external benefits. The relationship between management quality and short sales is further detailed by Drobetz *et al.* (2004) who conclude that investors will use the "Wall Street Walk" when faced with poor executive decisions. They will sell shares instead of trying to influence management. Ownership dispersion also has an intuitive link to short interest. With a high concentration of stock in the hands of institutional owners, shares are easier and cheaper to borrow, thereby encouraging short sales. Desai *et al.* (2006) study the behaviour of short-sellers around earnings restatements and find that they begin accumulating short positions several months before the restatement, thereby generating favourable returns from the detection of suspicious financial reporting.

Thus, there is a clear and demonstrated relationship between short sales, company fundamentals, announcements, ownership structures, financial misrepresentations and restatements. These are all variables that can be considered as proxies for corporate governance.

2.3 SAMPLE AND DATA

2.3.1 Governance Data

The data sample has been chosen to cover a full market cycle from July 2006 to July 2009, including the bull market ending in 2007 and the subsequent crash and recovery. The quality level of governance is approximated by RiskMetrics' Corporate Governance Quotient (CGQ®). The CGQ rating is built by evaluating each company against 67 criteria covering the full range of corporate governance (board, audit, charter/bylaws, takeover practices, compensation, ownership and other qualitative factors). The raw score obtained is then compared with other firms from the same index and a ranking system follows where the CGQ index score is the company's relative percentile ranking among its peers. For example, an Index CGQ of 84 indicates that the company's raw score was higher than 84% of the other firms in the same index. Simply put, a high CGQ ranking indicates better corporate governance practices. The CGQ database features over 5400 US companies with monthly scores. Since governance ratings do not change on a daily basis (or even monthly in most cases), this frequency level is satisfactory for the purpose of our study. Changes in governance ratings may have various causes. Examples that have an impact on the CGQ rating include the nomination of the CEO on the board to auditor rotation, features of poison pills, director compensation, board performance review, and stock ownership guidelines for executives.

Of the 5400 firms covered by the dataset, 3962 have continuous governance history for the 37 months included in our sample. Ratings range from 0.1 to 100, with a mean of 52.95, median of 54.40, standard deviation of 28.42 and skewness of -0.09. Kurtosis is relatively low at 1.83. Table 2.1 provides the descriptive statistics for the CGQ ratings.

[Please insert table 2.1 about here.]

2.3.2 Short-sales Data

The level of *utilization* is used as a proxy for short sales. Utilization is the number of securities on loan divided by the total number of lendable shares. It provides a more accurate estimate of short sales than pure short interest and avoids the trap of size, where larger firms would show higher raw short sales because of their market capitalization. Utilization is a close proxy for short interest but it is not perfect. Tax arbitrage – the act of lending securities to a domestic entity to avoid withholding tax in the hands of an international investor – has a limited impact on the quality level of utilization as a proxy for short interest. Prior to the Tax Relief Act of 1997, this technique was also widely used by U.S. entities for domestic holdings but the practice has since disappeared along with the tax advantages. Dividend reinvestment arbitrage provides a similar dilemma since investors sometimes exchange the dividend payment for a lending fee. Nevertheless, the benefits of using securities lending as a proxy (frequency, availability of data, etc.) far outweigh its shortcomings. Firm size can have an impact on the level of short sales. Short-sellers are believed to be skilful investors and stocks with large capitalizations tend to be followed more closely by analysts and institutional investors. Furthermore, the pool of lendable securities increases with firm size, which lowers the cost and difficulty of borrowing shares. All other things being equal, larger firms will have more lendable stock and selecting *utilization* as a proxy for short sales reduces the need to control for firm size.

Direct monthly short sale data are available from various market reports. Unfortunately, many short positions are closed within a few days and a monthly "snapshot" will not provide adequate information so alternative sources are necessary. The trend in short-sales research is to use securities lending data as a proxy for short interest. Several studies employ security loan rate data to measure the effect of short-sales constraints (e.g., Reed, 2001; Jones and Lamont, 2002; D'Avolio, 2002; Saffi and Sigurdson, 2011). For this thesis, securities lending data from Data

Explorer's Securities Finance Data Feed is used as a proxy for short sales. It is one of the most comprehensive datasets available on the market containing daily granular data for over 30,000 equities worldwide with stock-level loan data from over 100 market participants. For the period covered by this essay, this amounts to over seven million data points. To limit the field and match the governance figures, we have restricted the dataset to cover only US equities for the period of July 2006 to July 2009. This daily dataset is collected from hundreds of securities lenders and covers approximately 80% of all worldwide OTC and organized exchange transactions, with higher coverage for North American markets. It provides details such as the borrowed and lendable quantities and values, lending fees, loan tenure, and utilization.

To match our CGQ sample, we restrict the array of stocks to the 3962 firms under study. Each stock has one or more daily observations for aggregate short-sales transactions per lender for a period of 37 months; a total of 4,397,820 observations or 146,594 monthly averages. Further investigation reveals that all but one of the firms with no short sales over the entire sample period are "pink sheets" penny stocks with little or no volume. They are eliminated from the sample as they would not be subject to short sales due to the absence of liquidity.

We take the monthly utilization mean for all stocks to match the frequency of the corporate governance data. Utilization ranges from 0 to 100%, with some stocks showing no short sales at all over the three year period. The mean is 29.83%, with a median of 23.23%, a standard deviation of 22.91%, skewness of 0.94 and kurtosis close to that of a normal distribution at 3.03. As per Dechow *et al.* (2001) and Aitken *et al.* (1998), we eliminate all stock-months where utilization is below 2.5% to remove arbitrage and hedging transactions. After accounting for changes in the CUSIP, delisting and missing data, we obtain a dataset containing 3072 stocks with 113,664 data points detailing monthly governance ratings, securities lending averages and value-weighted average fees. Table 2.1 provides the descriptive statistics for the final sample.

2.4 HYPOTHESES AND POSSIBLE SHORT-INTEREST DETERMINANTS

2.4.1 Hypotheses Development

"*Corporate governance is the system by which companies are directed and controlled*" is a simple but far reaching comment taken from the 1992 Cadbury report. In essence, corporate governance mechanisms ensure that fund providers get proper returns on their investments. Methods used to enforce corporate honesty against poor governance include separation of ownership and control, protection of shareholder rights, legal prohibitions against self-dealing and concentrated ownership. Agency theory is considered the point of origin of any discussion on corporate governance. To safeguard their capital and generate an acceptable return, investors must ensure that managements act in the best interests of the fund providers. In developed countries, the principal-agent problem is partially solved by adopting a costly framework composed of legal restrictions, corporate charters and bylaws, as well as the threat of corporate control changeovers. Since the implementation of these defence mechanisms impose a burden on the firm's bottom line, investors require higher compensation for the additional costs they must bear. However, the general consensus among market participants, regulators and researchers is that better governance, which steers time and resources away from monitoring management, reduces the required rate of return, hence lowering the cost of capital.

A better understanding of the relationship between short sales and governance can be obtained from an examination of the dividend-discounting framework where the stock price (and ultimately the theoretical value of the firm) is a function of the book value of common equity plus the actualized value of all future abnormal earnings (Edwards and Bell, 1961; Ohlson, 1995). These future abnormal earnings are discounted at k, the cost of common equity capital or required rate of return:

$$P_{j,t} = B_t + \sum_{\tau=1}^{\infty} \frac{E_{j,t}(x_{t+\tau}^{a})}{(1+k_j)^{\tau}} \qquad (2.1)$$

Where $P_{j,t}$ is the price estimated or observed by trader (or analyst) j at time t, B_t is the book value of common equity at time t; $E_{j,t}(x_{t+\tau}^{a})$ is the investor's estimate at time t of the value of abnormal earnings at time ($t+\tau$) and k_j is the cost of common equity capital. The price $P_{j,t}$ and the required rate of return k_j are endogeneous variables. For a given market price, we can extract the implied cost of equity but the model is commonly used to estimate, from the perspective of an analyst j, the value of a firm's stock $P_{j,t}$ for a specific desired rate of return k_j.

The key parameter in this valuation model remains the discount rate k. Under-estimating the required rate of return will lead to an overvaluation of the firm's equity while over-estimating it will have the opposite effect. Numerous methods are used to estimate k. For example, the CAPM uses the risk-free rate plus a risk premium. All of these techniques demand careful analysis of the target firm. This is an undertaking which requires significant resources, both in the form of human capital and analytical tools. Institutional investors are well equipped for the task and it is expected that they should be more precise than individuals in their estimation of the cost of capital (or future abnormal returns), and will react more rapidly in the event of an unexpected change in the governance structure of a firm that affects the parameters in (2.1).

While the concept of weak governance appears relatively simple, expressing it in quantifiable terms is somewhat more complicated. In their paper, Gompers, Ishii and Metrick (2003) devise a measurable metric for the quality level of corporate governance based on the restriction of shareholder rights. Their findings link strong shareholder rights with higher stock returns. This was later confirmed by Drobetz *et al.* (2004) who construct a Corporate Governance Rating scale for the German market based on corporate governance commitment, shareholder's rights, transparency, auditing and management board matters. A poor score implies a higher likelihood of financial misrepresentation, more frequent restatements and generally weaker management, driving the cost of capital higher and firm value lower.

As discussed, short sales are mostly the domain of institutional investors and lead to a realignment of stock prices with their fundamental values. Furthermore, unrestricted short sales increase the informational content of markets (Diamond and Verracchia, 1987). Efficient and transparent markets reduce risk, thereby reducing the required rate of return. Charoenrook and Daouk (2009) empirically confirm that the presence of short sales reduces k through liquidity improvement, variance reduction and enhanced risk sharing.

Since the required rate of return is linked to both corporate governance and short sales, we expect to find a significant relationship between the two domains. This insight leads to three distinct testable hypotheses. First, the level of governance, by itself, should provide information about the level of short sales. Second, a (favorable) change in the governance rating of the firm (as a result of a vote at a shareholder meeting for example) should have a contemporary (inverse) effect on short interest. Third, short-sellers may be able to anticipate material changes in corporate governance due to board decisions, shareholder activism or any firm-specific event that has an impact on the governance rating.

We begin by examining the general relationship between governance and short sales. Better governance leads to a lower cost of capital (k), and this lower cost of capital drives expected firm valuation higher, thereby reducing short sales. Therefore, the level of utilization should have a negative relationship with corporate governance. For this test, no causality is implied. Our first hypothesis in its alternative form is as follows:

H_a^1: *The level of corporate governance is negatively related with the level of short interest.*

Short-sellers react to news, earnings announcements, financial misconduct and any corporate-driven events that can have a material impact on valuation. If firm *i* in month *t* experiences a material change in its governance rating, it is expected that short-sellers will react by immediately reducing or eliminating their short positions for value-creating (positive changes in CGQ ratings) events or increase short sales for expected losses in value (negative changes in CGQ ratings). Thus, our second hypothesis in its alternate form is as follows:

H_a^2: *A negative (positive) change in the governance level of a firm is positively (negatively) related contemporaneously with the change in the level of short sales.*

Desai *et al.* (2006), Karpoff and Lou (2010) and Fox *et al.* (2009) study the effect of firm-specific events such as earnings restatements, financial misrepresentations and negative corporate news. They conclude that not only do the short-sellers react to events as they unfold but that they can actually predict the news by accumulating short positions ahead of the announcements. If short-sellers can correctly anticipate changes in governance, this should be incorporated into the level of utilization in the period prior to the event. We formulate our third hypothesis in its alternate form to test whether the same conclusion can be drawn for changes in governance:

H_a^3: *A negative (positive) change in the governance level of a firm is preceded by a high (low) level of short interest.*

2.4.2 Potential Determinants of Short Interest

Many firm-specific factors have an effect on short interest and they are the subject of numerous studies. Graham *et al.* (1999) argue that trading costs have a direct influence on short sales; traders are more likely to short sell a stock when the cost is lower. Many proxies are used to estimate this cost. Higher trading volumes imply better liquidity and a resulting lower cost, and significant institutional ownership reflects a larger pool of lendable securities and also reduces borrowing rates. Since firms with higher market capitalizations tend to show higher levels of institutional ownership (Sias and Starks, 1997), it can be argued that market capitalization is also a proxy for trading costs. Gintschel (2001) finds that market capitalization and turnover explain 58% of the cross-sectional variation in average short interest. Fortunately, the short-sales database used in this essay also contains explicit data on short-selling fees on an aggregate per-lender level so no proxy for the costs of borrowing shares is necessary.

In our regressions, the independent variable $logShortCost$ accounts for the effect of trading costs on short interest. Because of outliers and the wide range of values (from 0 to 8000 basis points) reported for this variable, we take the log of the monthly value-weighted average fees as the control variable. Options and short sales can both be used to achieve a short position. Therefore, it is expected that the existence of options on a stock should have an effect on the level of short interest for that firm. Many studies confirm this assumption. For example, Gintschel (2001), Arnold *et al.* (2005) and Henry and MacKenzie (2007) conclude that short-interest levels are significantly related to the availability of options for a specific stock. We test the existence of options as a regressor and find in untabulated results that it is insignificant when the CGQ rating, lagged utilization and institutional ownership are used as independent variables.[2]

[2] These and any other untabulated findings are available from the authors.

The effect of past short sales on present short interest, also known as short momentum, is well documented in the literature. McKenzie and Henry (2007) and Dechow *et al.* (2001) report that short momentum is a significant control variable in assessing models related to short sales. Thus, we include a lagged term, $Utilization_{i,t-1}$, in our regressions.

Lower fundamental ratios are also linked to short sales. As investors notice that the book-to-market or the earnings-to-price ratios wane, they usually increase their short positions to take advantage of the potential drop in stock value. Firms with poorer governance ratings tend to have weaker fundamentals (Brown and Caylor, 2009; Drobetz *et al*., 2004). The literature on short sales identifies variables that we drop from the subsequently tabulated regression results because they lose their significance when coupled with governance as regressors. This is the case for the retention ratio, Tobin's Q, market capitalization, the existence of options and fundamental ratios such as P/E, M/B, etc. Ownership dispersion also links governance and short sales. Highly concentrated holdings have an impact on short sales through easier access to securities lending and this characteristic is related to governance as high concentration facilitates the enforcement of shareholder rights. Chung *et al.* (2010) also report that institutional ownership is a determinant factor when considering CGQ ratings and thus we include it in the list of independent variables.

2.5 EMPIRICAL METHODOLOGY AND RESULTS

2.5.1 Test of the First Alternative Hypothesis

Our first alternative hypothesis is that a lower level of governance is associated with a higher contemporaneous level of short sales. Since the use of the least square method relies on the stochastic process being stationary and to avoid the possibility of spurious regression results, we first determine if the dependent variable, $Utilization_{i,t}$, is integrated of order one or zero by performing a unit root test. The results (untabulated) indicate that, with a p-value of 0.000 for the Dicker-Fuller test,[3] we can reject the null of a unit root process and thus conclude that the series is stationary. We then conduct the Hausman test to choose between random and fixed effects and reject the null in favor of the fixed-effects (FE) model. We also complete an F-test and the results (p=0.0000) indicate that the pooled OLS method is not appropriate. We thus estimate regression model (2.2) below using a panel regression with period fixed effects and White diagonal standard errors to account for clustered standard errors. Furthermore, when the lagged dependent variable also appears as an explanatory variable as it is the case for equation (2.2), strict exogeneity of the regressors may no longer hold. Since our sample displays a large number of observations for a fixed number of periods, the least square estimation method may yield biased results. As a test of robustness, we also estimate equation (2.2) using a dynamic system GMM panel model with two lags (e.g. refer to Arellano and Bover, 1995).

Based on the determinants of short interest previously discussed, our regression model is as follows:

$$Utilization_{i,t} = \beta_0 + \beta_1 GovR_{i,t} + \beta_2 logShortCost_{i,t} + \beta_3 Utilization_{i,t-1} + \beta_4 InstOwn_{i,t} + \varepsilon_{i,t} \quad (2.2)$$

where:

$Utilization_{i,t}$ is the mean ratio of shares borrowed to lendable shares for stock *i* during month *t*;

$GovR_{i,t}$ is the CGQ rating for stock *i* for month *t*;

$logShortCost_{i,t}$ is the log of the value-weighted average shorting fee for stock *i* for month *t*;

$Utilization_{i,t-1}$ is the dependent variable lagged one month to control for short momentum; and

[3] Similar results are obtained using the common (Levin, Lin and Chu) and the individual (Perron) unit root processes.

$InstOwn_{i,t}$ is the percentage of shares owned by institutional investors of stock i for month t.

Table 2.2 reports the results for the tests of H_a^1 for our sample that includes 42,915 observations. Panel A provides the output details for the fixed-effects estimation method while Panel B reports the results obtained from the dynamic system GMM panel model. The table also reports the Bayes-adjusted critical t-values for the regressions. This adjusted critical t-value accounts for Lindley's (1957) and Jeffrey's (1939) statistical paradox that the standard p-values and t-statistics may lose their meaning with large samples. Leamer (1978) introduces a more rigorous test of statistical significance that uses a critical t-value equal to $\sqrt{(n-k)\left(\sqrt[n]{n}-1\right)}$, where n is the number of observations (42,915) and k is the number of parameters.

[Please insert table 2.2 about here.]

With a R^2 value of 0.85, an F-statistic of 9633 (p-value = 0.000) and a DW statistic of 2.02, we conclude that the regression model is well specified and that there is no issue with serial correlation in the residuals. All coefficients are statistically significant based on both the standard and the more stringent Bayes-adjusted critical t-values. The coefficient for $GovR_{i,t}$ is negative, confirming our hypothesis of an inverse relationship between the CGQ level and short interest. Higher short sales are associated with lower governance and vice-versa. Our results confirm prior studies that both the shorting fee ($ShortCost_{i,t}$) and institutional ownership ($InstOwn_{i,t}$) are positively related to short sales. As utilization rises, lendable shares are more difficult to find and the cost of borrowing the stock subsequently increases. Furthermore, the estimated coefficient for the lagged term $Utilization_{i,t-1}$ is statistically significant and its addition to the regression increases the R^2 value from 0.30 to 0.85, indicating that prior short sales play a strong role in the determination of contemporaneous short interest. To determine the linearity of the relationship between governance and short-sales, we perform a piecewise regression with knots at $GovR_{i,t}$= 20%, 40%, 50%, 60% and 80%. The results (untabulated) show that the coefficients of the dummy variables assigned to all breakpoints are insignificant at the 90% level. Furthermore, the explanatory power of the model, as expressed by the coefficient of determination, does not improve with the addition of partitions but remains at the 0.85 level. We therefore conclude that the relationship is linear between governance and short-sales.

The results obtained using the dynamic system GMM panel estimation method are qualitatively similar to that of the FE model. As reported in Panel B of Table 2.2, all the coefficients are statistically significant to Bayes-adjusted critical t-statistics and the signs of β_1, β_2, β_3 and β_4 are an exact match to those obtained from the fixed-effect regressions, thus confirming the validity of our results.

2.5.2 Test of the Second Alternative Hypothesis

The premise of our second alternative hypothesis is that a change in the level of a firm's governance rating has an impact on the contemporaneous variation in the level of short utilization for that firm. When short-sellers are informed of an event that has a material impact on the quality of corporate direction and control, they will adjust their short position to reflect their expectations for future stock returns as opposed to simply maintaining a high short balance. This hypothesis expands the relationship between governance and short sales established with regression model (2.2) to encompass direct action on the part of the traders, as opposed to a general relationship between two variables.

During the three-year period under study for our sample of 3072 stocks, there are 34,248 events where the governance rating changed from month *t-1* to *t*. We resize the sample to account for the frequency of the different independent variables. Since institutional ownership is reported quarterly while the rest of the data is monthly, the variable $\Delta InstOwn_{i,t}$ displays a value of 0 for two months of every quarter and those observations are therefore discarded. The new sanitized sample shows 12,199 observations. We perform the same unit root tests on $\Delta Utilization_{i,t}$ as described in section 2.5.1 and find that the series is stationary. As per regression model (2.2), we test H_a^2 by estimating the following regression model using a panel regression with period fixed effects and White diagonal standard errors to account for clustering and, for robustness purposes, with the dynamic system GMM panel method:

$$\Delta Utilization_{i,t} = \beta_0 + \beta_1 \Delta GovR_{i,t} + \beta_2 \Delta logShortCost_{i,t} + \beta_3 \Delta Utilization_{i,t-1} + \beta_4 \Delta InstOwn_{i,t} + \varepsilon_{i,t} \quad (2.3)$$

where all the variables are monthly changes from month *t-1* to *t* with the exception of $\Delta Utilization_{i,t-1}$, which is from month *t-2* to *t-1*. The variables are as previously defined for regression model (2.2).

Based on the results reported in Panel A of Table 2.3, the adjusted coefficient of determination for the least squares regression (2.3) is 0.08 and the Durbin-Watson statistic is 1.88, implying no autocorrelation. The F-statistic for the regression model of 65 is significant (p-value = 0.0000). As expected, the coefficient β_1 is negative and significant (p-value = 0.0000), indicating that short-sellers increase (decrease) their position for a negative (positive) change in CGQ rating. As per regression model (2.2), the change in the borrowing cost is significant (p-value = 0.0000) and positively linked to the change in utilization.

[Please insert table 2.3 about here.]

Panel B of Table 2.3 reports the results of regression model (2.3) estimated using the system GMM procedure for dynamic panels. The outcome is qualitatively similar to that of the fixed-effects method with the exception of the coefficient for the change in lending fee, which is now negative but insignificant according to Bayes-adjusted critical t-statistics. The coefficient for the change in governance rating is negative and, with a large t-statistic of -25.77, further confirms our previous findings.

The variation in lagged utilization ($\Delta Utilization_{i,t-1}$) is particularly informative. The significantly negative sign of the coefficient (p-value = 0.0000) for both the FE and dynamic system GMM methods defines a change in the pattern of short-sellers' actions between periods *t-2* and *t-1*. Because of short momentum, lagged short sales are normally highly correlated with present short interest. The correlation coefficient between $Utilization_{i,t}$ and $Utilization_{i,t-1}$ is 0.9134. Under monotonous conditions (without an intervening event such as a change in governance), we would expect that the coefficient for the change in lagged utilization ($\Delta Utilization_{i,t-1}$) would be significant and positive as the level of short sales in one period is highly correlated to that of the next. But the expected change in CGQ rating forces the sellers to alter their investing pattern from month *t-2* to month *t-1*. As a result, in the presence of an anticipated change in governance, the coefficient for the change in lagged utilization should become negative or insignificant. To verify this possibility, we run the same regression on a reduced sample of 1,117 events where the change in CGQ rating is null (0.00). With a coefficient β_3 of -0.004 and a t-statistic of -0.17, a R^2 of 0.06 and DW=2.13 as reported in Panel A of Table 2.4, the results using the FE method show that the coefficient for $\Delta Utilization_{i,t-1}$ is not statistically different from zero when $\Delta GovR_{i,t} = 0$, indicating that there is no significant change in lagged utilization when there is no change in governance. As detailed in Panel B of Table 2.4, the dynamic system GMM panel model yields similar results, namely that the coefficient for the lagged change in utilization is not significant, confirming our hypothesis that short-sellers do not change their position from *t-2* to *t-1* when no change in governance is expected.

[Please insert table 2.4 about here.]

Thus we conclude that the change in governance forces short-sellers to revise their investment strategy, disrupting the previously monotonous pattern and effectively impacting short interest. It is interesting to note that this change in the shorting trend occurs *prior* to the change in governance, opening the door to the possibility that some of the short-sellers can actually forecast the changes in CGQ rating ahead of the rest of the market.

2.5.3 Test of the Third Alternative Hypothesis

Our third alternative hypothesis deals with whether short-sellers can actually anticipate changes in governance and hold a short position accordingly in the period prior to the change. In essence, we examine if the level of utilization of month *t-1* is related to the change in the CGQ rating in period *t*. It could be argued that the change in governance for this test could be the dependent variable but this leads to a different interpretation. If $\Delta GovR_{i,t}$is regressed on $Utilization_{i,t-1}$, we imply causality that short-sellers actually influence changes in governance. At this point, we simply want to assess if short interest in month *t-1* is related to the change in CGQ rating from month *t-1* to *t*. The term $Utilization_{i,t-2}$ accounts for the impact of short sales in the month prior to the period under study. As per our previous regressions, we use a panel regression with period fixed effects and White diagonal standard errors to account for clustering. We also perform a robustness test with a two-lag dynamic system GMM panel process. The regression model used to test this hypothesis based on our sample of 38,776 change events is as follows:

$$Utilization_{i,t-1} = \beta_0 + \beta_1 \Delta GovR_{i,t} + \beta_2 logShortCost_{i,t-1} + \beta_3 Utilization_{i,t-2}$$
$$+\beta_4 InstOwn_{i,t-1} + \varepsilon_{i,t} \qquad (2.4)$$

where all the terms are as previously defined.

Based on the summary results for the regression model (2.4) reported in panel A of Table 2.5, we observe an R^2 of 0.84 with an F-statistic of 52,608 (probability 0.000). The estimate of least squares coefficient β_1 of -0.0080 is weakly significant (t-statistic = -1.89; p-value = 0.0588) and does not meet the more stringent standard of the Bayesian-adjusted critical t-value (t = ±3.25). We address this issue further in the robustness section of this chapter. Alternatively, as described in Panel B of Table 2.5, the dynamic panel method generates coefficient estimates that are significant to Bayes-adjusted critical t-values for all four independent variables, including $\Delta GovR_{i,t}$ with a t-statistic of -3.46. With the exception of this stronger relationship between governance and short sales, the results for both regression methods are qualitatively similar. The main purpose of regression (2.4) is to verify the sign of this coefficient for the change in CGQ ranking. It is negative, indicating that lagged utilization has an inverse relationship with the variation in governance rating. For a specific stock, sellers take a short position in the period preceding a negative change in governance regime or, alternatively, opt for neutral or reduced short holdings for positive changes.

[Please insert table 2.5 about here.]

While it is established that short positions are positively related to an anticipated negative governance event (and vice-versa), causality still remains in doubt. To study this issue, we reverse the order of our regression and impose $\Delta GovR_{i,t}$ as the dependent variable and $Utilization_{i,t-1}$ as the independent variable. Following in the footsteps of Moore and Porter (2007), we regress the change in governance from equation (2.4) on lagged utilization, Tobin's Q ratio, total firm assets, beta, financial leverage and payout rate. The untabulated results show that the coefficient for $Utilization_{i,t-1}$ is -0.0022 with an insignificant t-statistic of -1.37. This provides an initial insight as to the direction of causality; namely, that the anticipation of a change in governance rating drives the short sales in period *t-1*.

2.6 TESTS OF ROBUSTNESS

2.6.1 Asymmetric Effects of Changes in Governance

We also expect that the effect of the change in CGQ rating will have an asymmetric influence on short interest. A positive change in CGQ rating may have a limited impact on short sales as a seller can only reduce his short position until it becomes flat. In contrast, a negative change allows for more latitude as it only limits short sales to the maximum of the float or lendable shares. The only dampener on short sales is the escalating cost of borrowing the stock. To account for this possibility, we divide $\Delta GovR_{i,t}$ into its positive and negative components. $Neg\Delta GovR_{i,t}$ is $\Delta GovR_{i,t}$ multiplied by a dummy variable with a value of 1 for negative changes in governance and 0 for positive ones. $Pos\Delta GovR_{i,t}$ has the same properties but in reverse since the dummy takes the value of 1 for positive changes in governance and 0 otherwise. We expect the coefficient of $Neg\Delta GovR_{i,t}$ to be negative and statistically significant, and that of $Pos\Delta GovR_{i,t}$ to be positive and substantially smaller in absolute value. We modify regression model (3) as follows with the change in CGQ rating split into its two components and estimate it using the same methods as described in section 2.5.2:

$$\Delta Utilization_{i,t} = \beta_0 + \beta_1 \Delta logShortCost_{i,t} + \beta_2 \Delta Utilization_{i,t-1} + \beta_3 Pos\Delta GovR_{i,t}$$
$$+\beta_4 Neg\Delta GovR_{i,t} + \beta_5 \Delta InstOwn_{i,t} + \varepsilon_{i,t} \quad (5)$$

where all the terms are as previously defined.

Based on the FE regression results summarized in Panel A of Table 2.6, the regression is highly significant (F-statistic = 105, p-value = 0.000) although its adjusted R^2 is only 0.06. All coefficients are statistically significant whether they are measured against standard t-statistics or the more rigorous Bayes-adjusted critical values, with the exception of $Pos\Delta GovR_{i,t}$ which exhibits the lower significance level of 95% (t-value of 2.46). As we hypothesized, the absolute value of the coefficient β_4 is approximately 50% higher than that of β_3, signalling that negative changes in governance have a larger impact on utilization than positive ones. This implies that short-sellers respond more strongly to forecasted negative corporate events than positive ones. Furthermore, the difference in sign between β_3 and β_4 indicates that their reaction is commensurate with the direction of the change in governance. Panel B reports the results of the robustness test completed using the dynamic panel estimation process. The outcome differs from the least square method in two ways; first, all coefficients are statistically significant to the Bayes-adjusted critical t-statistics. Second, although the signs match those of model (2.3), the ratio between positive and negative changes in governance is anomalous, with a much larger absolute value for $Pos\Delta GovR_{i,t}$ than $Neg\Delta GovR_{i,t}$ (0.2098 for the former versus 0.0461 for the latter), casting a doubt on the nature of the asymmetric relationship.

[Please insert table 2.6 about here.]

As a further test of robustness, we run a similar regression with the change in lagged utilization, $\Delta Utilization_{i,t-1}$, as the dependent variable to test if the effect is also present when we consider the change in the level of utilization prior to the corporate event (i.e., change in governance rating). This test also verifies if the short position was in place for more than two periods, giving a possible indication as to the timeframe under consideration by short-sellers. The specific regression estimated is:

$$\Delta Utilization_{i,t-1} = \beta_0 + \beta_1 \Delta logShortCost_{i,t-1} + \beta_2 \Delta Utilization_{i,t-2} + \beta_3 Pos\Delta GovR_{i,t} + \beta_4 Neg\Delta GovR_{i,t} + \beta_5 \Delta InstOwn_{i,t-1} + \varepsilon_{i,t} \quad (2.6)$$

where all the terms are as previously defined.

As reported in Panel A of Table 2.7, the fixed-effects coefficients are all statistically significant and comparable to that for regression model (2.5), signifying that the asymmetric actions are present when the sellers accumulate or divest short positions prior to a change in CGQ ratings. The ratio of the absolute value of β_4 over β_3 is 1.61, replicating our previous findings that negative governance changes have a larger impact than positive ones. For a negative (positive) change in CGQ rating, short-sellers increase (decrease) their share-borrowing utilization during the two months prior to the governance rating change. More succinctly, short-sellers significantly change their holdings from period t-2 to t-1 in anticipation of the change in governance, lending further credence to the third hypothesis. Panel B shows that these results are replicated with the dynamic system GMM panel estimation model with the exception that the relationship between positive changes in governance and the lagged change in utilization is not significant. In economic terms, a trader with a short stock balance faced with an optimistic governance event can only reduce his negative holdings until he reaches a flat position. Alternatively, under adverse expectations, he can continue selling as long as the supply of lendable shares holds, thus anticipated positive changes in CGQ ratings should have a less significant impact on short sales than negative ones.

[Please insert table 2.7 about here.]

2.6.2 Excess Lagged Utilization and Expectations of a Change in Governance

Our third hypothesis rests on the premise that short-sellers may be able to foresee the next change in CGQ rating. Our results from equations (2.4) and (2.6) confirm this possibility. However, from regression model (2.4), the coefficient of $\Delta GovR_{i,t}$ obtained using the least squares estimation process does not meet the more severe Bayesian-adjusted critical t-value. To further investigate this weaker result, we design a new test using excess lagged utilization as the dependent variable. Excess lagged utilization ($XsUtilization_{i,t-1}$) is defined as lagged utilization minus average utilization over the whole time series for each stock i, or $XsUtilization_{i,t-1} = Utilization_{i,t-1} - AvgUtilization_i$. As a further test, we estimate the following regression model:

$$XsUtilization_{i,t-1} = \beta_0 + \beta_1 logShortCost_{i,t-1} + \beta_2 Utilization_{i,t-2}$$
$$+\beta_3 Pos\Delta GovR_{i,t} + \beta_4 Neg\Delta GovR_{i,t} + \beta_5 InstOwn_{i,t-1} + \varepsilon_{i,t} \quad (2.7)$$

where all the terms are as previously defined.

If short-sellers can anticipate changes in governance, excess lagged utilization should be related to changes in the CGQ rating. As was the case for regression models (2.5) and (2.6), we separate positive and negative changes in governance to test for asymmetry. We report the results in Table 2.8. For our sample of 37,677 observations, the fixed-effects regression is highly significant (F-statistic = 2185; p-value = 0.000) with good explanatory power (R^2 = 0.22). Except for β_3, all the coefficients meet the higher Bayesian-adjusted critical t-value hurdle, confirming that short-sellers adjust their positions in expectation of changes in governance. As per regression models (2.5) and (2.6), asymmetry is still present in the period prior to the change in CGQ rating, with a much more pronounced reaction for negative variations (i.e., β_3 versus β_2). The weaker significance of β_3 can be explained by the fact that short-sellers are more interested in negative changes in governance than positive ones. These results further substantiate our third hypothesis.

[Please insert table 2.8 about here.]

2.7 CONCLUSION

This chapter investigates the relationship between short sales and governance. It contributes to the literature by providing a new insight on the tools used by short-sellers to generate profits. We argue that short sales are linked to the overall level of corporate governance of a firm and that sellers react contemporaneously to changes in such governance. We investigate the determinants of short interest identified in the prior literature and find that the use of governance, institutional ownership and lagged utilization as independent variables renders insignificant other regressors such as fundamental ratios, market capitalization, the existence of options, etc.

Our findings support previous studies concluding that shorting costs increase with utilization and that short-sellers take appropriate action when faced with contemporaneous announcements and news related to changes in corporate governance. Furthermore, our results show that short traders may also be able to forecast changes in governance structure and react accordingly *prior* to the said changes and our findings support the notion that short-sellers are informed investors. This reaction is asymmetric, with a pronounced increase in short positions for actual and expected negative shifts in governance and a more subdued repurchase of previously shorted stock for positive changes.

CHAPTER 3

REDEFINING SHORT-SALES CONSTRAINTS

3.1 INTRODUCTION

While many methods exist to estimate the future value of a stock, quantifying the short-sales constraints is somewhat more elusive and the literature addresses this issue using a fragmented approach at best. Most papers on the subject consider only one or two components of such constraints in their analysis and too often use imprecise proxies to estimate the associated impact. As of this date, we do not fully understand the extent or magnitude of short-sales constraints.

In this chapter, we develop a more rigorous framework to extend the literature in this regard. We separate the constraints into two distinct categories: tangible short-sales constraints (those that can be readily calculated by the short-seller) and intangible constraints that are behavioral or regulatory in nature and are difficult to quantify.[4] We identify four tangible constraints: the lending fee, direct trading costs, the dividend repayment requirement and the ever-present taxes. Without accounting for these costs, a short-seller cannot expect to profit from the trade. Contrary to popular belief, the use-of-proceeds restriction does not generate a drag as we explain in section six of this chapter.

This essay contributes to the literature on the subject of short sales in numerous ways. We first introduce a new taxonomy for short-sales constraints, classifying them as tangible and intangible. We then develop a theoretical framework for the latter and quantify each of its four components

[4] Intangible short-sales constraints are numerous, cannot be summarily estimated by the seller and are often overlooked by many traders. They include recall risk and the scarcity of lendable supply, market opacity and search frictions, rules and regulations, moral resistance and impeding firm-based tactics.

empirically. In the process, we estimate various intrinsic value models,[5] adding to the research on this topic. We investigate mispricing, identify its determinants and show that overpricing is positively related to market returns. Relative misevaluation also follows a pattern inverse to firm-based attributes such as size, the level of governance, institutional ownership, earnings-per-share and the market-to-book ratio. Using the newly defined and assessed constraints, we test the overpricing theory originated by Miller (1977) and extended by others under various market conditions.[6]

We find that the literature on short sales is too narrow in its estimations of short-selling constraints, both in nature and magnitude. In contrast to previous mainstream research, we demonstrate that the use-of-proceeds does not create an implementation drag. The mean total tangible constraint for our sample accounts for 31.6% of estimated stock overpricing, defined as a stock's market price minus its estimated intrinsic value. Constraints such as taxes and direct trading fees are generally ignored but are quite substantial at 87.3% and 10.5% of total tangible short-selling costs respectively. The lending fee, by far the most popular proxy in past studies, accounts for a mere 1.6% of this same cost. When these higher shorting fees are considered, mispricing disappears or becomes negative under certain market conditions and Miller's theory does not hold during rapid market contractions.

The remainder of this chapter is organized as follows. Section two consists of a literature review. Section three outlines the theoretical framework for short-sales constraints while section four describes the sample and data. In section five we present the methodology used in this study, discuss the short-sales price and the various intrinsic value models. Section six is dedicated to the empirical evaluation and discussion of the tangible short-sales constraints.

[5] Intrinsic value is also referred to as fundamental or accounting value.
[6] Overpricing is often referred to as a speculative or fundamental bubble or misevaluation.

Section seven investigates overpricing under various market conditions and section eight concludes the chapter.

3.2 LITERATURE REVIEW

A short sale essentially consists of an investor selling an asset he does not own. To generate a profit, he must later repurchase this asset at a lower price. To complete the sale, the trader borrows the asset in question from a securities lender against a fee, called the lending fee. While under loan, a stock's ownership, cash-flow stream and inherent rights are transferred to the borrower. The proceeds of the sale, in addition to a Federal Reserve mandated 50% margin, are held in escrow as collateral and the seller does not have access to these funds until he returns the shares. Short selling is costly and considered risky. There is the constant threat of a short squeeze whereby the lender can, at any time, recall the loan and force the borrower to reinitiate a new loan or purchase the stock at open market prices. For these reasons, it is considered to be mostly the domain of sophisticated institutional investors (Christophe *et al.*, 2004; Boehmer *et al.,* 2008). The literature on short-sales constraints can be separated into two distinct categories: theoretical models and empirical studies.

3.2.1 Theoretical Models

Miller (1977) outlines the role of short-sales implemental drag under heterogeneous expectations. In a market with inhibited short sales, the demand comes from the investors that are the most optimistic about the stock's performance. Since pessimistic traders are restricted from expressing their opinion and selling the stock short, overpricing follows. The difference of opinions among buyers insures that, even if a stock is priced higher than its intrinsic value, there will be an investor willing to purchase the shares. Miller's theory is attractive because of its simplicity and intuitive nature. Miller (1977) states that, under heterogeneous expectations, short-sales constraints will inflate an asset's price above its intrinsic value. Optimists drive the price of the stock up while pessimists are impeded by short-sales constraints and cannot participate in the price discovery process. Of course, for the market to reach equilibrium there must be an investor willing to buy the stock at inflated values. The difference of opinions assumption insures that there will be an investor willing to hold the stock, even at inflated prices. Duffie *et al.* (2002) develop a theoretical model that demonstrates exactly this situation. It is difficult to debate the logic of Miller's argument and empirical tests have clearly shown that overpricing does exist when *both* differences of opinions and constraints are present.

A trader may realize that a stock is overpriced but cannot react until he can recoup the fees associated with the short sale, thereby allowing the price of the stock to rise up to or above the aggregate sum of the fundamental value and the shorting cost. Jarrow (1980) uses a single period mean-variance model of capital market equilibrium to assess the effect of a short-sales prohibition on asset prices. Under the standard CAPM, short sales are unrestricted and expectations are assumed to be homogeneous. Jarrow shows that the direction of share prices depends on the dispersion of beliefs about the covariance of next period's asset prices under restricted short sales. If these beliefs converge, relative risky asset prices always increase resulting in a deviation from the efficient markets assumption. In many markets, constraints merely impede but do not prohibit short sales.

Diamond and Verrecchia (1987) model the impact of short-sales constraints on the speed of adjustment of stock prices to private information. If market-makers are risk neutral, Diamond and Verrecchia conclude that constraints eliminate some of the pessimistic traders but do not bias asset prices upward as investors will consider the added fees when forming their expectations.

Since these added fees become an integral part of the asset's value, the increase in prices is warranted under the efficient markets assumption. Under short-sales restrictions, the absence of trades is considered bad news as long-only traders sit on the sidelines and potential short-sellers are kept out of the market by constraints. Allen *et al*. (1993) introduce a finite period general equilibrium model with asymmetric information to show that price bubbles can exist in the presence of trade secrecy and short-sale constrained agents with private information. Zhang (1997) develops a dynamic incomplete markets model with heterogeneous expectations. His conclusion supports those of Miller as he finds that constraints will push prices upwards.

Duffie *et al.* (2002) focus on the scarcity of lendable securities and integrate the lending fee into a dynamic multi-period model of asset prices. Their findings echo the notion that stock prices can reach levels above the valuation of the most optimistic buyers when stocks are difficult to borrow, lending credibility to the theory that constraints lead to overpricing. Chen *et al.* (2002) argue that the difference of opinions is an indication of valuation and that short-sales constraints keep negative information out of the market. They use low breadth (number of long-only investors) as an indicator of lower expected returns. For a given security, when there are few typical long investors such as mutual funds, they demonstrate theoretically and empirically that prices are high relative to fundamentals and that subsequent returns suffer accordingly. Cao *et al.* (2007) use a rational expectations model to examine the competing effects of a short-sales constraint on the price of a risky asset in the presence of asymmetric information. Upward price pressure occurs from constraints limiting supply and downward price pressure occurs when informational efficiency is reduced from decreased demand caused by bearish investors sitting on the sidelines. The final result depends on the predominant effect. Boehme *et al.* (2013) show that constraints alone are not sufficient to create mispricing as heterogeneous expectations are also necessary to ensure the presence of a buyer for a higher market price.

Scheikman and Xiong (2003) further support Miller by showing that the existence of a short-sales ban prevents arbitrageurs from bursting market bubbles. Their model generates prices above intrinsic values. Hong and Stein (2003) present a theory of market crashes based on heterogeneous expectations and constrained short sales. They show that because of these constraints, bearish traders initially stay out of the markets and their information is only revealed during downturns. Bai *et al.* (2006) contribute to the theory by focusing on two different reasons to trade: risk sharing and speculation. Risk sharing shifts demand and prices upwards while short sales based on private information increase uncertainty and dampen the demand by less informed investors. The effect that dominates dictates the final impact of the constraints. Gallmeyer and Hollifield (2008) also share this view but for a different reason; the optimist trader's intertemporal elasticity of substitution is the determining factor.

While there is no clear consensus, most theoretical models support the notion that, under heterogeneous beliefs and binding short-sales constraints, stock prices can be overvalued and market efficiency can be reduced.

3.2.2 Empirical Evidence

Most of the studies that support Miller's theory use returns on Fama-MacBeth portfolios to show empirically that overpricing exists in the face of heterogeneous beliefs and short-sales constraints. However, studies differ widely on their choice of proxies used to estimate such constraints. The list includes use-of-proceeds restrictions (Figlewski, 1981), margin requirements (Senchack and Starks, 1993), fundamental ratios, dividend yields and institutional ownership (Dechow *et al.*, 2001; Nagel, 2005; Berkman *et al.*, 2009), lending fees (Jones and Lamont, 2002; Duffie *et al.*, 2002; D'Aviolo, 2002; Ali and Trombley, 2006; Boehme *et al.*, 2012) and the introduction of options (Mayhew and Mihov, 2005). Jones and Lamont (2002) equate short-sales constraints to the lending fee. They also make reference to intangible constraints such as institutional or cultural biases, recall risk, market opacity but do not quantify them. Chen *et al.* (2002) introduce the concept that the decline in breadth of ownership (number of long-only holders) is a proxy for short-sales constraints becoming more binding and declare their skepticism that the lending fees play a significant role in overpricing. Whether by design or because of the difficulty in obtaining the data, few papers rely on more than one or two measures to characterize constraints. Others use behavioral or regulatory restrictions. To illustrate, Macey (1989) studies the impact of the uptick rule and moral resistance (public opposition to short sales) during the 1987 crash and concludes that the rule has outlived its usefulness as bear raids are unlikely in today's markets. While it was finally repealed in 2007, it was reintroduced as a diluted limit-down mechanism in February 2010. Crisp (2008) discusses firm-based tactics like stock splits, lawsuits, conditional distribution of dividends and limitations on lendable stock supply that are used to hinder short sales. Although these last two papers do not contain empirical tests, they shed light on the elusive category of intangible short-sales constraints that are difficult to quantify.

Even if the empirical literature supports the Miller hypothesis, there is at least one dissenting opinion. Mayhew and Mihov (2005) demonstrate that abnormal returns are subject to risk assumptions and disappear under alternative models. However, their study is restricted to the effect of the introduction of options and they find no evidence that the subsequent reduction in short-sales constraints can have an impact on prices. Dechow et al. (2001) show that short-sellers use three techniques to achieve superior returns. First, they avoid securities with a high transaction cost. Second, they use information beyond that of the fundamental-to-price ratios. Third, they discriminate between low ratios attributable to low fundamentals and those due to high prices.

The literature on short sales abounds with studies that document the abnormal returns associated with short selling. Chen *et al.* (2002) illustrate this dilemma in their conclusion; if risk-adjusted returns on short sales are so high, why is short interest so low? Why are there not more short-sellers taking advantage of a possible 1 or 2 % monthly return obtained using public information only? Jones and Lamont (2002) provide a potential insight. They contend that shorting costs as defined cannot fully account for overpricing and that a "generic short-sale constraint" inhibits arbitrageurs from depressing prices to their fundamental values. We provide theoretical and empirical evidence to help solve this dilemma and suggest that the literature has systematically underestimated the implementation drag associated with short selling.

3.3. THEORETICAL FRAMEWORK

To investigate this possibility, we begin by examining Miller's theory from an implementation perspective. The microstructure of a short sale can provide an insight as to the motivation of the speculating trader. As the price of a stock rises, a sophisticated short-seller can assess the intrinsic value of a stock based on his expectations. He understands that the stock is overvalued but cannot execute the sale until the market price reaches the sum of the expected future value plus the cost of completing the sale. Once the price crosses this threshold, our pessimistic investor can execute the sale and have a reasonable prospect for monetary gains. The short-seller faces a difficult task; not only must he correctly estimate the expected future value of a stock but he must also precisely assess in dollar terms the various fees and barriers that stand between him and his profit. The result of this scenario is intuitive. For a short sale to take place, the market price must be above the combination of the intrinsic value and the short-sales constraints otherwise a rational seller would not complete the trade.

Elton and Gruber (1970) study the marginal stockholder's tax rate and clientele effect using a model where underpricing is equal to $(P_c\text{-}P_e) - d$, where P_c is the price cum-dividend, P_e is the price ex-dividend and d is the dividend payable. This model describes a situation somewhat similar to that faced by our short-seller if underpricing becomes mispricing, P_c is replaced by the short-sales price, P_e by the intrinsic value and d by the costs of executing the sale.[7] We can clearly see that the trader will not execute the trade if, at a minimum, the tangible constraints cannot be recouped. If he is astute, he will also provide a buffer for the intangible costs. The consequences of this intuitive but simple scenario can have far-reaching implications. If Miller's theory is correct, the magnitude of the overpricing must encompass at least all of the tangible short-sales constraints. At this point, we restrict our study to pricing alone and leave the concept of return, which is subject to investment horizon and risk, for future consideration. At the exact moment when the profitability of a short sale becomes a possibility, we contend that the following equation must be respected:

$$\mathrm{SSP}_{i,t} = \mathrm{IV}_{i,t} + SSC^{T}_{i,t} + SSC^{I}_{i,t}, \quad (3.1)$$

where $\mathrm{SSP}_{i,t}$ is stock i's market price at time t (short-sale price); $\mathrm{IV}_{i,t}$ is the intrinsic or expected value of stock i at time t; $SSC^{T}_{i,t}$ represents the implementation drag from tangible short-sales constraints for stock i at time t; and $SSC^{I}_{i,t}$ represents the implementation drag from intangible short-sales constraints for stock i at time t.

[7] Elton, Gruber and Blake (2005) find that the direction of ex-dividend day price behavior for non-taxable and taxable dividend distributions by closed-end funds is not only consistent with a tax explanation but that the impact varies with changes in the tax law as predicted by the theory.

As the excess of the left-hand side of equation (3.1) over its right-hand side appears, arbitrageurs will short sell the stock. This will push the price back down towards equilibrium where the market price is equal to the right-hand side of equation (3.1). Miller (1977) and Diamond and Verracchio (1987) somewhat disagree on the effect of constraints on prices. The latter authors contend that prices are not biased upwards because investors consider the trading constraints in forming their expectations. The constraints they consider are, in fact, of the tangible category and can be calculated so there are grounds where both theories can be reconciled. The excess dollar value over and above the combination of intrinsic value and tangible constraints can thus be viewed as the just reward that short-sellers obtain for the risk of taking on the intangible constraints. They profit from assuming the risks associated with factors that they cannot readily observe or control.

Rearranging equation (3.1), we can show that this notion of overpricing ($OP_{i,t}$) is a function of the constraints given market equilibrium:

$$OP_{i,t} = SSP_{i,t} - IV_{i,t} = SSC_{i,t}^{T} + SSC_{i,t}^{I}, \tag{3.2}$$

To quantify the short-sales constraints, we must then assess overpricing. The shorting price (or market price) is readily available but intrinsic value is subject to interpretation. Most of the papers empirically testing the overpricing theory use abnormal returns to assess if the market price is above fundamental value. This method is not without its limitations. One of the primary assumptions when testing Miller is that the difference of opinion (and the overpricing) will subside over a long time horizon, sometimes many months. In most cases, no specific event is used to determine the convergence of opinions and the exact moment at which the price reverts to the expected value. Instead, researchers tabulate monthly returns to extrapolate abnormal yields on short-selling strategies. While using returns is useful to ensure stationarity when estimating regressions, they introduce a number of elements that can be detrimental to our analysis such as the necessity to arbitrarily choose a trading period and define the risk parameters. What if the price never reverts to its intrinsic value during the period under consideration? Then the returns method is fundamentally flawed, providing a potential explanation as to the reasons why the literature cannot explain the absence of short interest when potential profits are still available to short-sellers. To address this problem, we propose to use a granular, price-based approach to estimate overpricing for each stock in our dataset. The trading period is left to the discretion of the short-seller who will wait patiently until external events or market forces push the price down to its expected value.

We now define excess overpricing per share ($XSOP_{i,t}$) as the portion of the short-sale price over and above the trader's known and quantifiable variables:

$$XSOP_{i,t} = SSP_{i,t} - IV_{i,t} - SSC_{i,t}^{T} , \tag{3.3}$$

From equation (3), we can show that the excess overpricing for any rational speculative short sale is compensation for at least the intangible short-sales constraints. If $XSOP_{i,t}$ is significantly positive, then Miller's theory holds. The challenge now lies in assigning values to the variables in equation (3.3).

3.4 SAMPLE AND DATA

The sample is selected to cover a full market cycle from July 2006 to December 2010, including the bull run ending in 2007, the ensuing crash and the recovery. The sample is composed of over 1680 U.S. stocks from OTC and organized exchanges and lending data are obtained from Data Explorer's Securities Finance Data Feed®. It is one of the most comprehensive datasets available for the period under study and contains lender-level daily aggregate data for each stock including the quantity and value of shares on loan, total lendable balances, weighted average lending fees, dividend adjustment factor (repayment requirements), number of transactions per lender and the nature of collateral (cash or securities).

Lending data are a close but not perfect proxy for short sales. Prior to the Tax relief Act of 1997, securities lending was widely used for tax arbitrage where an international investor lends the securities to a domestic entity to avoid taxation. This practice has since disappeared, thereby increasing the overall quality of lending data as a proxy. Dividend reinvestment arbitrage – the act of exchanging the dividend for the lending fee – can also skew the data but it occurs relatively rarely and the dataset will reflect this possibility (for example, lending fee of 0 or negative). Nevertheless, the advantages of frequency, availability and range of information far outweigh the potential disadvantages and securities lending data are widely used as a proxy for short sales (e.g., Reed, 2007; Jones and Lamont, 2002; D'Avolio, 2002; Saffi and Sigurdson, 2011).

We obtain fundamental data such as actual earnings per share, cost of equity, book value, marginal tax rates, dividends and payout ratios from Compustat, expected earnings and long-term growth estimates from I.B.E.S. and transaction data (market price, bid-ask spread, volume, etc.) from C.R.S.P. Our original dataset includes 141,528 monthly observations but model estimation is input-sensitive and our data require extensive sanitization. For each stock-month, we require over twenty types of data. If one value is missing, we cannot complete the different computations for that stock-month and must drop the observation from our sample.

We use quarterly expected market risk premiums and risk-free rates from the survey of Chiefs Financial Officers (CFOs) from Duke University and CFO Magazine, as per Graham and Harvey (2012). Following in the footsteps of previous researchers, we eliminate events with missing data points, negative betas and expected earnings, forecast growth rates above 100% and below 0% as well as negative payout ratios. Our resulting sample includes 46,418 stock-month observations for over 1680 firms. The original sample of 141,528 observations has a short-sales mean of $22.75 with a variance of $40.99 while the final dataset shows a mean of $29.26 with a variance of $32.44, the difference resulting in part from the removal of Berkshire Hathaway from the sample. Table 3.1 provides the details of the sample reductions and the various causes.

[Please insert table 3.1 about here.]

3.5 METHODOLOGY

3.5.1 Intrinsic Value

Fundamental models are commonly used in finance and accounting to determine firm value. For example, D'Mello and Shroff (2000) use an earnings-based model to estimate economic value, Dong *et al*. (2006) examine the ratio of residual income model valuation over price to estimate misvaluation and Ma *et al*. (2011) use accounting ratios and the residual income model to detect valuation errors around mergers. We calculate fundamental value using multiple models including three abnormal growth earnings models (Dechow *et al*., 2001; Ohlson and Juettner, 2005; Easton, 2004), and two residual income valuation models (Claus and Thomas, 2001; Lee *et al*., 2003).[8]

While we have no reason to expect that our intrinsic value estimates are systematically biased, our findings are dependent upon the efficacy of those estimates. We obtain at least one expected value for each stock *i* during month *t*. Because of the various input requirements, some of the models generate more values than others and we assign the mean of all available model outputs

[8] Appendix A details the calculations and results for the various models.

as the fundamental value for each stock-month. The final intrinsic value sample, called IV^{AVG}, spans 54 months (July 2006 – December 2010) and contains 46,418 firm-month observations for 1680 stocks, with a mean $SSP_{i,t}$ / $IV^{AVG}_{i,t}$ ratio of 1.189 and standard deviation of 0.389. Shiller (1981) develops a variance-bound model to show that, in the presence of irrational price behavior in the form of a bubble (or misevaluation), the variance of the market price exceeds that of the fundamental value of a firm. Consistent with the prediction of Shiller's model, $MP_{i,t}$ displays a mean (median) of $28.92 ($22.66) with a variance of 1297 while $IV^{AVG}_{i,t}$ shows a mean of $27.39 ($18.17) and a lower variance of 1030 for our sample.

The residual income and abnormal growth models can display one potential weakness as both types rely on analyst estimates for future earnings-per-share or growth prospects. As a second measure of fundamental value, we use a model developed by Rhodes-Kropf, Robinson and Viswanathan (2004, 2005) or RRV (also known as RKRV) and more recently implemented by many researchers, e.g., Fu *et al.* (2013), Hertzel and Li (2010) and Hoberg and Philips (2010). The RRV model has recently become popular in the literature in great part because it avoids analyst biases in the projection of earnings and their growth rates as it assumes that the fundamental value of a firm is a linear function of its book value of equity, leverage and realized net income. Appendix A details the model and calculations required to obtain $IV^{RRV}_{i,t}$. The resulting set of RRV intrinsic values spans 54 months (July 2006 – December 2010) and contains 27,204 firm-month observations for 1680 stocks, with a mean $MP_{i,t}$ / $IV^{RRV}_{i,t}$ ratio of 1.301 and standard deviation of 1.502. The mean fundamental value obtained from the RRV model is $29.73, slightly lower than that of IV^{AVG}, with a median of $22.84 and a variance of 926 thus also conforming to Shiller's theory.

3.5.2 Short-sale Price

The exact trading price for each short sale can be extracted from our database of securities lending. The data includes the daily aggregate value of stock on loan per lender as well as the quantity. To match the frequency of the other datasets used in our study, we total all daily aggregates for each month and obtain an average monthly short-sale price for each stock. The short-sale price for stock *i* for month *t*, $SSP_{i,t}$, is simply the ratio of Dollar value of all shares on loan for firm *i* and month *t* divided by Quantity of shares on loan for same firm and month.

We then compute the simple dollar-denominated overpricing for each stock-month, $OP_{i,t}$, as $SSP_{i,t}$ - $IV_{i,t}$, and its percentage of the short-sale price, $\%OP_{i,t}$, as $OP_{i,t}$ /$SSP_{i,t}$, where all the terms are as previously defined. $OP_{i,t}$ is essentially the profit expected from the trade before factoring in the short-selling constraints.

Table 3.2 reports the descriptive statistics for $OP_{i,t}$ and % $OP_{i,t}$. The IV^{AVG} sample contains 46,418 observations with a mean overpricing, before considering constraints, of \$1.87 (6.39% of short-sale price), a median of \$2.91 (12.70%) and a standard deviation of \$16.12. The results obtained from the RRV intrinsic value model show a higher mean mispricing at \$3.60 (11.38%), with a median of \$2.67 (10.63%) and a standard deviation of \$17.24. With a skewness of 2.37 for OP^{RRV} versus -3.64 for OP^{AVG}, most of the values for overpricing from the RRV model appear to be concentrated below the mean with the extreme values to the right of the distribution while the AVG model exhibits the opposite. As it is commonly done in the corporate finance literature (for example, Hoberg and Philips, 2010), we run a test of robustness by removing all firms belonging to the financial industry (SIC codes 6000-6999), which we name NOFIN, and repeat the same analysis. All of the means and medians of the reduced sample are lower, indicating that the financial industry contributes positively to mispricing and, with a skewness value of 1.18 for OP^{RRV} versus -4.03 for OP^{AVG}, the difference confirms our previous observation concerning the distribution of prices for each model.

3.6 TANGIBLE SHORT-SALES CONSTRAINTS

The tangible short-sales constraints consist of costs and fees that a trader can readily estimate or calculate before completing the sale. They are a direct, measurable restriction to free and clear short sales. They include the lending fee (the most commonly used proxy for overall constraints), the trading or transaction cost, the losses on dividend reimbursements and tax considerations. Use-of-proceeds and margin requirements are occasionally used as constraints in the literature but we show that they do not generate an actual cost in practical applications. All of the measurements are on a per-share basis. We now discuss each in turn.

3.6.1 Lending Fee

The lending cost data for each stock are obtained directly from our dataset as a dollar-weighted average of the aggregate daily fee ($VWAF_{i,t}$) in basis points per firm and lender. The lending fee is a time-dependent constraint in that it cumulates as the holding period increases. Francis *et al.* (2005) establish that the mean holding period for institutional investors is 33 days or roughly one month, so for each stock we calculate the weighted average lending fee for a 30-day month *t*. We use this mean trade length to calculate the borrowing cost. If a trade is of a shorter or longer duration, the lending fee needs to be adjusted accordingly. This period also conveniently matches our data frequency. The short-sales constraint associated with the securities lending fee ($SSC_{i,t}^{L}$) is expressed as:

$$SSC_{i,t}^{L} = VWAF_{i,t} * (30/360) * SSP_{i,t}, \qquad (3.4)$$

3.6.2 Use-of-proceeds Restrictions and Margin Requirements

When a short-seller initiates a trade, the proceeds are escrowed as a guarantee that the stock will be returned upon demand. This guarantee normally takes the form of a cash deposit although the collateral can be in non-cash form such as Treasury securities. The lender receives the cash collateral and delivers the shares but he rebates the equivalent of the overnight repo rate (minus the lending fee) to the short-seller on a daily basis. This reimburses the borrower for the opportunity cost of the collaterized cash. If the guarantee is in a non-cash form, a straight fee that accounts for the repo rate is charged by the lender. Our database shows that 89.24% of the transactions in dollar terms are done against cash collateral. In short, there is little or no use-of-proceeds cost for the short-seller that is not already factored into the lending fee. This is in stark contrast with the assumptions made in some of the early literature (Miller, 1977; Jarrow, 1980; Figlewski, 1981; Senchack and Starks, 1993; Jouini and Kallal, 1995) where the use-of-proceeds is considered a proxy for short-sales constraints. Furthermore, the Federal Reserve Regulation T requires that an additional 50% of the dollar-equivalent of the trade be added to the collateral which is almost always posted in non-cash form. Since the borrower earns the interest on the deposit, no opportunity cost is incurred and therefore no short-sale constraint is associated with the posted margin.

3.6.3 Direct Trading Costs

To complete a short sale, a trader needs to perform at least four transactions: sell the stock on the open market, borrow the shares, buy the stock back, and return the shares. Putting aside the securities lending fee, the administrative cost of borrowing and returning the shares is buried in the operating cost of a trading firm and can be difficult (if not impossible) to isolate. The direct trading cost of buying and selling the shares on the open market has been the subject of many empirical studies. One of the most comprehensive (Jones, 2002) examines the trading cost over the past century. He finds that the average cost (half-spread plus commissions) of a one-way transaction in the new millennium is approximately 0.25%, which is conservative when compared with the standard industry assumption of 0.4% to 0.6%. French (2008) finds a similar average one-way cost of 21 basis points for 2006. But none of these measures are firm-specific. Since the short-seller must complete a two-way trade (sell then buy), we estimate the constraint associated with the direct transaction cost ($SSC_{i,t}^{TC}$) by using the dollar-denominated average bid-ask quoted spread ($\text{BASpr}_{i,t}$) for each stock-month from the CRSP database.[9] With a mean transaction cost for a two-way trade of 36.73 basis points, the results for our sample are comparable to previous studies on the subject.

3.6.4 Dividend Repayment

One of the drawbacks of holding a short position is that any dividends paid to the stock holder (borrower) on title on the record date must be paid back to the lender. Bali and Hite (1998) find that the average ratio of the change in market price to the value of the dividend varies from 0.7653 (taxable cash dividends) to 0.8626 (non-taxable cash dividends). This price effect has an important impact on the short-seller's financial position. The drop in market price (her gain) is smaller than the cost of the dividend to be paid, therefore creating a loss and adding to the tangible short-sales constraints. For the purposes of this study, we use the average of both ratios, 0.81, to estimate the price drop/dividend ratio for dividend payments. This means that 19% of the value of the cash dividend is lost by the stock borrower.

For some short trades, the lender and borrower can enter into an agreement where only a fraction of the dividends is payable to the securities lender. Our dataset contains a field called

[9] Effective spreads tend to be smaller than quoted spreads (see Roll, 1984).

"dividend adjustment factor" detailing the portion of a dividend payment a lender is entitled to should their shares be on loan over a dividend record date. For any stock-month where a dividend is payable, we estimate the dividend-related tangible short-sales constraint as $SSC_{i,t}^{D}$= 0.19 * $D_{i,t}$ * $DAF_{i,t}$, where SSC_D is the per-share short-sales constraint due to the dividend; D is the dividend payment; and DAF is the dividend adjustment factor.[10]

3.6.5 Taxes

Long buyers enjoy a preferential tax treatment over short-sellers because the proceeds from long positions are considered capital gains while the income generated from short selling is considered as being ordinary income (Crisp, 2008). This differential is sizable and can reach 20% of payable taxes. To account for this effect, we compute the expected potential gain for each stock-month as the differential between the short-sales price ($SSP_{i,t}$) and the intrinsic value ($IV^{AVG}_{i,t}$) minus all tangible costs. Naturally, a firm will have other deductions to offset taxable gains (overhead, administrative costs, etc.) but these cannot be readily estimated by a trader contemplating a short sale and therefore should not be included in the tangible constraints. Losses on short trades, however, can be used to offset gains on other short sales and thus constitute a tax rebate for an active institutional investor.

We use the average marginal tax rate ($ATR_{j,t}$) as a measure of taxes payable on the expected proceeds of short sales. The profits are taxable in the hands of the seller. Since 98% of the short-sellers are institutional entities, we use Damodaran's industry classification and Compustat to find the mean monthly marginal tax rate for 905 firms in the banking, insurance and diversified financial sectors. We use the average tax rate over all institutional investors j in month t ($ATR_{j,t}$) as a measure of taxes payable on the expected proceeds of short sales. As per tax rules, only 33%

[10] Close to 74% of the firm-months in our sample pay no dividends. The mean (median) dividend is thus relatively low at $0.0355 (0.000) with a mean (median) DAF of 55.18% (51.33%).

of the dividends are taxable so we adjust $SSC_{i,t}^{D}$ accordingly. The constraint due to taxes is then equivalent to sale proceeds, minus costs and the writing off of losses against other gains, multiplied by this average tax rate:

$$SSC_{i,t}^{Tx} = [SSP_{i,t} - IV^{AVG}_{i,t} - (SSC_{i,t}^{D} * 0.67) - SSC_{i,t}^{TC} - SSC_{i,t}^{L}] * ATR_{j,t}, \quad (3.5)$$

3.6.6 Total Tangible Short-sales Constraint Costs

The total tangible short-sales constraint costs ($SSC_{i,t}^{T}$) per share are equal to ($SSC_{i,t}^{L}$+$SSC_{i,t}^{TC}$+$SSC_{i,t}^{D}$). Thus:

$$SSC_{i,t}^{T} = (1 - ATR_{j,t})*[(VWAF_{i,t} * (30/360) * SSP_{i,t}) + BASpr_{i,t}]$$

$$+[(1-(0.67*ATR_{j,t}))*(0.19 * D_{i,t} * DAF_{i,t})] + [(SSP_{i,t} - IV^{AVG}_{i,t}) * ATR_{j,t}] \quad (3.6)$$

3.6.7 Empirical Estimates of the Tangible Short-sales Constraints

Table 3.2 reports the descriptive statistics as well as the absolute and relative (to overpricing) magnitude of the total tangible short-sales constraint and its components. The mean (median) total tangible short-sales constraints for the AVG model account for 31.61% (30.08%) of overpricing. For each trade, taxes account for the largest drag at 27.6% of overpricing (87.3% of total tangible constraints), followed by the transaction cost at 3.3% (10.5%), the lending fee at 0.5% (1.6%) and finally the loss on dividends at 0.2% (0.6%). Our results on the cost of borrowing confirm past research (e.g., D'Aviolo, 2002) that pegs the mean yearly lending fee in the 25 to 50 basis points range. At 28.0%, 2.0%, 0.3% and 0.11% respectively, the values for the different constraints (SSCTx, SSCTc, SSCL and SSCD) obtained using the RRV sample are similar to those for the AVG and further confirm our assessment.

To ensure robustness in our model selection decision, we recalculate the total tangible short-sales constraints on a sample excluding from IV^{AVG} the OJ, CT and LN models which performed the poorest in our comparative study. These last three models tend to indicate undervaluation and under these new conditions, the tangible constraints increase slightly from 31.6% to 33.9% of overpricing while the variance remains similar (0.087 versus 0.083 for the latter), indicating that our results are robust to model selection. As previously discussed in section 3.5.2, the finance industry appears to contribute positively to mispricing so we expect the exclusion of these stocks from the sample to lower the mean constraints. As indicated in Table 3.2, the results for the reduced sample confirm our prediction. Furthermore, the relative magnitudes of the restrictions remain similar with taxes leading and dividend repayment in the last position.

[Please insert table 3.2 about here.]

Previous studies rely on proxies or partial costs for short-sales constraints. Contrary to earlier research (Miller, 1977; Jarrow, 1980; Figlewski, 1981; Senchack and Starks, 1993; Jouini and Kallal, 1995), we show that the use-of-proceeds restrictions and margin requirements in fact do not generate a cost to the seller. Lending fees alone are also popular as a proxy for short-sales constraints (Jones and Lamont, 2002; Duffie *et al.*, 2002; D'Aviolo, 2002; Ali and Trombley, 2005; Boehme *et al.*, 2012) but they materially underestimate even the total tangible cost of a short sale, potentially weakening the results obtained by these studies. Both the transaction costs and dividend repayment requirements are usually ignored. Tax considerations constitute a sizable drag on short sales but are absent from most if not all studies. Furthermore, since taxes are price-dependent, their variance and statistical properties differ from the literature's most common proxy for short-selling costs (lending fees).

We also substantiate the conclusion reached by Jones and Lamont (2002) who contend that shorting costs as previously defined cannot fully account for overpricing. In fact, such constraints are systematically underestimated in the literature by the use of incomplete tangible cost proxies. One important question remains: does Miller's mispricing theory still hold in light of the higher tangible costs? Considering the existence of intangible constraints that are yet unaccounted for and left for future study, we expect that excess overpricing still endures even when we factor in higher tangible shorting costs.

3.7 OVERPRICING, EXCESS OVERPRICING, AND MARKET STATE CONDITIONING

Because of the size of our samples, standard critical t-statistics may lose their meaning. Leamer (1978) introduces a more rigorous test of statistical significance that uses a critical t-value equal to $\sqrt{(n-k)\left(\sqrt[n]{n}-1\right)}$, where n is the number of observations and k is the number of parameters. We use these Bayes-adjusted critical t-values to examine the robustness of all our inferences in this and the following sections of the paper.

3.7.1 Overpricing

Overpricing in the absence of constraints is defined as the surplus of the short-sales price over intrinsic value for firm *i* at time *t*, or $OP_{i,t} = SSP_{i,t} - IV_{i,t}$. For Miller's (1977) hypothesis of overpricing to hold in its weakest form, $OP_{i,t}$ must be greater than zero. Thus, our first testable hypothesis in its alternate form is:

H_a^1: *Overpricing is positive.*

Table 3.2 reports the descriptive statistics for the variables $OP_{i,t}$ and $\%OP_{i,t} = OP_{i,t} / SSP_{i,t}$ for our sample of 46,418 firm-month observations. For OP^{AVG}, we find mean overpricing of \$1.87 (6.39%), and standard deviation of \$16.12 (33.05%). The numbers in brackets represent overpricing as a percentage of short-sale price. With a calculated t-statistic of 23.63 and a Bayes-adjusted critical t-value of 3.28, we can reject the null and conclude that mean overpricing is positive and highly significant. Since the distribution of overpricing is not normal, we also perform a non-parametric Wilcoxon signed-rank test on the median for robustness purposes. With a p-value of 0.0000, we find that the median of $2.92 (12.7%) is positive and highly significant. These results simply replicate what was already clear in the literature; namely, that stocks are generally overpriced when compared to their intrinsic values.

As a test of robustness, we repeat the same analysis on a reduced AVG sample with all stocks from the financial industry (SIC codes 6000-6999) removed. The mean (median) overpricing now stands at $1.17 ($2.49) or 4.04% (10.65%) of the short-sales price, a marked reduction from the results obtained using the complete dataset. Table 3.2 provides the details of the statistics for the truncated sample. With this reduced sample of 32,342 firm-months, we perform the same tests on the mean and the median. With a t-statistic of 13.18 and a Bayes-adjusted critical t-value of 3.22 for the t-test and a probability of 0.0000 for the Wilcoxon signed-rank test on the median, we reject the null that the mean (median) is equal to zero and conclude that overpricing is positive and significant for our reduced sample. As a further measure of robustness, we repeat the Wilcoxon signed-rank test on the median and the t-test of the mean using OP^{RRV} as a measure of overpricing and find similar results. This further supports our inference that mispricing is positive and significant, and is not model-specific.

3.7.2 Potential Determinants of Overpricing

We study two measures of mispricing; raw and relative overpricing. Raw or absolute overpricing captures the dollar profit of a short-sale after removing the expected value of the stock (i.e., $OP_{i,t} = SSP_{i,t} - IV_{i,t}$). Comparing the raw value of $OP_{i,t}$ for one stock-month to that of a different stock-month can be problematic because of differences in prices. To illustrate, mispricing on a $500 stock cannot be compared to that of a penny stock. We thus also use another metric, the relative overpricing, where the mispricing is expressed as a percentage of the short-sale price ($\%OP_{i,t} = OP_{i,t} / SSP_{i,t}$).

3.7.2.1 Absolute and Relative Overpricing Determinants

To our knowledge, the determinants of $OP_{i,t}$ and $\%OP_{i,t}$ are still unknown so we first run a regression of overpricing in both its forms against a number of firm-specific and macroeconomic control variables. These include size (market capitalisation), market-to-book ratio, price-earnings ratio, beta, dividends, earnings per share, institutional ownership, short-sales lending fee, level of governance, short-sales volume, the existence of options, utilization (number of shares on loan/lendable quantity), the return of the S&P index, the short-sales price and, finally, the total tangible short-sales constraints which are composed of our four previously defined restrictions. Since we are trying to assess the explanatory power of the information set available to a trader at the beginning of period *t*, we use lagged values (*t-1*) of all the independent variables as regressors.[11] The specific regression is:

$$OP_{i,t} or\ \%OP_{i,t} = \beta_1 BETA_{i,t-1} + \beta_2 CGQ_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 EPS_{i,t-1} + \beta_5 logMCAP_{i,t-1} + \beta_6 OPT_{i,t-1} + \beta_7 PE_{i,t-1} + \beta_8 IO_{i,t-1} + \beta_9 MB_{i,t-1} + \beta_{10} SSP_{i,t-1} + \beta_{11} SSC^T_{i,t-1} + \beta_{12} SSVOL_{i,t-1} + \beta_{13} UTIL_{i,t-1} + \beta_{14} SPXLVL_{t-1} + \beta_{15} SPXRET_{t-1} + \varepsilon_{i,t}; \text{ and} \quad (3.7)$$

where

$BETA_{i,t-1}$ is the beta of stock *i* for month *t-1*;

$CGQ_{i,t-1}$ is RiskMetrics' Corporate Governance Quotient (CGQ®);

$DIV_{i,t-1}$ is the dividend for stock *i* and month *t-1*;

[11] Gulen *et al.* (2012) argue that using lagged regressors significantly reduces simultaneous effects and omitted variable bias since lagged regressors can be considered as being predetermined. According to Hayashi (2000), the effect of lagged regressors on the dependent variable is estimated consistently since lagged regressors act as pre-determined variables. Furthermore, the use of lagged regressors is the default specification for regression-based empirical research in finance and accounting. For example, Parsons and Titman (2009) state that this is the case for regression-based empirical research on capital structure.

$EPS_{i,t-1}$ is the earnings per share of stock *i* and month *t-1*;

$logMCAP_{i,t-1}$ is the log of the market capitalisation for stock *i* and month *t-1*;

$OPT_{i,t-1}$ is a dummy variable taking the value of 1 if options exist for stock *i* and month *t-1*, and 0 otherwise;

$PE_{i,t-1}$ is the price-earnings ratio for stock *i* and month *t-1*;

$IO_{i,t-1}$ is the percentage of institutional ownership for stock *i* and month *t-1*;

$MB_{i,t-1}$ is the market-to-book ratio for stock *i* and month *t-1*;

$SSP_{i,t-1}$ is the short-sale price for stock *i* and month *t-1*;

$SSC^{T}_{i,t-1}$ is the total short-sales constraints for stock *i* and month *t-1*;

$SSVOL_{i,t-1}$ is the short-sales volume for stock *i* and month *t-1*;

$UTIL_{i,t-1}$ is the level of utilization for stock *i* and month *t-1*;

$SPXLVL_{t-1}$ is the level of the S&P index for month *t-1*; and

$SPXRET_{t-1}$ is the return of the S&P index for month *t-1*.

We conduct the Breusch Pagan (1979) test and reject the null that the pooled OLS method is appropriate for our sample, limiting our choice to fixed or random-effects specifications. Plumper and Troeger (2007) show that the fixed-effects method is inefficient when estimating regressions with low time-variance factors. Since $OPT_{i,t}$, $IO_{i,t}$, and $CGQ_{i,t}$ all exhibit low within variance, we determine that the random-effects specification is preferable and estimate both versions of equation (3.7) using a panel EGLS regression with period random-effects, Swamy and Arora component variances and White diagonal standard errors and covariances to account for clustered standard errors. Table 3.3 reports the results.

[Please insert table 3.3 about here.]

We begin our analysis with the AVG model and use Bayes-adjusted critical t-values as a threshold for significance. For both the absolute and relative measures of mispricing, we find that the lagged level of systematic risk, dividends, the existence of options, the price-earnings ratio, selling price, short-sales volume, level of the S&P index and utilization are not significant. Both $OP_{i,t}$ and $\%OP_{i,t}$ are significantly and inversely related to the lagged market-to-book ratio. This result is not surprising as this measure is often used as a proxy to summarily determine if a stock is "expensive". The total tangible short-sales constraints, which we argue are an integral component of overpricing, are also significant for both metrics. The coefficient of $SSC^T_{i,t-1}$ (β_{11}) is positive, indicating that the implementation drag increases with overpricing. The parameters for lagged governance level ($CGQ_{i,t-1}$), institutional ownership ($IO_{i,t-1}$), size ($logMCAP_{i,t-1}$) and earnings per share ($EPS_{i,t-1}$) are statistically significant for the relative measure only. Stocks with large stakeholders are subject to increased scrutiny and are widely covered by analysts, resulting in a better valuation process. Since better governance and higher earnings are also associated with stronger shareholder protection and lower moral hazard, the stock premium is reduced and we expect the signs of $\beta_2, \beta_4, \beta_5$ and β_8 to be negative. Our results confirm this assumption. Finally, the coefficient for the lagged return on the S&P index is positive and highly significant for both metrics. Positive returns during period *t-1* tend to feed investor optimism resulting in larger overpricing for period *t*. The adjusted coefficients of determination are 0.7742 and 0.4841 for $OP_{i,t}$ and $\%OP_{i,t}$ respectively, indicating that the models are a good fit.

We thus find that the determinants of raw overpricing for the AVG model are $MB_{i,t-1}$, $SSC^T_{i,t-1}$ and $SPXRET_{t-1}$ while that of relative overpricing differ with $CGQ_{i,t-1}$, $EPS_{i,t-1}$, $logMCAP_{i,t-1}$, $IO_{i,t-1}$, $MB_{i,t-1}$, $SSC^T_{i,t-1}$ and $SPXRET_{t-1}$. We also tested other independent variables such as the market volatility in the form of the level of VIX index, the market sentiment and the change in market sentiment (see Baker and Wurgler, 2007) but found them to be non-significant.[12]

We also estimate equation (3.7) using OP^{RRV} and $\%OP^{RRV}$ as the dependent variable. Table 3.3 reports the results. The determinants of absolute overpricing are qualitatively similar to that of OP^{AVG} except for the lagged market-to-book ratio which is only weakly significant. For relative mispricing, the list is truncated by one variable ($EPS_{i,t-1}$) and extended with $SSVOL_{i,t-1}$ and $SPXLVL_{t-1}$. The lagged short-sales price also impacts relative overpricing. It displays a negative sign, indicating that the ratio $\%OP^{RRV}$ is reduced as stock prices increase. This is explained by higher priced shares being more actively analyzed and traded by institutional investors leading to more efficient price discovery and market values closer to their intrinsic values. As a further measure of robustness, we repeat the analysis above using the reduced *NOFIN* version of our dataset. The results for both the AVG and RRV models (untabulated) are an exact qualitative match of those obtained from the full sample.

A trader contemplating a short sale has an array of information at her disposal, characterized by the determinants discussed above. These in turn can be grouped in subsets to assess which, if any, has the highest explanatory power. We thus create four subcategories namely firm-based, composed of *BETA*, *CGQ*, *OPT* and *SSP*; fundamentals, containing *DIV*, *EPS*, *logMCAP*, *PE*, *IO* and *MB*; market-related, containing *SSVOL*, *UTIL*, *SPXLVL* and *SPXRET*; and tangible constraints, decomposed into *SSCTx*, *SSCD*, *SSCL* and *SSCTc*. To eliminate look-ahead bias, all variables again are lagged one period. We estimate a variant of generic regression (3.7) for absolute and relative mispricing, using both the AVG and RRV model estimates of fundamental values to determine overpricing. Taxes appear to have a strong impact on mispricing so we also

[12] These and all other untabulated findings are available from the authors.

include an after-tax version of $OP_{i,t}$ and $\%OP_{i,t}$ to ascertain if the various adjusted coefficients of determination remain comparable. For that test, we redo the above analysis when taxes are removed from overpricing on the left-hand side of the equation and from the constraints subgroup on the right-hand side.

[Please insert table 3.4 about here.]

As shown in panel A of Table 3.4, the before-tax results for mispricing calculated using the AVG model show that, at 84.34% and 39.65% for absolute and relative mispricing respectively, the tangible constraints have the highest adjusted coefficients of determination. The fundamentals subset follows far behind, slightly above the firm-based attributes. Finally, the market-related subgroup has the lowest explanatory power. The results from the RRV model follow the same pattern with a minor deviation for OP^{RRV} where the importance of the fundamentals and firm-based variables are reversed. We run the same test on the reduced *NOFIN* sample (untabulated) with a similar outcome. These results confirm our previous assumption that the tangible constraints have a large impact on overpricing. To further assess their impact, we redo the analysis using after-tax overpricing as the dependent variable. While the explanatory power of the firm-based, fundamentals and market-related subgroups remains the same, that of the tangible constraints drops drastically to levels near the 0-1% range. These results are replicated with the *NOFIN* dataset. Thus, this further supports our inference that taxes play a major role in the determination of overpricing.

3.7.3 Absolute Overpricing and the Four Tangible Short-sale Constraints

Using the determinants of mispricing defined in the previous section, we regress the tangible short-sales constraints (as defined in section 3.6) on overpricing to determine the significance level of each restriction. We break down $SSC^{T}_{i,t}$ into its four components, namely the tax, transaction cost, lending and dividend repayment drags. In accordance with Miller's theory, higher constraints should imply higher positive mispricing. If each of the tangible constraints increase with $OP_{i,t}$ and $\%OP_{i,t}$, we expect that the coefficients of the tax burden, transaction cost, lending fee and dividend repayment cost are positive and statistically significant. Thus, we test the following hypothesis in its alternate form:

H_a^2*: Overpricing increases as the tangible short-sales constraints increase.*

We first test this hypothesis using our raw overpricing measure. Following the same rationale and methodology as per the previous regressions, we estimate a variant of generic model (3.7) using a panel EGLS regression with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariance to account for clustered standard errors. Specifically, for our sample of 25,520 events, we estimate the impact of $MB_{i,t-1}$, $SSC^{Tx}{}_{i,t-1}$, $SSC^{D}{}_{i,t-1}$, $SSC^{L}{}_{i,t-1}$, $SSC^{Tc}{}_{i,t-1}$ and $SPXRET_{t-1}$ on $OP_{i,t}^{AVG}$.

[Please insert table 3.5 about here.]

Based on the results reported in Table 3.5, the adjusted coefficient of determination for the regression is 0.8365. The F-statistic for the regression model of 21,528 is highly significant (p-value = 0.0000). As expected, the parameters of the tax and transaction cost constraints are positive and significant, even under the more rigorous Bayes-adjusted critical t-values while that of the dividend repayment constraint is significant at the weaker 99% level. A change of $1 in taxes translates into an increase of $3.17 in overpricing. With a t-statistic of 1.62, the coefficient for the lending fee is not significant even under traditional critical t-values, lending credibility to our argument that the lending fee alone is not the best proxy for short-sales constraints. As previously surmised, all (lagged) tangible short-sales constraints contribute positively to stock overpricing. The lagged market-to-book ratio has a negative and significant effect on mispricing as a change of 1% in $MB_{i,t\text{-}1}$ results in a decrease of 0.04% in $OP_{i,t}^{AVG}$. We repeat this test using $OP_{i,t}^{RRV}$ as the dependent variable and the appropriate determinants as control variables with similar results with the exception that the regressor $SSC^{D}_{i,t-1}$ loses its significance. As a test of robustness, we run the same analysis on the *NOFIN* sample with the exact same qualitative outcome.

3.7.4 Relative Overpricing and the Four Tangible Short-sale Constraints

We now estimate a variant of generic regression model (3.7) using $\%OP_{i,t}$ as the dependent variable and the determinants that are significant as previously identified, namely the lagged level of governance, earnings per share, market capitalization, level of institutional ownership, market-to-book ratio and return on the S&P 500 index. We test H_a^2 on the same sample, using relative overpricing as the dependent variable, and a panel EGLS regression with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariance.

As reported in Table 3.5, we obtain results for the tangible short-sales constraints that are comparable to that of section 3.7.3. The coefficients of the lagged tax, transaction cost and dividend repayment drags are highly significant while the t-statistic of the coefficient lending fee for $SSC^{L}_{i,t-1}$ of -0.131 is not significant even based on traditional critical t-values. The adjusted R-squared for the regression is 0.4866 with an F-statistic of 1626 (p=0.0000). The coefficients for the significant tangible drags are all positive, signifying that overpricing increases with the tangible short-sales constraints, further confirming our second hypothesis. The coefficient for the lagged S&P index return is also significant under Bayes-adjusted critical t-values. It is positive so a 1% increase in market return at time *t-1* has a 0.37% net positive effect on relative mispricing. These results confirm those obtained using absolute overpricing. Furthermore, we use the mispricing obtained from the RRV model and conduct a similar analysis. Table 3.5 reports the results. The outcome is similar to that of absolute overpricing whereby the coefficient of the dividend repayment drag becomes insignificant while that of the tax and transaction costs continue to have an important impact on relative mispricing. The lending fee still remains insignificant but the coefficient for the lagged short-sales price is negative and, with a t-value -7.44, highly significant for $OP_{i,t}^{RRV}$ only. A 1% increase in selling price during period *t-1* implies a 0.03% decrease in mispricing. Finally, we repeat the analysis using our *NOFIN* sample. The untabulated results qualitatively confirm all of our main findings.

We thus conclude that overpricing increases with the tangible constraints and with lagged market returns, with the caveat that the lending fee does not play a significant role in this relationship.

3.7.5 Robustness Tests using After-tax Overpricing

Since the tax constraint appears to play an important role in misevaluations, the explanatory power of other dependent variables might be stifled by its presence. To verify this possibility, we use the after-tax version of $OP_{i,t}$ and $\%OP_{i,t}$ to assess the variants of generic regression model (3.7) from sections 3.7.3 and 3.7.4. After-tax overpricing is defined as $AtaxOP_{i,t} = BtaxOP_{i,t} - SSC_{i,t}^{Tx}$, the before-tax (*Btax*) overpricing for stock *i* at time *t* minus the taxes payable (or recaptured for losses) for that same stock-month. The constraint $SSC_{i,t}^{Tx}$ is also removed from the right-hand side of the equations. We limit our discussion to the changes in significance levels for the various regressors reported in Table 3.6. For the dependent variable $OP_{i,t}^{AVG}$, the t-statistic for the coefficient of the lagged lending fee increases from 1.62 (before-tax) to 6.78 (after-tax), thus meeting the Bayes-adjusted criteria, and the parameter for the dividend repayment constraint moves from the 99% significance level down to the weaker level of 95%. These results are replicated for $OP_{i,t}^{RRV}$ with the exception that the transaction cost becomes insignificant. For the relative measure of overpricing, the outcome is similar. The coefficient for $SSC^{L}_{i,t\text{-}1}$ gains some significance while that of $SSC^{Tc}_{i,t\text{-}1}$ is reduced to the 95% level. Finally, the after-tax lagged lending fee becomes highly significant for relative overpricing calculated using the RRV model. We conduct the same complete analysis on the *NOFIN* sample with the outcome that the coefficients for $SSC^{L}_{i,t\text{-}1}$ gain significance but that of $SSC^{Tc}_{i,t\text{-}1}$ remain relatively unchanged.

[Please insert table 3.6 about here.]

These results shed a light on the extensive use of the lending fee in the literature as a proxy for overall short-sales constraints. In the absence of taxes, the lending fee is positively related to overpricing and the significance of other constraints is weakened.

3.7.6 Excess Overpricing and Tangible Short-sale Constraints

An astute investor facing a short-sales decision must consider his cost when implementing the transaction. A short sale should not be completed if the potential profits do not at least cover quantifiable (tangible) costs. Excess overpricing, defined as $XSOP_{i,t} = SSP_{i,t} - IV_{i,t} - SSC_{i,t}^{T}$, is in practice the expected profit from the trade. For Miller's theory to hold, $XSOP_{i,t}$ must be positive for our sample. Thus, our third testable hypothesis in its alternate form is as follows:

H_a^3: *Excess overpricing after the removal of only tangible constraint costs is null or positive.*

Table 3.2 reported a mean excess overpricing of \$1.27 (4.37% of short-sales price) for $XSOP_{i,t}^{AVG}$ with a standard deviation of \$11.53. Because of the inclusion of the tangible drags, the mean excess overpricing is much smaller in magnitude than the corresponding values for overpricing. Both the simple t-test and Wilcoxon signed-rank test show that the results are statistically significant (t-statistic of 3.82 versus a critical Bayes-adjusted critical value of 3.28

and a p-value of 0.0000 respectively). The mean and median dollar excess overpricing are significant. We repeat the same tests on a reduced sample with all financial firm-months removed. The mean excess overpricing drops to $0.85 (2.94% of SSP) but remains positive and significant. Furthermore, the results using the RRV model are qualitatively similar for both the full and truncated samples. We thus surmise that Miller's (1977) overpricing theory still holds for the period of 2006-2010 for our overall sample even when using the higher tangible short-sales constraints. However, there is a caveat to this conclusion. From section 3.7.4, we know that a decline of 1% in the index results in a decrease of 0.37% in overpricing. If the market experiences a sudden large decrease in value during a crash, relative mispricing can potentially become negative. Since $XSOP_{i,t}$ is lower in value than $OP_{i,t}$, the effect is compounded. Under those conditions, the overpricing theory of Miller may not hold. We thus investigate market state conditioning in the next section.

3.7.7 Market State Conditioning

Our sample contains a wide range of market conditions, including a bull run, a crash and a recovery. Since overpricing is positively related to index returns, we suspect that relative mispricing may become negative during periods of rapid price decreases and that the overpricing theory may not hold when examined under specific market conditions. To verify this possibility, we construct an index $XSOP_t^{IND}$ ($\%XSOP_t^{IND}$) composed of the equal-weighted average absolute (relative) excess overpricing for each month from July 2006 to December 2010. Top (bottom) graph in Figure 1 depicts the monthly $XSOP_t^{IND}$ ($\%XSOP_t^{IND}$) values overlaid with the monthly closing prices (returns) for the S&P 500 index. These results are robust since we find similar behaviors using unreported price- or value-weighted indices of excess overpricing.

[Please insert figure 3.1 about here.]

The excess overpricing ratio follows a short-term pattern similar to that of the market, with $XSOP_t^{IND}$ cresting as the market cycle temporarily peaks. The top graph in Figure 3.1 also illustrates numerous periods where absolute excess overpricing forms a local maximum while the S&P 500 index reaches a provisional high. The bottom graph in Figure 3.1 provides the relative mispricing information displayed against the return of the index. While the S&P index is at a 3-month high level of 1400 with a return of 4.7% in May 2008, the AVG excess overpricing index hits a period peak of $3.38 while that of RRV also reaches a high of $1.92. The same relationship applies to most cycle highs and lows for our sample as evidenced by the data for June 2007, February 2009, October 2010, and so forth. From February to April 2009, as the market revelled in the bailout of Bear Sterns and entered a countertrend bear rally with a cumulative return of over 20%, relative excess overpricing reached a provisional peak of 6.6% for the AVG model. These observations are compatible with the variant of regression model (3.7) described in section 3.7.4 which forecasts a 0.3761% (standard error of 0.0737%) increase in overpricing for every percentage point increase in the S&P 500 index. During the period in question, as the market rapidly gained 20% of its value, the model predicts a mispricing increase of 7.5%. Excess overpricing rose 7.6%, well within one standard deviation of expectations.

During periods of rapid price compression, relative excess overpricing falls near or below zero but shows remarkable resilience and rebounds to the mean as stock prices stabilize. Excess mispricing, as measured by both the AVG and RRV models, crossed the null threshold downwards numerous times for our sample. Among these occurrences, the period of January to March 2009 is a prime example where both $XSOP_t^{IND}$ and $\%XSOP_t^{IND}$ fall temporarily into negative territory. We thus conclude, as expected, that Miller's overpricing theory does not always hold even when only tangible costs are considered.

3.8 CONCLUSION

The literature on short sales is somewhat deficient on the impact of constraints on short-selling implementation drag. This chapter contributes to the literature by building a theoretical framework where excess overpricing is equal to the shorting price minus the sum of the expected value of the stock as proxied by its intrinsic value and the associated tangible costs of the sale, where the latter can be estimated by the seller prior to the transaction. Under heterogeneous expectations, theory dictates that this excess overpricing should be equal to or greater than zero. The tangible short-sales constraints considered are the lending fee, dividend repayments requirements, direct trading costs and taxes payable (recouped) on the profits (losses) from short trades.

We estimate five valuation models for the intrinsic value of each stock, with mixed results. Abnormal growth models perform better (Dechow *et al*., 2001; Easton, 2004; Ohlson and Juettner, 2005) than the two residual income models (Claus and Thomas, 2001; Lee *et al*., 2003) when assessed on their correlation coefficients, bias, accuracy and feasibility. Using the average intrinsic-values estimates from the five models as each firm's expected price, we compute the costs associated with the four tangible short-sales constraints for each stock-month. Unlike the literature, we find that a widely used proxy, the lending fee, is insufficient both in magnitude and variance to fully capture the sum of these tangible costs. The tax constraint accounts for 87.3% of the total tangible drag (27.6% of overpricing) while direct trading costs account for 10.5% (3.3%), the lending fee for 1.6% (0.5%) and finally the loss on dividends for 0.6% (0.2%). We also illustrate that the use-of proceeds and margin requirements do not generate a short-selling constraint cost as the lender rebates the equivalent of the repo rate to the borrower. As tests of robustness, we also examine mispricing based on an intrinsic value model developed by Rhodes-Kropf, Robinson and Viswanathan (2005), verify our hypotheses on a truncated sample with no financial firms, and investigate the before and after-tax variants of overpricing, with all offering similar results.

We identify the determinants of absolute mispricing as including institutional ownership, the market-to-book ratio, the short-sales price and our four tangible constraints. In contrast, the determinants of relative mispricing include the level of governance, the earnings per share, firm size, the price-earnings ratio, institutional ownership, the market-to-book ratio, all four tangible constraints, the short-sales volume and the return on the S&P 500 index. We find that overpricing increases in step with the lagged tangible constraints costs and market returns, and decreases with the firm-based measures mentioned above.

In light of the higher summed costs associated with these tangible constraints, we find periods where Miller's (1977) overpricing theory does not hold for a shorting index composed of the equal-weighted mean relative excess overpricing for each stock-month. We find that relative excess overpricing generally exists but becomes null or negative during periods of rapid price compression. This is explained by the price dependency of the tax constraint and the relative price-independency of the other three restrictions, which results in a larger (smaller) profit ratio as the gap between the short-selling price and the fundamental value tightens (widens). Nevertheless, we find that mean excess overpricing still stands at 4.37% of the selling price after removing the tangible short-sales constraints costs. We surmise that the existence of positive excess overpricing (expected gain), after factoring in the higher tangible drag, is due to the presence of intangible constraints as identified in the introduction to this chapter. This subject certainly deserves further consideration and the relationship between mispricing, tangible and intangible constraints and utilization levels potentially can provide further insight into the motivation behind short sales, and the validity of the belief that short-sellers “leave money on the table”.

CHAPTER 4

EXCESS OVERPRICING AND INTANGIBLE SHORT-SALES CONSTRAINTS

4.1 **INTRODUCTION**

Behavioral models for overpricing can be divided into four categories: biased self-attribution where the trader ignores signals that do not match his opinions, feedback trading where only recent movements are considered, representativeness heuristic where investors overreact to popular news and glamor stocks and, finally, heterogeneous expectations and short-sales constraints where overvaluation is believed to be the result of asymmetric drag imposed on sellers. While optimists can purchase shares at relatively low cost, pessimists face numerous costs commonly known as constraints. Since these constraints impose a cost on the seller, they must therefore let the stock price rise above its intrinsic value before triggering the trade to recoup these costs. While the field generally agrees on this principle, few articles directly address the issue of the nature or magnitude of the implementation drag associated with short-selling.

In this chapter, we extend the literature on overpricing by examining short-sales drag caused by various behavioral biases and indirect influences. We extend Miller's overvaluation model, identify seven intangible constraints and empirically assess their effect using two measures of mispricing: absolute and relative excess overpricing. Excess overpricing is defined as the surplus of the short-sales price over the sum of the intrinsic value of the stock and the tangible drag (taxes, the lending fee, direct trading costs and dividend repayments). We find that some constraints, such as the risk of a recall or short-squeeze, market opacity, market sentiment and the difficulty in locating lendable shares contribute to an increase in overvaluation while others like the existence of options and the level of institutional ownership have a negative impact on mispricing. We support previously reported evidence that some short-selling regulations (such as the uptick rule) have no significant impacts on prices. Firm-based bullying, whereby corporate managements vigorously attempts to hinder short-selling, increases mispricing until short-sellers overcome the defenses. The effect of the short-restrictive tactics then reverses because firms are for the most part unsuccessful in their strategy and the simple act of adopting these tactics imply that the stock price is already under fire.

We broaden the literature on overvaluation by empirically assessing the characteristics of overpriced shares and find that short-sellers should concentrate on stocks from small firms with low institutional ownership, no options, higher price-earnings multiples, higher systematic risk and lower market-to-book ratios. We show that mispricing varies across industries. Using data publicly available, we build a portfolio of the most overvalued stock-months and demonstrate that a trader choosing to short-sell this portfolio could expect a mean potential profit of 28% per trade if positions are held until the stock reaches its intrinsic value.

While we have no reason to suspect that our results are systematically biased, our findings are dependent on the choice and efficacy of the various intrinsic value models used. The models and inputs required to calculate overvaluation are available *prior* to the execution of such trades and are within the reach of most analysts. The only unknowns are if and when the stock will revert to its fundamental value. We discuss that noise trader risk, whereby shares can remain in a bubble state for extended periods, amplifies the hazards associated with shorting as the seller never is certain if or when the stock will mean-revert to its fundamental level. Since most short trades remain uncovered for less than two months, we compute the ex-post returns for four different holding periods (15, 30, 45 and 60 days) and find that the top decile (complete sample) displays a monthly-adjusted mean return of 7.05% (1.84%) for a 15-day position. The monthly-equivalent ex-post returns are negatively related to the length of the short holding period.

The remainder of this chapter is organized as follows. Section two outlines the theoretical framework for intangible short-sales constraints and section three describes our sample and data. In section four we present the methodology used in the study. Section five is dedicated to the discussion of the characteristics of overvalued stocks and the determinants of mispricing. Section six investigates the empirical relationship between intangible constraints and mispricing while section seven concludes the chapter.

4.2 THEORETICAL FRAMEWORK

A short sale consists of an investor selling an asset he does not own. He repurchases this same asset at a later date, hopefully at a lower price, to lock in his profits. To complete the trade, he must borrow the stock, against a fee, from a securities lender. While under loan, a stock's ownership, cash-flow stream and inherent rights are transferred to the borrower. The various costs supported by the seller, implicitly or indirectly, are known as short-sales constraints. They can take a tangible, rational form such as lending fees, taxes, transaction costs and dividend repayment requirements or be more elusive in nature like moral resistance or the risk of a short-squeeze. The common belief in the academic world is that these constraints result in a sustainable overvaluation of asset prices.

Miller (1977) introduces the role of short-sales constraints under heterogeneous expectations to present the framework for overpricing. In a market with inhibited short-sales, optimistic investors have little difficulty expressing their opinions while the pessimists must face the costs associated with a short trade. To ensure coverage of this implement drag, the latter must let the price rise above its intrinsic value before triggering the short sale. Differences of opinions will ensure that a buyer is available at the higher price (Duffie *et al.*, 2002) and overvaluation follows. Boehme *et al*. (2006) show that constraints alone are not sufficient to create mispricing; both the implementation drag and heterogeneous expectations are necessary. Scheikman and Xiong (2003) support Miller by showing that the existence of a ban on short-sales inhibits arbitrageurs from bursting market bubbles. They develop dynamic models that show buyers are willing to pay prices above their valuations in the hopes of selling at a higher price later. Bai *et al.* (2006) develop a theoretical model focused on risk sharing and speculation as reasons to trade while Gallmeyer and Hollifield (2007) introduce the concept of a trader's intertemporal elasticity of substitution as the determining factor for positive mispricing. Banerjee and Graveline (2013) argue that liquid securities warrant a price premium as long buyers are willing to pay a higher price to earn lending fees while shorts are hampered by those same fees.

Ample empirical evidence supports Miller's theory and many proxies are used for short-sales constraints: use-of-proceeds restrictions (Figlewski, 1981), margin requirements (Senchack and Starks, 1993), fundamental ratios, dividend yields and institutional ownership (Dechow *et al.*, 2001; Nagel, 2005; Berkman *et al.*, 2008), lending fees (Jones and Lamont, 2002; Duffie *et al.*, 2002; D'Aviolo, 2002; Ali and Trombley, 2005) and the introduction of options (Mayhew and Mihov, 2004). Most of the studies use abnormal returns as a test of overpricing. Mayhew and Mihov (2004) find that abnormal returns are subject to risk assumptions and disappear under alternative models but their study is restricted to the effect of the introduction of options. Market bubbles are the most notorious result of overpricing. Xiong and Yu (2011) study the warrants market in China to find that the ensuing bubble was the result of a combination of the differences of opinions on the fundamental values of the securities and the complete ban on short-sales in the Chinese market, further lending credence to Miller's overpricing theory.

The literature on short-sales overwhelmingly supports the notion of overpricing and abnormal returns for short traders but somewhat fails to explain the reasons. Chen and Stein (2002) express their puzzlement at the apparent bounty left untouched by traders: why is short interest so low when monthly returns of 1 or 2% can be obtained by using public information only? Dupuis and Kryzanowski (2013) provide a possible answer: the literature underestimates the costs associated with short-sales. They classify the constraints into tangible that can be readily calculated by a trader, and intangible which are behavioral or more elusive in nature and cannot be readily estimated a priori by a trader. Leaving the intangible constraints unstudied, they find that the mean total tangible implementation drag consumes 5.98% of the selling price. The tangible constraints, as detailed in their model, include taxes, the direct trading fees, dividend repayments and the lending fee. While the latter is the most common proxy used in the literature, it represents only 0.61% of the tangible drag.

We build on their study of short-sales constraints. At equilibrium, under rational market expectations, the market or short-sales price will be equal to the sum of the "true" worth of the stock as proxied by its intrinsic value and the total sales drag. We classify the constraints into tangible and intangible based on a trader's capacity to calculate precisely the restriction prior to the short-sale. At the price-point where a trade becomes profitable, we contend that:

$$\mathrm{SSP}_{i,t} = \mathrm{IV}_{i,t} + SSC_{i,t}^{T} + SSC_{i,t}^{I}, \tag{4.1}$$

where $\mathrm{SSP}_{i,t}$ is stock i's market price at time t (short-sale price); $\mathrm{IV}_{i,t}$ is the intrinsic or expected value of stock i at time t; $SSC_{i,t}^{T}$ represents the implementation drag from tangible short-sales constraints for stock i at time t; and $SSC_{i,t}^{I}$ represents the implementation drag from intangible short-sales constraints for stock i at time t. We identify four quantifiable (tangible) constraints; namely taxes, the lending fee, transaction or trading fees and dividend repayment requirements. If we move $IV_{i,t}$, and then also $SSC_{i,t}^{T}$ from the right to the left-hand side of equation (4.1), we obtain respectively overpricing ($OP_{i,t}$) over intrinsic value and excess overpricing per share ($XSOP_{i,t}$) over both intrinsic value and the value of tangible constraints:

$$OP_{i,t} = SSP_{i,t} - IV_{i,t} = SSC_{i,t}^{T} + SSC_{i,t}^{I}, \quad (4.2)$$

$$XSOP_{i,t} = SSP_{i,t} - IV_{i,t} - SSC_{i,t}^{T} = SSC_{i,t}^{I}, \quad (4.3)$$

Relative excess overpricing ($\%XSOP_{i,t}$) or the ex-ante return for stock *i* at time *t,* with no time horizon attached, is obtained by dividing the ex-ante net profit $E(P)_{i,t}$ given by (4.3) by the short-sales price $SSP_{i,t}$:

$$E(R)_{i,t} = SSC_{i,t}^{I} / SSP_{i,t} = [SSP_{i,t} - (IV_{i,t} + SSC_{i,t}^{T})] / SSP_{i,t} = \%XSOP_{i,t} \quad (4.4)$$

From the literature on short-sales, we previously identified seven intangible elements that can increase or decrease constraints. Thus, equation (4.3) for stock *i* and month *t* becomes:

$$XSOP_{i,t} = SSC_{i,t}^{I} = SSC_{i,t}^{LS} + SSC_{i,t}^{IO} + SSC_{i,t}^{SF} + SSC_{i,t}^{RR} + SSC_{t}^{MS} + SSC_{i,t}^{FR} + SSC_{i,t}^{Op} \quad (4.5)$$

where:

$SSC_{i,t}^{LS}$ is the intangible constraint associated with the lendable supply and recall risk;

$SSC_{i,t}^{IO}$ is the impact associated with the level of institutional holdings;

$SSC_{i,t}^{SF}$ is the restriction associated with search frictions and market opacity;

$SSC_{i,t}^{RR}$ is the constraint associated with market rules and regulations;

SSC_{t}^{MS} is the intangible constraint associated with market sentiment and moral resistance;

$SSC_{i,t}^{FR}$ is a measure of the drag associated with firm-based short restrictive tactics; and

$SSC_{i,t}^{Op}$ represents the impact of the existence of an options market.

4.3. METHODOLOGY

We estimate intrinsic values using five models (Dechow *et al*., 2001, Ohlson and Juettner, 2005; Easton, 2004; Claus and Thomas, 2001 and Lee *et al*., 2003). We assign the mean of all available model outputs as the fundamental value for each stock *i* and month *t* and label the resulting dataset "AVG". While we do not suspect that our AVG intrinsic values are biased, the residual income and abnormal growth models share one potential weakness as both types use analyst estimates of expected earnings and growth to determine fundamental value. To ensure inferential sturdiness of our findings we also use a model developed by Rhodes-Kropf, Robinson and Viswanathan (2004, 2005) or RRV.[13] This estimation model has been recently implemented by many researchers, e.g., Fu *et al.* (2013), Hertzel and Li (2010) and Hoberg and Philips (2010). It assumes that the fundamental value of a firm is a linear function of its book value of equity, leverage and realized net income. We attach the moniker "RRV" to the dataset resulting from this method.

4.4 SAMPLE AND DATA

The data are chosen to cover a full market cycle from July 2006 to July 2010, thus ensuring that all possible scenarios for mispricing are represented. It includes the bull run ending in 2007, the crash that followed and the ensuing recovery. Our dataset includes 1589 stocks from OTC and organized exchanges subject to short sales during this time perioid, with a mean excess overpricing of $2.11 (9.87%) and a median of $2.26 (14.85%) for sample AVG and $2.39 (6.04%) and a median of $1.93 (10.18%) for RRV. While the mean and median for both valuation methods are similar, their descriptive statistics differ. Absolute excess overpricing computed with the AVG (RRV) model displays a variance of 86.14 (102.95), kurtosis of 126.98

[13] Also known as RKRV.

(54.16) and skewness of -2.11 (1.16). Both sets of results are leptokurtic with heavy tails but the distribution for AVG (RRV) is right (left) skewed. These distributional differences could have an material impact on our findings.

All the information pertaining to the short-sales originates from Data Explorer's Securities Finance Data Feed®. As one of the most comprehensive datasets available for the period under study, it contains lender-level monthly granular data for each stock including the quantity and value of shares on loan, total lendable balances, weighted average lending fees, utilization (# shares on loan/total lendable), dividend adjustment factor (repayment requirements), total number of transactions per lender and the nature of collateral (cash or securities). We calculate the mean short-sales price $SSP_{i,t}$ for each stock-month from the daily aggregates of our dataset by dividing the value of loaned shares for firm i and month t by the quantity of shares on loan for the same firm and month. We obtain fundamental data such as actual earnings per share, book values, marginal tax rates, number of outstanding shares, dividends and payout ratios from Compustat, expected earnings and long-term earnings growth estimates from I.B.E.S. and transaction data (market prices, bid-ask spreads, volumes, etc.) from C.R.S.P. Institutional ownership and market sentiment values are respectively from the Thomson-Reuters' Institutional Holdings (13F) database and Wurgler's website (http://people.stern.nyu.edu/jwurgler/).

4.5 EXCESS OVERPRICING AND PROFITS

4.5.1 Characteristics of Trades with the Highest Expected Payoffs

For each stock i and month t, we have data for the short-selling price, the computed intrinsic value as well as the tangible drags and are now in a position to calculate the expected profit

$E(P)_{i,t}$,and the ex-ante net return $E(R)_{i,t}$ for each short-trade event based on equations (4.3) and (4.4), respectively.

What are the characteristics of the shorted stocks that promise the best potential non-time-differentiated returns for short-sellers? To answer this question, we rank our dataset of 32,220 stock-month events by absolute (dollar-denominated) excess overpricing from high to low before separating them into deciles. Although the same stock can appear in more than one decile, it represents different monthly events (potential short-sales) because of the time stamp. This same analysis is conducted using relative excess overpricing. We compare the features of the top and bottom deciles to examine their differences. The top and bottom decile samples as ranked by $XSOP_{i,t}$ are referred to as "AI" (absolute I) and "AX", respectively, while the top and bottom decile samples as ranked by $\%XSOP_{i,t}$ are referred to as "RI" and "RX", respectively. We perform the analysis using our AVG samples (AVG AI, AVG RI, etc.) and the RRV samples (RRV AI, RRV RI, etc.).

We test the null hypothesis that the mean differences are greater or lesser than 0 for the pairings of our four main deciles (AI and AX, RI and RX) for the various stock-specific and market-wide attributes listed in Table 4.1. The significance levels also are reported for these t-tests in Table 4.1. When compared with their bottom counterparts, the top deciles generally display a higher value for systematic risks, earnings per share, book values per share, PE ratios and utilizations. They exhibit lower levels of governance, market capitalizations and market-to-book ratios.

[Please insert table 4.1 about here.]

To determine if mispricing is more prevalent in certain industries, we classify all stock-month events into the high and low overpricing deciles by their spheres of activity according to

Damodaran's industry classification codes. Appendix B details the methodology and results for this analysis. We find that stocks from the maritime, railroad and utility industries tend to prevail in the most overpriced deciles (AVG AI and RI) while firms operating in the fields of aerospace and defense, medical supplies, tobacco and precious metals dominate in the most underpriced deciles AX and RX.

4.5.2 Potential Determinants of Excess Overpricing

While the previous section provided a perfunctory analysis of the characteristics of mispricing, a more rigorous approach is warranted. Since we are estimating the explanatory power of the information set available to a trader at the beginning of period *t*, we use lagged dependent variables (*t-1*) in all model estimations. Gulen *et al.* (2012) contend that using lagged regressors significantly reduces simultaneous effects and omitted variable bias since they can be considered as being predetermined.[14] Furthermore, the use of lagged regressors is the default specification for regression-based empirical research in finance and accounting.[15] Since the variables $EPS_{i,t}$, $MB_{i,t}$ and $PE_{i,t}$ enter directly in the computation of mispricing, we exclude them as independent variables. Thus, we estimate the following regressions to identify the determinants that have may a significant impact on overpricing:

$$XSOP_{i,t} \text{ or } \%XSOP_{i,t} = \beta_0 + \beta_1 BETA_{i,t-1} + \beta_2 CGQ_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 logMCAP_{i,t-1} + \beta_5 OPT_{i,t-1} + \beta_6 IO_{i,t-1} + \beta_7 VWAF_{i,t-1} + \beta_8 SPXRET_{t-1} + \beta_9 SPXVIX_{t-1} + \beta_{10} SSVOL_{i,t-1} + \beta_{11} SSP_{i,t-1} + \varepsilon_{i,t} \quad (4.6)$$

where

$BETA_{i,t-1}$ is the beta of stock *i* for month *t-1*;

[14] Hayashi (2000) concurs that the effect of lagged regressors on the dependent variable is estimated consistently since they act as pre-determined variables.

[15] Parsons and Titman (2009) state that this is the case for regression-based empirical research on capital structure.

$CGQ_{i,t-1}$ is RiskMetrics' Corporate Governance Quotient (CGQ®);

$DIV_{i,t-1}$ is the dividend for stock i and month $t-1$;

$logMCAP_{i,t-1}$ is the log of the market capitalisation for stock i and month $t-1$;

$OPT_{i,t-1}$ is a dummy variable taking the value of 1 if options exist for stock i in month $t-1$, and 0 otherwise;

$IO_{i,t-1}$ is the percentage of institutional ownership for stock i and month $t-1$;

$VWAF_{i,t-1}$ is the short-sales lending fee for stock i and month $t-1$;

$SPXRET_{t-1}$ is the return of the S&P index for month $t-1$;

$SPXVIX_{t-1}$ is the level of the S&P VIX volatility index for month $t-1$;

$SSVOL_{i,t-1}$ is the short-sales volume for stock i and month $t-1$;

$UTIL_{i,t-1}$ is the level of utilization for stock i and month $t-1$;

$SSP_{i,t-1}$ is the short-sale price for stock i and month $t-1$; and

all the other terms are as previously defined.

We conduct the Breusch Pagan (1979) test and reject the null that the pooled OLS method is appropriate for our sample, limiting our choice to fixed or random-effects specifications. Plumper and Troeger (2007) show that the fixed-effects method is inefficient when estimating regressions with low time-variance factors. Since $OPT_{i,t}$ and $UPT_{i,t}$ are dummy variables and exhibit low within variance, we determine that the random-effects specification is preferable and estimate equation (4.6) using a panel EGLS regression with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariance to account for clustered standard errors. Since our sample displays a large number of observations over a fixed period of time, the panel EGLS method may yield biased results. Thus, we also estimate equation

(4.6) using a dynamic system GMM panel model with one lag (e.g. refer to Arellano and Bover, 1995).

Because of the size of our sample, standard critical t-statistics may lose their meaning. Leamer (1978) introduces a more rigorous test of statistical significance that uses a critical t-value equal to $\sqrt{(n-k)\left(\sqrt[n]{n}-1\right)}$, where n is the number of observations and k is the number of parameters. We use these Bayes-adjusted critical t-values along with the traditional critical t-values for assessing the significance of the coefficient estimates for all regressions.

[Please insert table 4.2 about here.]

Table 4.2 reports the results for absolute and relative excess overpricing for the two valuation models (AVG and RRV) and both estimation methods (panel EGLS and dynamic system GMM). The sign of the coefficient for the intercept β_0 is always significant and positive (negative) for the AVG (RRV). Excess overpricing decreases significantly with the lagged level of governance, firm size, level of institutional ownership and the existence of an options market for the stock. All of these characteristics are associated with "blue chip" firms which are believed to be more accurately valued by the market. High market volatility, as measured by the S&P VIX index, is also associated with lower mispricing. Excess overpricing increases significantly with the lagged systematic risk, short-sales volume and the selling price. Finally, the lagged dividend payments, lending fees and market returns are not significantly associated with excess mispricing. As it is commonly done in the corporate finance literature (for example, Hoberg and Philips, 2010), we run a test of robustness by removing all firms belonging to the financial industry (SIC codes 6000-6999), which we name NOFIN, and repeat the same analysis. The untabulated results for both the AVG and RRV models are a qualitative match with those obtained from the full sample. These findings imply that a short-seller would do well to concentrate on stocks from relatively poorly managed, small firms, with high systematic risks, low institutional ownerships and no options traded on them.[16]

4.5.3 Ex Ante and Ex-Post Profits and Returns

In this section, we first calculate the ex-ante profits and returns assuming that the prices of the stocks in each decile equal their fundamental values at some undefined future points in time. Since a stock may never revert to its intrinsic value, there is no assurance that this hypothetical profit can be realized but this conundrum also exists for long positions. Making the strong assumption that the average time horizons are similar across deciles or, alternatively, that their differences do not systematically bias our results, we calculate expected excess overpricings, dollar profits and percent returns assuming that the full mispricing is captured by the trader. For our sample of 32,220 stock-month events from July 2006 to July 2010, the mean excess overpricing is $15.33 (28.06%) for AVG AI and $9.02 (33.35%) for RI versus -$13.66 (-28.56%) and -$11.98 (-32.51%) for deciles AX and RX. The differences are substantial and significant (t-statistics of 41.4 and 39.6 respectively). Furthermore, the RRV valuations are somewhat higher than the corresponding AVG valuations for the top decile ($20.88 versus $15.33) but similar for the bottom equivalent (-$13.22 versus -$13.66) but remain qualitatively similar. Since the bottom deciles clearly show undervaluation, a short-seller would do best to steer away from these trades.

The mean expected dollar profit (percent return) after the deduction of tangible costs for every share sold short is $2.11 (9.87%) for the AVG sample and $2.39 (6.04%) for the RRV sample. As expected, the mean expected returns per share depend upon the ability of the short-seller. They range from 40.47% with a variance of 0.12% for the top decile RRV RI (see Table 4.1) to -39.12% with a variance of 0.26% for the bottom decile RRV RX. While *all the factors*

[16] These stocks also tend to have higher direct trading fees as measured by the bid-ask spread. These imply higher commissions for trading that are already factored into the tangible constraints.

necessary to choose the best decile of short trades are quantifiable prior to short-selling, the primary risk is whether (or when) markets will follow rational expectations and stock prices will reach their fundamental values. The danger, of course, is that the trades could be carried indefinitely or that the stock prices may diverge further from their fundamental values.

Estimates of the mean length of a short trade vary from approximately ten days (Reed 2007) to between one and two months (mean of 33 days with a median of 42 days) for institutions (Daske *et al.*, 2005, p. 7) to about 37 days (Boehmer *et al.*, 2008). Given this diversity, we calculate the ex-post return based on holding periods of 15, 30, 45 and 60 days. For example, in decile AI, one event would be the short sale of stock XYZ during the month of June 2009 (one stock-month). We then calculate the 15, 30, 45 and 60 day (equivalent monthly) ex-post returns, net of payable dividends, for that specific short trade. Each decile contains 3220 such trades and we take the mean and median of all 15, 30, 45 and 60 day ex-post returns and report the results in Table 4.3 for the complete sample and each of the four extreme deciles.

[Please insert figure 4.1 and table 4.3 about here.]

Based on Figure 4.1, the monthly ex-post returns diminish as the holding period increases. To verify this possibility, we use one-tail t-tests to ascertain if the mean return at time *t* is lower than that at time *t+1*. We repeat the procedure using Wilcoxon signed-rank tests for the medians. Based on Table 3, decile AVG RI generates a mean ex-post monthly return of 7.05% for a 15-day holding period, the highest in our dataset, followed by AVG AI at 4.08% versus AX at -0.11% and finally RX at -1.53%. The complete sample's mean monthly-equivalent return is 1.84% for a 15-day shorting period and reduces to 0.12% for a 60-day shorting period. The results using the RRV model are qualitatively similar although the range between the top and bottom deciles is narrower. Surprisingly, decile RRV AX produces a positive return of 0.25%

while all the other bottom decile counterparts are in negative territory. Thus, returns generally diminish when short positions are held for longer periods of time, with significance weakened for the bottom deciles and the longest open positions.

4.6. IMPACT OF INTANGIBLE SHORT-SALES CONSTRAINTS

4.6.1 Hypotheses Development for the Intangible Short-sales Constraints

The intangible short-sales constraints represent the elements that impede the short-sales process but cannot be readily quantified by the short-seller. Intangible short-sales constraints include recall risk and supply shortage, regulatory framework, market rules and legal restrictions, lending market opacity, investor sentiment, moral resistance, and firm-based tactics to limit short sales.

4.6.1.1 Recall risk and scarcity of lendable supply

To complete a short-sale, a trader must borrow the stock and deliver it to the buyer. Unless the lending contract is negotiated as a guaranteed term loan, which occurs rarely, the securities lender can recall the stock at any time thus creating an inherent risk that the seller can be "squeezed" out of the trade and will need to find more securities to borrow (possibly at a higher cost) or unwind the position by buying the shares on the open market. Recalls are associated with high intraday volatility and abnormally large volumes so the risk to the short-seller is sizable but also difficult to quantify. D'Aviolo (2002) concludes that while they can be relatively rare at less than 2% of his sample in a typical month, the mean time required to re-establish the dislocated position is 23 days, an eternity in the trading world, thereby increasing the risks associated with short-selling. Jones and Lamont (2002) include the risk that the short position may have to be involuntarily closed as one of the constraints along with the lending fee and legal costs but fail to quantify the recall risk or assign it a proxy. Their conclusion clearly leaves the field open for further studies on the subject of short-sales constraints: "… in addition to the shorting costs that we observe, there must be some other short sale constraint which allows these stocks to become overpriced."

Following in D'Aviolo's footsteps, we use a measure of availability as a proxy for recall risk. When demand is high and the pool of lendable shares dwindles, available stock is scarce and recall risk is greater. Thus, we use the lagged level of utilization, $UTIL_{i,t-1}$, obtained by dividing shares on loan by total lendable supply, as a proxy for recall risk and the scarcity of lendable shares. We expect excess overpricing, as our measure of intangible short-sales constraints, to be positively related to utilization. This leads to our first alternative hypothesis:

H_a^1: *The intangible short-sales constraint as measured by excess overpricing are positively related to the recall risk and the scarcity of lendable supply as proxied by utilization.*

4.6.1.2 Institutional ownership

Boehmer *et al*. (2008) estimate that approximately 98% of all short sales originate from institutions and specialists while the remaining 2% is attributed to individuals. D'Aviolo (2002) states that big custody banks are the primary lenders in the U.S. market. Their customer base consists of passive investors that include mutual funds, pension and retirement funds and endowments. By charter or by their nature (also, supported by Almazan et al., 2004), most of these funds with the exception of hedge funds take long-positions only, thereby providing a large pool of lendable shares concentrated in the hands of a few custodians. The Investment Company Act of 1940 also places restrictions on the actions of fund managers. If they have a bearish perspective, they are forced to hold cash (Crisp, 2008). Furthermore, institutions tend to invest in stocks that are widely followed by analysts, leading to an extensive and more precise valuation process that reduces mispricing.

Chen *et al.* (2002) test Miller's overpricing theory (1977) using breadth of ownership, defined as the holdings of long-only institutional investors in the form of mutual funds, and find that short-sales constraints bind and negative information is withheld from the market when breadth is low. Berkman *et al.* (2008) also use institutional ownership in their assessment of short-sales constraints since stocks with a large institutional base are easier to borrow and sell short. Prado *et al*. (2013) find that lower, concentrated institutional ownership is associated with lower lending supply, higher shorting constraints and reduced market efficiency. Thus, our second alternative hypothesis is as follows:

H_a^2: *The intangible short-sales constraint as measured by excess overpricing are negatively related with the lagged level of institutional ownership*.

4.6.1.3 Market opacity and search frictions

Market opacity refers to the difficulty in locating shares to borrow. Since no central market exists, short-sellers must contact various lenders and develop multiple relationships to find lendable stock or use the services of a third-party broker, incurring additional search costs. Kolanski *et al.* (2010) model the effects of opacity on the relationships between lenders and borrowers, surmising that each borrower consolidates their demand to gain volume discounts and that each transaction represents a unique borrower. Kolanski *et al.* (2010) suggest that frictions from opacity greatly benefit lenders and account for significant barriers to short entry. Lenders implement such bargaining power by, for example, increasing lending fees, a tangible constraint that has already been reflected in excess overpricing.

Our dataset differs from their dataset in that each lender reports a daily aggregate for all loans of a specific security on a given day. If borrowers consolidate their requests, then the number of transactions reported by each lender represents the number of borrowers on that day. Furthermore, if three event reports appear on a specific date, then three different lenders were involved. We compute monthly totals for the number of reports (lenders) and the number of transactions (borrowers). While market opacity could be estimated by simply considering the number of lenders, this measure could be misleading. For example, if there is no demand, then there will be few lenders regardless of search frictions so we must also consider the number of borrowers for each period. If frictions are important, the ratio borrowers/lenders will increase and short-sellers must struggle to find lendable stock. In a centralized market, this ratio would be low as a large number of lenders would be readily available for all borrowers and search costs would be minimal so that short-sellers would have no difficulty locating lendable shares. For a given level of demand, as the number of lenders decreases, lendable shares are more difficult to find and search frictions increase. In practical terms, if only one firm out of thousands has stock to loan, it is much more difficult to locate the shares than if all potential lenders have it available.

We construct a ratio ($BLNDR_{i,t}$) of the number of transactions (number of borrowers) over the count of reported events (number of lenders) for every stock-month to estimate the dispersion in borrower-lender relationships. Computing a lender concentration ratio like the Herfindahl index would be preferable, but we have no data as to the total number of potentially available lenders in the market. A higher ratio indicates narrower availability, greater difficulty in locating shares, higher market opacity and higher excess overpricing. Thus, our third alternative hypothesis is:

H_a^3: The intangible short-sales constraint, as measured by excess overpricing, is positively related to market opacity and search frictions as proxied by the lagged ratio of the number of borrowers over the number of lenders.

4.6.1.4 Market rules and regulations

Much of the literature on short-sales aims at providing guidance for governments and regulatory bodies in establishing market rules and regulations. By design or delay, some of the conclusions reached by academia are ignored in favor of heuristics; short-sales restrictions are a prime example. Short sales *prohibition* refers to a complete ban on short selling for a specific stock. To illustrate, a complete ban was initiated on September 18, 2008 on 797 financial stocks (except for market makers) that lasted until October 9. The interdiction on *naked* short selling was never revoked and is still in place today.[17] The evidence overwhelmingly suggests that bans have a negative effect on market quality (Boulton *et al*., 2010; Boehmer *et al*., 2013; Beber and Pagano, 2013). Reduced liquidity, slow price discovery, contribution to bubbles and crashes, and the failure to support prices are among the many adverse effects of the prohibition of shorts (e.g. Macey et al., 1989). Since our study involves trades completed under a combination of short sales and heterogeneous expectations, short-prohibited stocks are not part of our database.

In contrast, shorting is possible under certain conditions under a short-sale *restriction*. In the U.S., regulation SHO took effect on January 3, 2005. It stipulates that a broker must ensure that the securities can be borrowed before placing a short trade. In practice, the regulation is difficult to enforce and has little impact on trading as brokers rely on "easy-to-borrow" lists to establish reasonable grounds that a stock can be lent out (Crisp, 2008).

[17] The Securities Exchange Commission defines naked short selling as a short sale completed without borrowing the stock. The policy is in place to curb failures-to-deliver.

The "Uptick Rule" (SEC Rule 10a-1) is probably one of the better known restrictions on short sales whose objective was to prevent short-sellers from exacerbating downward pressure on share values. The constraint existed for listed shares only (OTC stocks were exempt) and was adopted during the depression. Since futures contracts were also exempt, one of the asymmetrical impacts of the rule was to hamper index arbitrage. As a pilot project in 2005, the regulation was suspended for one-third of the Russell 3000 stocks to investigate the efficiency of the constraint. However, there was no significant impact on stock prices during the pilot project (Boehmer *et al.*, 2009) mostly because prices oscillate between up and down ticks so frequently that traders have no difficulty executing short-sales at will (Crisp, 2008). An analysis by the Office of Economic Analysis supported the removal of the short-sales price-test restrictions. The Uptick Rule was then repealed for all stocks in the U.S. on July 3, 2007.

Since our sample period includes listed and OTC stocks traded before and after the rule was repealed, we include a dummy variable, UPT_t, to account for the effects of rule 10a-1 on intangible short-sales constraints. UPT_t takes on a value of 1 if the rule is in effect for a specific stock-month and 0 otherwise. Our fourth testable alternative hypothesis is as follows:

H_a^4: *The intangible short-sales constraint, as measured by excess overpricing, is positively related to the existence of the uptick rule.*

4.6.1.5 Market sentiment and moral resistance

Defined broadly, market sentiment is the aggregated belief of market participants about the intrinsic value and risk characteristics of a stock that is not rooted in contemporaneous fact. The first impulse of rational investors is to arbitrage the price back to its "reasonable" value. However, as Shleifer and Vishny (1997) explain, betting against sentiment can be costly and risky. They introduce the concept that arbitrage is the work of a relatively small group of professional traders who become ineffective when faced with sustained, extreme share price divergence from fundamental value. To illustrate, at the beginning of a bubble, a short-seller might recognize that a stock is grossly overvalued but has no indication as to how long the overpricing will endure or how high behavioural biases will push the share price. DeLong *et al.* (1990) coined the term "noise trader risk" based on the concept of investors who push stock prices away from their intrinsic value and have a material impact on market prices, but still manage to generate high expected returns while bearing excessive self-generated risk. Since maintaining a short position in a rising market implies posting additional margin requirements and running the risk of a short-squeeze exit at a loss, traders are reluctant in forcing prices to their intrinsic value and mispricing endures or increases as investor sentiment remains buoyant. Baker and Wurgler (2007) develop a top-down, macroeconomic model to measure investor sentiment and provide information about the attributes of stocks that are more likely to be influenced by unjustified exuberance or fear. They create an index of market sentiment and find that shares of younger growth firms with no dividends, low capitalization, high volatility and low profitability are more sensitive to swings in investor's beliefs.

Moral resistance is an elusive constraint rooted in the age-old opinion of politicians and corporate managers that short-selling is detrimental to market efficiency and ultimately immoral. Short-sellers are portrayed as evil, greedy investors who manipulate share prices for profits, with little or no regard for fundamentals. Although the literature has shown this to be mostly false (Diamond and Verrecchia, 1987; Dechow *et al*., 2001; Bai *et al*., 2006; Boehmer *et al.,* 2013; Boulton and Braga-Alves, 2010), the stigma still endures and has a negative impact on free and clear short trades. Hong and Stein (2003) create a theoretical model of market crashes based on heterogeneous expectations to show that the heavy participation of short-sellers during such collapses is not due to greed. Because of constraints, rapid market downturns are one of the few periods when short traders can fully express their opinion. Crisp (2008) contends that short-sales placed by corporate managers or directors may be inappropriate but insider trading rules and disclosure requirements effectively legislate these potential conflicts. He further states that short trades are necessary for market-making and may help detect corporate fraud. In 2001, James Chanos, a famed short-seller, identified fraudulent accounting practices for Enron Corporation with the ensuing results that are well known in the financial industry. Karpoff and Lou (2010) support the notion that short-sales are beneficial through faster discovery of corporate misconduct and dampened inflated prices when earnings are overstated. Even in the face of such evidence, the fact remains that the general political opinion, fueled by lobbying pressure from corporate managers, continues to view short-sales as damaging.

"When you sell short, you are betting against the team. At a minimum, it is an emotional issue…" These words from the SEC Commissioner Joseph Grundfest (Washington Post, May 8, 1988) clearly embody the resistance faced by short-sellers in the wake of a substantial market decline or crash. In 1995, the Malaysian Finance Ministry went as far as proposing mandatory caning as punishment for traders engaged in short-selling (the beating "will be light, similar to the punishment carried out on juveniles") (Jayasankaran, 1995).

Although the informational role of short-sellers has been empirically and theoretically demonstrated (Miller, 1977; Figlewski, 1981; Diamond and Verracchia, 1987; Dechow *et al*., 2001; Bai *et al*., 2006; Crisp, 2008; Boehmer *et al*., 2009; etc.) the public opinion expressed by market commentators, regulators and firm managers points to the propensity to blame short sales for large declines in stock prices. It has been argued that shorting during the bear raids in the 1920s and program trading in the 1980s were partly responsible for the market crashes that followed in 1929 and 1987 (Macey *et al.*, 1989). Hong and Stein (2003) lend some credibility to this theory but with a caveat; namely, short-sellers played an indirect role as they are kept out of the market by short-sales constraints until the crash, at which point they participate and their information is revealed. For our purposes, whether there is truth to this allegation is not the debate because the effect is clearly felt by those traders who unconsciously feel as traitors, villains or outcasts, thereby hampering their shorting activity. This "short bashing" by politicians and CEOs can last until the market regains strength, a period ranging from six months to many years depending on the severity of the market decline.

In rising markets, short-sellers are impeded by investor sentiment. When stock prices are declining, they are subject to moral resistance and reluctant to become the "bad guys" as portrayed by the media. The end result of both scenarios is reluctance from the part of the pessimists to enter the market, a loss in informational efficiency as their expectations cannot be expressed, an increase in intangible drag and a rise in excess overpricing. To account for the short-sales constraints related to investor sentiment and moral resistance, we use the sentiment index as per Baker and Wurgler (2007). With a monthly frequency, SENT_t is constructed using trading volume as measured by NYSE turnover; the dividend premium; the closed-end fund discount; the number and first-day returns on IPOs; and the equity share in new issues. Baker and Wurgler associate higher (lower) sentiment with lower (higher) subsequent returns, an indication of high (low) mispricing. Thus, our fifth alternative hypothesis is:

H_a^5: *The intangible short-sales constraint, as measured by excess overpricing, is positively related to the level of the lagged market sentiment index.*

4.6.1.6 Firm-based constraints

Firms are not without teeth in the battle for higher share prices. Managers and directors benefit from lofty stock prices in the form of bonuses and equity-based incentives like options so there is a strong incentive to discourage short-sellers who tend to depress stock prices. Jensen (2005) applies agency theory to demonstrate that managers actively attempt to support excess overpricing. He argues that many CEOs and CFOs are victims of the system and must maintain the elevated share prices or, alternatively, that they are simply ignorant of the overvaluation.

Since the tactics are mostly behavioral in nature, they are difficult to quantify and little research has been done on the subject. Lamont (2004) and Crisp (2008) describe the various schemes used by corporations to combat short selling. They include technical restrictions such as stock splits, share repurchase programs, trading halts, "cornering" the lendable supply and the willful reduction of borrowable share supply through "custody only stock".[18] Under market manipulation rules, there is nothing illegal about such activities but the motives sometime fall into a grey area (e.g., recalling shares for a 1.1:1 split). Liu and Swanson (2012) empirically show that repurchases are used by firms to support share prices and thwart short-sellers. Since the data suggest that such actions take place when the stock is fairly or even overpriced, Liu and Swanson conclude that the actual motive for the repurchases is to prevent price corrections, thus impeding market efficiency.[19]

Firms have also publicly urged shareowners to trade their street form stock for paper certificates and moved stock into friendly hands or lending-restricted entities such as employee-purchase programs. Another strategy is to leave the Depositary Trust Clearing Corporation, forcing all share owners to hold paper stock, essentially extinguishing any possibility of lending

[18] The SEC intervened in 2004 and prohibited companies from interfering with the transfer of securities to intermediaries.
[19] Similarly, in the framework of the acquisition of an overpriced firm, Fu *et al.* (2009) suggest that, equity overvaluation increases agency costs and benefits managers more than shareholders.

the shares. Non-technical strategies such as lawsuits, requests for regulatory investigations and public statements are also used. In 2008, when hints of Lehman Brothers' potential demise started surfacing months before it became official, the company was quick to issue a public statement denying the rumors and attributing them to bear raiders. Lamont (2004) describes the characteristics of firms more likely to try to impede short sales: "… event firms are high volume, high short interest, growth firms of above median size." (p. 20). The success rate of such actions remains dubious as the firms in Lamont's sample lost close to 42% of their market capitalization over three years but the distress of facing the wrath of a large corporation is sometimes enough to deter some short-sellers.

We create a measure called PROBF to capture the likelihood that a stock's firm-based short-sales constraints are high relative to the rest of our sample. We construct $PROBF_{i,t}$ according to Lamont's criteria by ranking the firm-months (trades) in our sample, from low to high, by average monthly volume, short interest, market-to-book ratio and market capitalization ($SSVOL_{i,t}$, $UTIL_{i,t}$, $MB_{i,t}$ and $logMCAP_{i,t}$) . We also include a measure based on monthly repurchases as a percentage of outstanding shares. We then compute the equal-weight mean rank for all five variables for each stock-month and spread the values over a unit interval (between 0 and 1). To illustrate, if a stock-month displays rankings of 65th, 44th, 96th, 34th and 55th for each of the five criteria, the average ranking is then 50th in a sample of 500 events so $PROBF_{i,t}$ will take the value of 50/500 = 0.10. $PROBF_{i,t}$ increases with increases in each of its components and a high value for $PROBF_{i,t}$, indicates a strong probability that a firm will attempt to combat short-selling. We thus postulate our sixth alternative hypothesis as:

H_a^6: The intangible short-sales constraint, as measured by excess overpricing, is positively related to the likelihood that a firm will resort to the use of short-sales restrictive tactics as proxied by $PROBF_{i,t-1}$.

4.6.1.7 Existence of options

From the long put to the synthetic short, many option strategies allow a bearish investor to take the equivalent of a short position. Thus, options can be seen as a substitute for direct short selling and should alleviate the constraints by reducing demand for lendable shares. The relationship between options and short interest is well documented. Figlewski and Webb (1993) show that options increase market efficiency and reduce short-sales drag. Sorescu (2000) finds that the existence of an options market for a specific stock reduces its price, an indication that negative information previously withheld is now factored into the price. Gintschel (2001), Arnold *et al.* (2005) and Henry and MacKenzie (2007) conclude that short-interest levels are significantly related to the availability of options for a specific stock. Ofek *et al.* (2002) find that violations of the put-call parity are strongly linked to a measure of tangible short-sales constraints, namely the lending fee. Mayhew and Mihov (2005) offer a somewhat dissenting opinion since they find no impact of option volume on the cost of short-selling. Since the dollar-denominated impact of the existence of an options market on stock price is difficult to readily estimate as a trader contemplates a sale so it is appropriate to classify this constraint as intangible. To assess the impact of this constraint, we use the lagged dummy variable $OPT_{i,t}$ that is set at 1 if options are available and 0 otherwise. Thus, our seventh alternative hypothesis is:

H_a^7: The intangible short-sales constraint, as measured by excess overpricing, is negatively related to the existence of an options market for a specific stock.

4.6.2 Empirical Methodology

To estimate the impact of each restriction on mispricing, we regress the seven proxies for intangible constraints on our two measures of excess overpricing (absolute and relative). As controls, we include the lagged systematic risk, level of governance, institutional ownership, market volatility, stock price and the existence of options, which were found to be significant using Bayes-adjusted critical t-values previously in section 4.5.2 but are not incorporated in our measure $PROBF_{i,t-1}$.

Using the same rationale and methodology as in section 4.5.2, we estimate the following variant of equation (4.6) using a panel EGLS regression with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariances to account for clustered standard errors. For a sample size of 17,215 observations we estimate:

$$XSOP_{i,t} \text{ or } \%XSOP_{i,t} = \beta_0 + \beta_1 UTIL_{i,t-1} + \beta_2 IO_{i,t-1} + \beta_3 BLNDR_{i,t-1} + \beta_4 UPT_{t-1} + \beta_5 SENT_{t-1} + \beta_6 PROBF_{i,t-1} + \beta_7 OPT_{i,t-1} + \beta_8 CGQ_{i,t-1} + \beta_9 BETA_{i,t-1} + \beta_{10} SPXVIX_{t-1} + \beta_{11} SSP_{t-1} + \varepsilon_{i,t} \quad (4.7)$$

where

$UTIL_{i,t-1}$ is the level of utilization for stock *i* and month *t-1*;

$IO_{i,t-1}$ is the percentage of institutional ownership for stock *i* and month *t-1*;

$BLNDR_{i,t-1}$ is the borrower to lender ratio for stock *i* and month *t-1*;

UPT_{t-1} is a dummy variable taking the value of 1 if the uptick rule exists for month *t-1*, and 0 otherwise;

$SENT_{t-1}$ is the level of the market sentiment index for month *t-1*;

$PROBF_{i,t-1}$ is a measure of the likelihood that firm *i* will engage in short-sales restrictive tactics during month *t-1*; and

all other variables are as described in section 4.5.2.

4.6.3 Empirical Results

The results for our composite AVG model and RRV model are summarized in Table 4.4. The regressions for both dependent variables are significant (F-statistics = 79 and 221, p-values = 0.000) with an adjusted coefficient of determination equal to 0.0475 and 0.1236 for AVG $XSOP_{i,t}$ and $\%XSOP_{i,t}$ respectively. The Durbin-Watson statistics indicate no autocorrelation for both regression models. Estimation using the RRV sample yields qualitatively and quantitatively comparable results except for the intercept, which is negative for RRV and positive for AVG. A possible reason for this difference was discussed earlier in section 4.4.

[Please insert table 4.4 about here.]

The coefficient of $UTIL_{i,t-1}$, β_1, is positive and significant only at the 99% level for AVG $XSOP_{i,t}$ but meets the Bayes-adjusted critical t-value for $\%XSOP_{i,t}$ and for both measures using RRV. An increase of 1% in utilization results in an increase of 0.03% in absolute mispricing, thus supporting our expectations that excess overpricing increases as the supply of lendable shares dwindles and the intangible constraint associated with recall risk and limited supply intensifies. The possibility that a lender may retract the loan while new shares are scarce increases intangible short-sales drag and therefore mispricing.

The coefficient for $IO_{i,t-1}$, β_2, is negative and highly significant for $\%XSOP_{i,t}$ and for both measures of RRV excess overpricing. An increase of 1% in institutional ownership leads to a 0.0429% reduction in relative excess overpricing. The negative sign indicates that overvaluation decreases when the target firm's stock is held by large organizations. Shareholder activism, large research budgets and the propensity to hold long-only positions are all characteristics associated with institutional ownership and result in a dampening effect on mispricing. Furthermore, large firms such as pension and mutual funds are preferred lenders and tend to increase the lendable supply, reducing the drag associated with search frictions.

The coefficient for $BLNDR_{i,t-1}$, β_3, which proxies for market opacity and search frictions, is positive and weakly significant for both regression models, demonstrating that mispricing rises as the number of borrowers increases for a given number of lenders. Since the lending fee has already been removed from overpricing to obtain excess overpricing, the increase in borrowing fees does not explain the positive relationship. As the appetite for lendable stock grows and/or the number of lenders decreases, shares are either not borrowable or are more difficult to locate whithout the intervention of a broker who charges a fee. This added risk may discourage some traders who opt out of the short market, thereby increasing mispricing.

Since the coefficient of UPT_t, β_4, is insignificant for both $XSOP_{i,t}$ and $\%XSOP_{i,t}$, we support the following conclusion of Boehmer *et al.* (2009): "There are no significant stock price effects when the SEC announces the repeal of the uptick rule." Prices oscillate between up and downtick fast enough that sellers were not impeded by the trading restriction, hence its removal in 2007.

The coefficients for lagged investor sentiment, β_5, are positive as expected and weakly significant for AVG $\%XSOP_{i,t}$ and RRV $XSOP_{i,t}$ but meet the Bayes-adjusted standard for RRV $\%XSOP_{i,t}$. This indicates that market sentiment creates a drag on short trades and increases overpricing. Short-sellers are hampered by bad publicity and moral pressure during rapid market downturns when investor sentiment is low and fare no better when stock prices are rising because of noise trader risk.

The coefficients for $PROBF_{i,t-1}$ are highly significant across all models. At *t-1*, the likelihood that a firm will engage in firm-bullying tactics increases mispricing. As a test of robustness, we compute regression (7) replacing $PROBF_{i,t-1}$ by its components ($SSVOL_{i,t-1}$, $UTIL_{i,t-1}$, $MB_{i,t-1}$,

$logMCAP_{i,t-1}$ and lagged relative monthly repurchases). The untabulated results show that the coefficients for $MB_{i,t-1}$, $logMCAP_{i,t-1}$ and monthly repurchases are negative and significant to Bayes-adjusted critical t-values while that of $UTIL_{i,t-1}$ and $SSVOL_{i,t-1}$ are positive and also significant. [20] The signs and significance levels of the coefficients for all other independent variables remain the same, indicating that our measure $PROBF_{i,t-1}$ is adequate. We replicate this analysis using the RRV model and obtain qualitatively similar results.

We expect the intangible drag to be negatively associated with the existence of an options market for a specific stock-month. We find that in regression (4.7) the coefficient of $OPT_{i,t-1}$, β_7, is significant and negative for AVG $XSOP_{i,t}$ and both measures of RRV while positive, but with a weaker significance level, for AVG $\%XSOP_{i,t}$. Thus, the existence of an options market for a specific stock-month translates into a mean reduction of 0.7% in absolute overpricing. The positive coefficient of $OPT_{i,t-1}$ for relative mispricing (AVG $\%XSOP_{i,t}$) appears to be anomalous since it implies that the reduction in absolute excess overpricing (the numerator $XSOP_{i,t}$) is smaller than that of the mean stock price (the denominator $SSP_{i,t}$). Furthermore, it disagrees with the results using RRV and with the results obtained in section 4.5.2 where the coefficient for $OPT_{i,t-1}$ is negative for both absolute and relative excess mispricing.

4.6.4 Robustness tests

To ensure robustness, we estimate the variant of equation (4.7) using the Fama MacBeth method. The macroeconomic independent variables (UPT_{t-1}, $SENT_{t-1}$ and $SPXVIX_{t-1}$) are withheld from the test as they are constant for the cross-section. Table 4.5 reports the results, which are qualitatively and quantitatively similar to those obtained using the panel regression estimation method. The discrepancy in sign for the coefficient of $OPT_{i,t-1}$ for AVG $\%XSOP_{i,t}$, as

[20] These and all other untabulated findings are available from the authors.

previously observed from the panel EGLS regression, disappears under the Fama MacBeth estimation method thus confirming that the existence of an options market in period *t-1* reduces mispricing in period *t.* As a further test, we use the Fama MacBeth estimation method on six subsets of our sample where UPT_{t-1} is either equal to zero or one, $SENT_{t-1}$ is larger or smaller than the mean of 0.017, and $SPXVIX_{t-1}$ is above or below the mean of 24.85. Each of the sub-samples yields untabulated results are similar to those for the complete dataset.

As a further test of robustness and following the reasoning and methodology outlined in section 4.5.2, we repeat the analysis using a dynamic panel GMM estimation model and the truncated sample NOFIN. The results, reported in Table 4.5, qualitatively confirm our previous findings.

[Please insert table 4.5 about here.]

Finally, we estimate a variant of regression model (4.7) using contemporaneous independent variables. The untabulated results are similar to those presented and discussed earlier using lagged regressors with one notable difference. The coefficient for $PROBF_{i,t}$ is now *negative* and highly significant with t-statistics of -17.48 for AVG $XSOP_{i,t}$ and -25.87 for AVG $\%XSOP_{i,t}$. During period *t-1*, firm-restrictive tactics increase mispricing but, at time *t*, the relationship is reversed. We explain this result as follows: if corporate managers adopt a short-sale restrictive strategy, the stock comes under price pressure as it is already under attack at time *t* and actively sold by traders. Since Lamont's results indicate that firm-bullying actions are far from successful, we thus surmise that short-sellers can win the war against combative firms whose tactics are often used as a shield against fair market valuation. Thus, the positive coefficients for $PROBF_{i,t-1}$ are consistent with the premise that the stock displays higher mispricing at *t-1* but short-sellers subsequently drive the share price down at time *t*. In turn, this results in a negative relationship between excess overpricing and contemporaneous $PROBF_{i,t}$.

4.7 CONCLUSION

The literature on equity valuation agrees that stocks are generally overpriced when compared to their intrinsic values. Some measures of positive mispricing are explained by the existence of quantifiable short-sales constraints such as taxes, lending fees, dividend repayment requirements and direct transaction costs. In this chapter, we theoretically and empirically examine short sales to investigate excess overpricing, defined as the surplus of the short-sales price over the intrinsic value and the tangible drag. We identify the intangible determinants of overvaluation and ascertain the characteristics of stocks that are the most attractive to short-sellers. We measure absolute and relative excess overpricing to show that overvaluation is greatest for firms that are relatively poorly managed, smaller in size with lower institutional ownership, no options, higher price-earnings multiples, higher systematic risks and lower market-to-book ratios. Our findings support the notion that noise-trader risk is endemic to the panoply of difficulties faced by short-sellers.

We classify all stock-months by excess overpricing from highest to lowest and build ten portfolios of trades where all the data necessary to build these portfolios (market price, intrinsic value and tangible constraints) are available to traders *prior* to the initiation of all short-sales. We compute the ex-post returns for various shorting periods (15, 30, 45 and 60 days) and find that the top deciles display a monthly-adjusted mean return of 7.05% for a 15-day trade while the complete sample shows 1.84% for the same time frame. We also demonstrate that the ex-post returns are inversely related to the holding period; longer uncovered positions result in less return for short-sellers.

We find that the risk of a recall or short-squeeze, market opacity, market sentiment and the difficulty in locating lendable shares significantly increase mispricing while the existence of options and the level of institutional ownership have the opposite effect and the uptick rule does not act as an short-sales restriction. Firm-based restrictive tactics initially increase overpricing but signal to the market that the stock is under selling pressure. Since such tactics are rarely effective, firm-bullying becomes negatively related to mispricing. While this chapter provides some answers regarding overpricing and short-sales constraints, the sellers' target price, valuation methods and trading horizon still remain somewhat elusive and could provide further insights into mispricing and the actual performance of short-sellers.

CHAPTER 5

CONCLUSION

This thesis examines short sales in relation to corporate governance, binding constraints and heterogeneous expectations. The study of mispricing, overvaluation, expected and ex-post returns provides new insights in the tools used and determinants considered by investors to generate shorting profits. While this thesis pushes the boundaries of the empirical evidence on short sales, some of the results thus obtained are also actionable by short traders.

Four major conclusions follow from the empirical findings presented in the second chapter with regards to the impact of corporate governance on short sales. Firstly, short interest is inversely related to the quality level of corporate governance and sellers react appropriately to contemporaneous changes, reducing their short holdings for positive announcements and increasing it for negative news. Secondly, as informed investors, short-sellers may also be able to forecast changes in governance structures and act accordingly *prior* to the said changes thus pre-empting the market as they increase informational efficiency by bringing forward previously undisclosed findings. Thirdly, the reaction of sellers is asymmetric, with a pronounced increase in short positions for actual and expected negative shifts in governance and a more subdued repurchase of previously shorted stock for positive changes. Finally, shorting costs increase with utilization. As the demand for lendable shares increases, supplies are reduced and the lenders profit by increasing fees. Chapter two also investigates the determinants of short interest to show that the use of governance, institutional ownership and lagged utilization as regressors renders insignificant other independent variables common in the literature such as fundamental ratios, market capitalization, the existence of options, etc.

These conclusions open the door to interesting research questions. If the data shows that short-sellers can, on average, correctly foresee changes in corporate governance, the methods they use remains undisclosed. Two possibilities emerge. The first is that shorting entities use superior resources and skill to analyze public information faster and more accurately than other market investors. The second, less desirable, is that short traders may be able to manipulate corporate governance events to their advantage. By borrowing shares, using the voting rights then selling the stock, they could depress the price and profit from these actions. Whether short-sellers gain abnormal returns by shrewd analysis or shady dealings, remains for further study.

In chapter three of this thesis, five major conclusions result from the examination of constraints and overpricing. Firstly, a new taxonomy for implemental drag is outlined where the short selling constraints are classified as tangible that can be estimated by the seller prior to the transaction, and intangible that are more behavioral or regulatory in nature. The latter includes recall risk and the scarcity of lendable supply, market opacity and search frictions, rules and regulations, moral resistance and, finally, impeding firm-based tactics. Tangible short-sales constraints encompass the lending fee, dividend repayments requirements, direct trading costs and taxes payable on the profits from the trade. The importance of the distinction between tangible and intangible drag lies in the capacity of a trader to precisely estimate the former prior to execution while the latter is difficult to quantify at best. The literature underestimates the scale of short-sales constraints, resulting in the documented puzzlement surrounding shorting returns. Secondly, chapter three introduces a theoretical framework where excess overpricing is equal to shorting price minus the sum of the expected value of the stock and the associated tangible costs of the sale. Under heterogeneous expectations, theory dictates that this excess overpricing should be equal to or greater than zero.

Thirdly, empirical analysis shows that the most widely used proxy for short-sales constraints, the lending fee, is inadequate both in magnitude and variance. Taxes account for the bulk of the tangible drag, followed far behind by direct trading costs, the lending fee and dividend losses. Furthermore, the margin requirements do not generate constraints as the funds are generally deposited in the form of treasury bills or other market instruments, thus generating no opportunity loss. The same assessment applies to the use-of-proceeds restriction, another commonly used proxy for implemental drag. As the lender rebates the equivalent of the repo rate to the borrower, no cost is incurred.

Fourthly, overpricing increases in step with the tangible constraints and with market returns. The fifth conclusion of chapter three is that the overpricing theory generally holds true except during periods of rapid price contraction when excess overpricing, defined as the remaining mispricing after removal of the tangible constraints, becomes null or negative. This is explained by the fact that the tax constraint is price-dependent but the other restrictions are relatively static in relation to sales price, leaving a larger (smaller) profit ratio as the gap between the short-selling price and the fundamental value widens (tightens).

These conclusions have far-reaching implications and should lead to a revision of the proxies used when assessing short-sales constraints. Excess overpricing (expected gain) remains positive after the removal of the tangible drag and the intangible constraints as identified are believed to be the reason. This subject certainly deserves further consideration and the relationship between mispricing, tangible and intangible constraints and utilization levels could provide further insight into the motivation behind short-sales.

Five major conclusions can be drawn from the fourth chapter. Firstly, excess overpricing is the potential profit from short selling and empirical analysis shows that overvaluation is greatest for firms that are smaller in size, relatively poorly managed with lower institutional ownership, higher systematic risk, no options, higher price-earnings multiples and lower market-to-book ratios. Secondly, the theoretical short sales model is extended to include intangible constraints. Excess overpricing is attributed to these restrictions. Empirical results show that the risk of a recall or short-squeeze, market opacity, market sentiment and the difficulty in locating lendable shares significantly increase mispricing while the existence of options and the level of institutional ownership have the opposite effect. The uptick rule did not act as an restriction while it was enforced. Firm-based restrictive tactics initially increase overpricing but signal to the market that the stock is under selling pressure. Since such tactics are rarely effective, firm-bullying becomes negatively related to mispricing.

The third conclusion reached in chapter four concerns returns associated with short sales. All shorting events in the sample are classified by excess overpricing from highest to lowest and ten portfolios of trades are constructed. All the data necessary to build these portfolios (market price, intrinsic value and tangible constraints) are available to traders *prior* to the initiation of all short-sales. If traders select the top group and hold the stocks until they reach fundamental value, their potential mean profit per trade for the four year sample period is over 28% per trade with a variance of 0.33%. In practice, this return is rarely realized as noise-trader risk is endemic to the panoply of difficulties faced by short-sellers and some stocks do not mean-revert to their fundamental value within the time frame of the transaction.

Fourthly, shorting a portfolio, built using public information, of the most overvalued stocks results in ex-post monthly-equivalent returns in excess of 7% for 15-day trades. Returns are also inversely related to the holding period; longer short trades equate to a lower return for sellers. Finally, overvaluation varies across industries.

These findings equally serve the academic community and the finance industry. The extension of the theoretical overpricing model and the following empirical results lead to actionable items that are implementable by short-sellers who only need public data to potentially achieve higher returns. While some answers regarding overpricing and short-sales constraints are provided in this chapter, questions still remain concerning specific shorting price targets and valuation methods. Actual trading horizons are elusive and the literature requires more clarity on that subject.

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APPENDICES

A. Intrinsic value calculations

To ensure robustness, we calculate fundamental value using multiple models including three abnormal growth earnings models (Dechow *et al*., 2001; Ohlson and Juettner, 2005; Easton, 2004), and two residual income valuation models (Claus and Thomas, 2001; Lee *et al*., 2003).

The frequency of the intrinsic value estimates is monthly and we obtain at least one expected value for each stock *i* during month *t*. Because of the various input requirements, some of the models generate more values than others.

We use the following notation for the five models discussed below:

$IV_{i,t}$: Firm's intrinsic value.

Bv_0: Book value of equity per share.

bv_t: Expected future book value of equity per share at time *t*, where $bv_t = bv_{t-1} + eps_t - d_t$ (clean surplus accounting).

eps_t: Expected future earnings per share for period (*t-1*, *t*) using either explicit analyst forecasts or future earnings derived from short- and long-term growth forecasts g_{ST} and g_{LT}, respectively.

dp: Dividend payout ratio.

d_t: Expected future net dividends per share for period (*t-1*, *t*) computed as the dividend payout ratio (dp) times the earnings per share forecast eps_t.

r_e: Cost of equity capital

A.1 Required Rate of Return

The literature on the cost of equity capital describes various methods to estimate the required rate of return. Dechow *et al*. (2001) use a basic static long-term return of 12%. Others (Francis *et* *al.,* 2000; Ali *et al*., 2006; Jorgensen *et al*., 2005) estimate it by calculating an industry average discount rate with a modified CAPM where $r_e^{ind} = r_f + \beta_{ind}(E(r_m)\text{-}r_f)$, where β_{ind} is the mean of all the betas for stock j's industry class and $E(r_m - r_f)$ is the expected market risk premium. Each firm in the same industry thus displays the same expected cost of equity. Fama and French (1997) use a three-factor industry risk premium model with $r_e^{ind} = r_f + \beta_{ind}(E(r_m)\text{-}r_f) + r_{smb} + r_{hml}$, where r_{smb} and r_{hml} are the returns of the small-minus-big and high-minus-low benchmark portfolios. All of these studies use historical data as model inputs but the short-seller looks to the future to evaluate intrinsic values. For this reason, we exclude the Fama and French three-factor model as the benchmark portfolios are based on ex-post observations. Furthermore, the intrinsic value models are highly sensitivity to the choice of the discount rate. For example, in 2007, the small-minus-big and high-minus-low factors are -8.32% and -12.3% respectively, leading to negative discount rates for many observations in our sample if we use the three-factor model. We therefore compute the required rate of return using the CAPM, *expected* market risk premiums and long-term historical industry betas, all of which are available to the trader at the time he sells the stock.

We separate the stocks according to Damodaran's one hundred industry SIC code taxonomy to ensure maximum coverage and a wide range of industry betas. The long-term historical industry betas are estimated by regressing monthly returns of stocks against the NYSE index with five years of data or the listed period if shorter (no estimation if less than two years). The quarterly expected market risk premiums and risk-free rates originate from the survey of Chiefs Financial Officers (CFOs) from Duke University and CFO Magazine, as per Graham and Harvey (2012). We thus compute the expected discount rate for each stock-month. The final cost of equity for the firms in our sample displays the following statistics: a mean of 7.70% with a standard deviation of 1.20%, a median of 7.72%, maximum of 12.32% and a minimum of 3.93%.

A.2 Dechow *et al.*, 2001 (*DC*)

Following in the footsteps of Dechow *et al.*, we estimate the intrinsic value of stock *i* at time *t* as the sum of its book value and the discounted value of its future abnormal earnings:

$$IV_{i,t} = BV_{i,t} + \quad {}^{\infty}_{\tau=1} \; E_t[X^a_{t+\tau}] \quad (1 + r_e)^{\tau} \;, \qquad \text{(A1)}$$

where $BV_{i,t}$ is the book value of firm *i* at time *t*; and $X^a_{t+\tau}$ = $earnings_{t+\tau}$ - $r_e BV_{t+\tau-1}$.

As per Ohlson (1995) and Dechow *et al.* (1999, 2001), abnormal earnings are estimated with the autoregressive model $X^a_{t+\tau} = \omega X^a_t + \varepsilon_{t+1}$. Thus, the intrinsic value can be expressed as $IV_{i,t}$ = $BV_{i,t} + \alpha X^a_t$, with $\alpha = \omega \quad 1 + r_e - \omega$, where ω is the persistence parameter for abnormal earnings and r_e is the expected rate of return. If ω=0, the model becomes pure book value while ω=1 transforms it into a pure earnings model. Dechow *et al*. (1999) show that using a persistence parameter of 0.6 when computing the IV/MV (intrinsic/market value) ratio results in a stronger relationship with future returns when compared with the methods using earnings-to-price or book-to-market ratios.

This model is superior to book value alone as it allows for the integration of abnormal earnings. Since traders sell short based on their expectations of the future price of a firm's equity, contemporaneous book value is not sufficient to estimate the intrinsic value of the stock. We obtain the persistence factor by performing the following regression for each stock in our sample using at least the five previous years of data for each year *t*:

$$AE_{i,t-1} = \alpha_0 + \omega_{i,t-1} AE_{i,t-2} + \varepsilon_{i,t-1}, \qquad \text{(A2)}$$

where AE_t (abnormal earnings) = $Earnings_t$ - rBV_{t-1}. We use the persistence factor $\omega_{i,t-1}$ for each stock-year to compute a yearly parameter α for each shorted stock. Our results are slightly lower than Dechow *et al*. (1999, 2001) as we obtain an average persistence factor ω of 0.32 for the period 2006-2010. Since we cover a full market cycle including a financial crisis, it is expected that abnormal earnings display less persistence.

A.3 Easton, 2004 (*EA*)

Easton derives a model of earnings and growth based on Ohlson and Jeuttner-Nauroth (2000) where the change in the short-run forecast of abnormal growth in accounting earnings is computed to adjust for the forecasts of analysts instead of economic earnings. This model is normally used to estimate the expected rate of return on equity capital for a given ex-post market price P_0 but can also provide an estimate of the intrinsic value if we use our previous estimate of $E(r_e)$ as the required rate of return. The *EA* model is expressed as follows:

$$IV_{i,t} = \frac{dp \cdot eps_1}{r_e} + \frac{eps_1 \cdot g_{ST}}{r_e^2} . \quad \text{(A3)}$$

A.4 Ohlson and Juettner, 2005 (*OJ*)

This abnormal growth model uses the present value of dividends to determine price without imposing restrictions on the expected future sequence of such dividends. As with Easton (2004), this model can be used to estimate the fundamental value $IV_{i,t}$ with $E(r_e)$ as the discount rate.

$$IV_{i,t} = \frac{dp \cdot eps_1}{r_e - g_{LT}} + \frac{eps_1 \cdot (g_{ST} - g_{LT})}{r_e(r_e - g_{LT})} , \quad \text{(A4)}$$

The *OJ* model has obvious limitations when used to compute the price $IV_{i,t}$. If the estimated long-term growth is higher than the discount rate, the model generates negative expected share prices. Furthermore, the short term growth g_{ST} is expected to decay asymptotically to g_{LT} but, because of the effect of the 2008 crisis, a substantial portion of the observations in our sample show a value of g_{ST} lower than g_{LT} , leading to a negative numerator in the second term of the equation. Finally, as the difference between r_e and g_{LT} tends to 0, the price reaches infinite.

The estimate for the long-term growth prospects of each firm is critical to model output but, as any prediction would be, the expected g_{LT} can be subject to analyst bias. Gode and Mohanram (2003) bypass this issue by assuming a single perpetual economic growth rate γ equal to 3% but state that "… our choice of γ is not central to our results" (p. 408). A short-seller attempting to compute fundamental value is more likely to use firm-specific data and analyst estimates are readily available. Since our goal is to replicate the thought process of a trader contemplating a short sale, we use long-term growth data from I.B.E.S., compute the fundamental values, and trim the sample within two standard deviations of the $MP_{i,t}/IV^{OJ}_{i,t}$ ratio. As per Gode and Mohanram (2003), we find that the restrictive criteria of the *OJ* model seriously constrict the sample size. Table 1 provides the details of the number of observations lost and the cause for each sample reduction.

A.5 Claus and Thomas, 2001 (*CT*)

Claus and Thomas develop an ex-ante abnormal earnings model where the present value of future dividends is restated as the sum of the book value of equity and future accounting earnings, or:

$$IV_{i,t} = bv_0 + \sum_{t=1}^{5} \frac{(eps_t - r_e \cdot bv_{t-1})}{(1+r_e)^t} + \frac{(eps_5 - r_e \cdot bv_4)(1+g_{LT})}{(r_e - g_{LT})(1+r_e)^5}, \qquad \text{(A5)}$$

with $bv_{t+1} = bv_t + 0.5 * eps_{t+1}$.

The *CT* model suffers from the same limitations as *OJ* with respect to the discount rate and long-term growth prospects and, as a result, the sample is reduced to 3% of its original size for our sample period.

A.6 Lee, Ng and Swaminathan, 2007 (*LN*)

This model belongs to the category of residual income valuation models and uses a discounted cash flow framework over a fifteen year period to evaluate the intrinsic value of a stock. As per our previous models, it is designed to extract the market implied risk premium for a specified price P_0 but can provide a fundamental value when the discount rate is set at $E(r_e)$.

$$IV_{i,t} = \frac{dp \cdot eps_1}{(1+r_e)} + \frac{dp \cdot eps_2}{(1+r_e)^2} + \sum_{t=3}^{15} \frac{eps_t \times (1-b_t)}{(1+r_e)^t} + \frac{eps_{16}}{r_e(1+r_e)^{15}}, \tag{A6}$$

Earnings forecasts from year 4 to year 16 for this model are given by:

$$g_t = g_{t-1} \times \exp\left[\log\left(g_{LT} / g_{ST}\right)/\left(T-1\right)\right]$$
$$eps_t = eps_{t-1} \times \left(1 + g_t\right)$$

The plowback rates from year 3 to year 15 are given by:

$b_t = b_{t-1} - \quad b_2 - b \quad T - 1$, where $b = g_{LT} / r_e$, and $b_2 = 1 - dp$.

A.7 Model for Robustness Tests: Rhodes-Kropf, Robinson and Viswanathan (2005)

The residual income and abnormal growth models display one potential weakness as both types rely on analyst estimates for future earnings-per-share or growth prospects. As a measure of robustness, we use a model developed by Rhodes-Kropf, Robinson and Viswanathan (2005) or RRV or RKRV and more recently implemented by many researchers, e.g., Fu et al. (2013), Hertzel and Li (2010) and Hoberg and Philips (2010). The RRV model avoids analyst biases in the projection of earnings and their growth rates and assumes that the fundamental value of a firm is a linear function of its book value of equity, leverage and realized net income. Its methodology uses an accounting multiples approach to decompose the market-to-book ratio into a combination of industry-level and firm-specific mispricing. Thus the first step is obtaining the industry coefficients $\beta_{.,j,t}$. Specifically, we estimate:

$$Ln(MP_{i,t}) = \beta_{0j,t} + \beta_{1j,t}Ln(bv_{i,t}) + \beta_{2j,t}Ln(|ni_{i,t}|) + \beta_{3j,t}DLn(|ni_{i,t}|) + \beta_{4jt}lev_{i,t} + \varepsilon_{i,t} \quad \text{(A7)}$$

where all parameters can vary across time *t* and industry *j* in which firm *i* operates and:

$MP_{i,t}$: Market price of the stock for firm *i* and time *t*.

$bv_{i,t}$: Book value of equity for firm *i* and time *t* .

$ni_{i,t}$: Net income for firm *i* and time *t* .

D: Dummy variable that takes the value of 1 if net income is negative, 0 otherwise.

$lev_{i,t}$: Market leverage ratio for firm *i* and time *t*.

Following RRV, and to avoid look-ahead bias, we match Compustat fundamental data for fiscal year *t* with CRSP market prices $MP_{i,t}$ obtained three months after a firm's fiscal year-end. As a sample for industry coefficients, we use all of the Compustat U.S. universe where matching CRSP data are available. We run a cross-sectional regression of equation (A7) for all firms in each of the 12 industries defined by Fama and French (1997) for each year and use a ten-year rolling window to average the time series. For example, we use the 1995-2005 range of data for 2006. We thus obtain the long-run parameter estimates of equation (A7), $\beta_{.,j}$ as the mean value of the time series for the parameter estimates $\beta_{.,j,t}$.

Since our short sales sample contains monthly observations, we convert the yearly results into monthly data and, following the method outlined by RRV, we compute the total mispricing ratio for firm *i* in industry *j* for month *t* using:

$$Ln\left(\frac{MP}{IV^{RRV}}\right)_{i,t} = Ln\left(MP_{i,t}\right) - \left(\beta_{0,j} + \beta_{1,j}Ln\left(bv_{i,t}\right) + \beta_{2,j}Ln\left(\left|ni_{i,t}\right|\right) + \beta_{3,j}DLn\left(\left|ni_{i,t}\right|\right) + \beta_{4,j}lev_{i,t}\right) \quad \text{(A8)}$$

From equation (A8), we compute $IV_{i,t}^{RRV}$. We trim the resulting dataset of monthly fundamental values according to the same rules as IV^{AVG}. Table 3.1 provides the details of the number of observations lost and the cause for each sample reduction. The resulting set of intrinsic values, called IV^{RRV}, spans 54 months (July 2006 – December 2010) and contains 27,204 firm-month observations for 1680 stocks, with a mean MP$_{i,t}$ / IV$^{AVG}{}_{i,t}$ ratio of 1.396 and standard deviation of 1.547.

B. Mispricing by industry

The aggregate of all short sales for a specific stock *i* and month *t* are considered a single event and the values of XSOP and %XSOP represent the mean mispricing of the short trades for that specific stock-month. To illustrate, if stock *i* is shorted during month *t*, it is counted as one event. If a new short position is undertaken for the same stock at any point in time during five different months in our sample period, then they are counted as five distinct events. We total the number of events per industry for each of our four key extreme deciles and calculate the mean excess overpricing to obtain the industry's statistics for that month. We compute the event ratio by calculating the number of industry events in the specific decile (AI, AX, RI or RX) over the same for the complete sample. To illustrate, the banking industry accounts for 261 stock-month events (number of events where the shares of a firm in banking are in the "most overpriced" portfolio as ranked by absolute excess mispricing). If there are five stocks in the banking sector that are in the top decile for two months each (10 stock-months) and the complete sample contains 50 stock-months for the banking industry, then the ratio becomes 10/50 = 20%. This ratio gives an indication of the proportion of all banking trades that are in the most overpriced/underpriced subsamples.

For the period of July 2006 to July 2010, we rank the components of deciles AI, AX, RI and RX by the proportion of industry events in relation to the total number of stock-months in our complete sample for that specific sphere of activity. The results are reported in Table B.1. More than 57% (11 stock-months) of the maritime industry events are in the top decile as ranked by absolute excess overpricing, followed by railroads (34.4%, 55), metals and mining (34.0%, 16), newspapers (31.7%, 26) and integrated petroleum (31.5%, 47). The underpriced portfolio AX is led by the tobacco industry with 78.3% (18), followed by aerospace/defense (40.4%, 184), precious metals (40.0%, 16), educational services (37.7%, 29) and the beverage trade (37.1%, 49).

[Please insert table B.1 about here.]

TABLES AND FIGURES

Table 2.1 Descriptive statistics for the sample

This table provides basic statistics for our sample. The original dataset contains 146,594 monthly observations including 3962 firms. It was reduced to 113,664 monthly observations for 3072 firms after removing illiquid stocks, penny stocks and delistings, and then further reduced to 67,321 monthly observations for 3072 firms after the removal of missing data and utilization levels lower than the 2.5% threshold. The period under study covers a full market cycle from July 2006 to July 2009. $GovR_{i,t}$ is the CGQ rating for stock i for month t; $Utilization_{i,t}$ is the average ratio of shares borrowed to lendable shares for stock i during month t; $logShortCost_{i,t}$ is the log of the value-weighted average shorting fee for stock i and month t; and $InstOwn_{i,t}$ is the percentage of the free float of stock i owned by institutional entities for month t.

Variable	***Range***	***Mean***	***Median***	***Std. Deviation***	***Skewness***	***Kurtosis***
$GovR_{i,t}$	0.1 - 100	52.22	53.10	28.42	-0.09	1.83
$Utilization_{i,t}$	2.5 - 100	29.83	23.23	22.91	0.94	3.03
$logShortCost_{i,t}$	0 - 9.44	3.57	2.92	1.50	0.70	2.91
$InstOwn_{i,t}$	0 - 0.98	0.69	0.74	0.30	-0.38	2.70

Correlation	$GovR_{i,t}$	$Utilization_{i,t}$	$logShortCost_{i,t}$	$InstOwn_{i,t}$
$GovR_{i,t}$	1.00	-0.06	-0.02	0.07
$Utilization_{i,t}$	-0.06	1.00	0.52	0.001
$logShortCost_{i,t}$	-0.02	0.52	1.00	-0.27
$InstOwn_{i,t}$	0.07	0.001	-0.27	1.00

Table 2.2 Summary regression results for tests of the first hypothesis

This table reports summary regression results for a test of the first alternative hypothesis; namely, that a lower level of governance is associated with a higher level of short sales. Specifically, we estimate:

$$Utilization_{i,t} = \beta_0 + \beta_1 GovR_{i,t} + \beta_2 logShortCost_{i,t} + \beta_3 Utilization_{i,t-1} + \beta_4 InstOwn_{i,t} + \varepsilon_{i,t} \quad (2.2)$$

$Utilization_{i,t}$ is the average ratio of shares borrowed to shares lendable for stock i during month t; $GovR_{i,t}$ is the CGQ rating for stock i for month t; $logShortCost_{i,t}$ is the log of the value-weighted average shorting fee for stock i for month t; $Utilization_{i,t-1}$ is the independent variable lagged one month to control for short momentum; and $InstOwn_{i,t}$ is the percentage of shares owned by institutional investors of stock i for month t. The sample contains 42,915 observations. The Bayes-adjusted critical t-value is ±3.27. Panel A reports the results of the hypothesis tested by using a panel regression model with period fixed effects and White diagonal standard errors to account for clustering. Panel B reports the regression output for equation (2.2) estimated using a dynamic system GMM panel model.

Panel A - Estimation Method with Period Fixed Effects				
Variable	Coefficient	Std. Error	t-statistic	p-value
C	-2.7254	0.2025	-13.45	0.0000
$GovR_{i,t}$	-0.0096	0.0015	-6.27	0.0000
$logShortCost_{i,t}$	1.4427	0.0479	30.09	0.0000
$Utilization_{i,t-1}$	0.8661	0.0030	289.04	0.0000
$InstOwn_{i,t}$	2.7412	0.1727	15.87	0.0000
Adj. R-square		0.85		
F-statistic		9633		
Prob(F-statistic)		0.0000		
Durbin-Watson statistic		2.02		

Panel B - Dynamic System GMM Panel Model				
Variable	Coefficient	Std. Error	t-statistic	p-value
$GovR_{i,t}$	-0.1791	0.0242	-7.39	0.0000
$logShortCost_{i,t}$	0.7837	0.1127	6.95	0.0000
$Utilization_{i,t-1}$	0.5750	0.0147	38.88	0.0000
$Utilization_{i,t-2}$	-0.0319	0.0064	-4.95	0.0000
$InstOwn_{i,t}$	74.403	3.5197	21.13	0.0000
J-statistic		562		

Table 2.3 Summary regression results for a test of the second hypothesis

This table contains the summary regression results for a test of H_a^2; namely, that a negative (positive) change in the governance level of a firm is positively (negatively) related contemporaneously with the change in the level of short sales. Since institutional ownership is obtained quarterly and all other variables have a monthly frequency, the sample is reduced to exclude all observations where $\Delta InstOwn_{i,t}$ is equal to 0 (i.e., between reporting months). This situation occurs for two of the months per quarter. The final sample contains 12,199 observations. Our second alternate hypothesis is estimated using a panel regression method with period fixed effects and White diagonal standard errors to account for clustering (Panel A) and a dynamic system GMM panel model for robustness purposes (Panel B). Specifically, we estimate:

$$\Delta Utilization_{i,t} = \beta_0 + \beta_1 \Delta GovR_{i,t} + \beta_2 \Delta logShortCost_{i,t} + \beta_3 \Delta Utilization_{i,t-1} + \beta_4 \Delta InstOwn_{i,t} + \varepsilon_{i,t} \quad (2.3)$$

$\Delta Utilization_{i,t}$ is the change in the average ratio of shares borrowed to shares lendable for stock *i* from month *t-1* to month *t*; $\Delta GovR_{i,t}$ is the change in the CGQ rating for stock *i* from month *t-1* to month *t*; $\Delta logShortCost_{i,t}$ is the log of the change in the value-weighted average shorting fee for stock *i* from month *t-1* to month *t*; $\Delta Utilization_{i,t-1}$ is the change in the lagged independent variable from month *t-2* to month *t-1* to control for lagged short momentum; and $\Delta InstOwn_{i,t}$ is the change in the percentage of shares owned by institutional investors of stock *i* from *t-1* to month *t*. The Bayes-adjusted critical t-value is ±3.07.

Panel A - Estimation Method with Period Fixed Effects				
Variable	Coefficient	Std. Error	t-statistic	p-value
C	-0.0456	0.0809	-0.56	0.5727
$\Delta GovR_{i,t}$	-0.0564	0.0107	-5.25	0.0000
$\Delta logShortCost_{i,t}$	0.8051	0.0815	9.87	0.0000
$\Delta Utilization_{i,t-1}$	-0.0916	0.0149	-6.11	0.0000
$\Delta InstOwn_{i,t}$	12.5911	1.8629	6.76	0.0000
Adj. R-square		0.08		
F-statistic		65		
Prob(F-statistic)		0.0000		
Durbin-Watson statistic		1.88		

Panel B - Dynamic System GMM Panel Model				
Variable	Coefficient	Std. Error	t-statistic	p-value
$\Delta GovR_{i,t}$	-0.1834	0.0071	-25.77	0.0000
$\Delta logShortCost_{i,t}$	-0.0279	0.0102	-2.72	0.0064
$\Delta Utilization_{i,t-1}$	-0.0518	0.0034	-14.99	0.0000
$\Delta Utilization_{i,t-2}$	2.4928	0.0571	43.59	0.0000
$\Delta InstOwn_{i,t}$	53.678	0.5770	93.02	0.0000
J-statistic		298		

Table 2.4 Summary regression results for a test of the second hypothesis using the reduced sample (*ΔGovR =0)*

This table contains the results for a test of H_a^2 when $\Delta GovR = 0$ in order to test if there is a significant change in lagged utilization when the change in CGQ rating is zero. This hypothesis is estimated with a reduced sample of 1,117 pooled observations, using a panel regression model with period fixed effects and White diagonal standard errors to account for clustering (Panel A) and a dynamic system GMM panel model for robustness purposes (Panel B). The estimated equation is:

$$\Delta Utilization_{i,t} = \beta_0 + \beta_1 \Delta logShortCost_{i,t} + \beta_2 \Delta Utilization_{i,t-1} + \beta_3 \Delta InstOwn_{i,t} + \varepsilon_{i,t} \quad (2.3)$$

$\Delta Utilization_{i,t}$ is the change in the average ratio of shares borrowed to shares lendable for stock *i* from month *t-1* to month *t*; $\Delta logShortCost_{i,t}$ is the change in the log of the value-weighted average shorting fee for stock *i* from month *t-1* to month *t*; $\Delta Utilization_{i,t-1}$ is the change in the lagged independent variable from month *t-2* to month *t-1* to control for lagged short momentum; and $\Delta InstOwn_{i,t}$ is the change in the percentage of shares owned by institutional investors of stock *i* from *t-1* to month *t*. The Bayes-adjusted critical t-value is ±2.65.

Panel A - Estimation Method with Period Fixed Effects				
Variable	Coefficient	Std. Error	t-statistic	p-value
C	0.0174	0.2701	0.06	0.9485
$\Delta logShortCost_{i,t}$	0.7307	0.2322	3.14	0.0017
$\Delta Utilization_{i,t-1}$	0.0060	0.0382	0.16	0.8745
$\Delta InstOwn_{i,t}$	17.069	5.8226	2.93	0.0034
Adj. R-square		0.09		
F-statistic		7.77		
Prob(F-statistic)		0.0000		
Durbin-Watson statistic		1.94		

Panel B - Dynamic System GMM Panel Model				
Variable	Coefficient	Std. Error	t-statistic	p-value
$\Delta logShortCost_{i,t}$	1.2771	0.1107	11.53	0.0000
$\Delta Utilization_{i,t-1}$	-0.0237	0.0171	-1.384	0.1664
$\Delta Utilization_{i,t-2}$	-0.1831	0.0146	-12.46	0.0000
$\Delta InstOwn_{i,t}$	43.278	1.3053	33.15	0.0000
J-statistic		160		

Table 2.5 Summary regression results for a test of the third hypothesis

This table reports the summary regression results for a test of our third alternative hypothesis that short-sellers can anticipate changes in governance so that they take the proper position prior to the change in the governance rating. A change in the governance level of a firm is thus negatively related to the preceding level of short interest. Panel A reports the results of the hypothesis tested by using a panel regression model with period fixed effects and White diagonal standard errors to account for clustering. Panel B reports the regression output for equation (2.4) estimated using a dynamic system GMM panel model. The regression model is:

$$Utilization_{i,t-1} = \beta_0 + \beta_1 \Delta GovR_{i,t} + \beta_2 logShortCost_{i,t-1} + \beta_3 Utilization_{i,t-2} + \beta_4 InstOwn_{i,t-1} + \varepsilon_{i,t} \quad (2.4)$$

$Utilization_{i,t-1}$ is the average ratio of shares borrowed to shares lendable for stock i for month *t-1*; $\Delta GovR_{i,t}$ is the change in the CGQ rating for stock i from month *t-1* to *t*; $logShortCost_{i,t-1}$ is the change in the log of the value-weighted average shorting fee for stock i from month *t-2* to month *t-1*; $Utilization_{i,t-2}$ is the independent variable used to control for lagged short momentum; and $InstOwn_{i,t-1}$ is the percentage of shares owned by institutional investors of stock i for month *t-1*. The sample is composed of 38,776 observations. The Bayes-adjusted critical t-value is ±3.25.

Panel A - Estimation Method with Period Fixed Effects				
Variable	Coefficient	Std. Error	t-statistic	p-value
C	-3.1505	0.1852	-17.01	0.0000
$\Delta GovR_{i,t}$	-0.0080	0.0042	-1.89	0.0588
$logShortCost_{i,t-1}$	1.4461	0.0444	32.51	0.0000
$Utilization_{i,t-2}$	0.8637	0.0030	277.37	0.0000
$InstOwn_{i,t-1}$	2.9603	0.1777	16.66	0.0000
Adj. R-square		0.84		
F-statistic		52,608		
Prob(F-statistic)		0.0000		
Durbin-Watson statistic		2.02		

Panel B - Dynamic System GMM Panel Model				
Variable	Coefficient	Std. Error	t-statistic	p-value
$\Delta GovR_{i,t}$	-0.0495	0.0142	-3.46	0.0005
$logShortCost_{i,t-1}$	0.5495	0.1286	4.27	0.0000
$Utilization_{i,t-2}$	0.5611	0.0154	36.2	0.0000
$Utilization_{i,t-3}$	-0.0287	0.0067	-4.26	0.0000
$InstOwn_{i,t-1}$	68.918	3.4795	19.80	0.0000
J-statistic		515		

Table 2.6 Summary regression results for asymmetry in short-seller reactions to governance changes

This table reports the summary regression results for a test of the presence of asymmetry in the reactions of short-sellers to changes in governance. Panel A reports the results of the hypothesis tested by using a panel regression model with period fixed effects and White diagonal standard errors. As a test of robustness, Panel B provides the regression output for equation (2.5) estimated using a dynamic system GMM panel model. The sample contains 38,746 observations. The regression estimated is:

$$\Delta Utilization_{i,t} = \beta_0 + \beta_1 \Delta logShortCost_{i,t} + \beta_2 \Delta Utilization_{i,t-1} + \beta_3 Pos\Delta GovR_{i,t} + \beta_4 Neg\Delta GovR_{i,t} + \beta_5 \Delta InstOwn_{i,t} + \varepsilon_{i,t} \quad (2.5)$$

$\Delta Utilization_{i,t}$ is the change in the average ratio of shares borrowed to shares lendable for stock *i* from month *t-1* to month *t*; $\Delta logShortCost_{i,t}$ is the log of the change in the value-weighted average shorting fee for stock *i* from month *t-1* to month *t*; $\Delta Utilization_{i,t-1}$ is the change in the lagged independent variable from month *t-2* to month *t-1* to control for lagged short momentum; $Pos\Delta GovR_{i,t}$ is the change in the CGQ rating for stock *i* from month *t-1* to *t* multiplied by a dummy variable that is equal to 1 if the change is positive and zero otherwise; $Neg\Delta GovR_{i,t}$ is the change in the CGQ rating for stock *i* from month *t-1* to *t* multiplied by a dummy variable that is equal to 1 if the change is negative and zero otherwise; and $\Delta InstOwn_{i,t}$ is the change in the percentage of shares owned by institutional investors of stock *i* from *t-1* to month *t*. The Bayes-adjusted critical t-value is ±3.25.

Panel A - Estimation Method with Period Fixed Effects				
Variable	Coefficient	Std. Error	t-statistic	p-value
C	-0.4012	0.0527	-7.60	0.0000
$\Delta logShortCost_{i,t}$	0.8606	0.0475	18.11	0.0000
$\Delta Utilization_{i,t-1}$	-0.0802	0.0095	-8.36	0.0000
$Pos\Delta GovR_{i,t}$	0.0197	0.0080	2.46	0.0137
$Neg\Delta GovR_{i,t}$	-0.0301	0.0091	-3.28	0.0010
$\Delta InstOwn_{i,t}$	11.890	1.7556	6.77	0.0000
Adj. R-square		0.06		
F-statistic		105		
Prob(F-statistic)		0.0000		
Durbin-Watson statistic		1.98		

Panel B - Dynamic System GMM Panel Model				
Variable	Coefficient	Std. Error	t-statistic	p-value
$\Delta logShortCost_{i,t}$	0.9421	0.1279	7.36	0.0000
$\Delta Utilization_{i,t-1}$	-0.0381	0.0078	-4.88	0.0000
$\Delta Utilization_{i,t-2}$	-0.0433	0.0059	-7.33	0.0000
$Pos\Delta GovR_{i,t}$	0.2098	0.0413	5.07	0.0000
$Neg\Delta GovR_{i,t}$	-0.0461	0.0103	-3.52	0.0004
$\Delta InstOwn_{i,t}$	43.805	10.011	4.37	0.0000
J-statistic		443		

Table 2.7 Summary regression results for asymmetry when positions of short-sellers anticipate governance changes

This table presents summary regression results for a test if asymmetry is also present when short-sellers change their short positions from month t-2 to t-1 in anticipation of a change in firm governance. The estimated regression is similar to regression model (2.5) but substitutes the change in lagged utilization as the dependent variable along with the corresponding independent variables. The regression model that is estimated is:

$$\Delta Utilization_{i,t-1} = \beta_0 + \beta_1 \Delta logShortCost_{i,t-1} + \beta_2 \Delta Utilization_{i,t-2} + \beta_3 Pos\Delta GovR_{i,t} + \beta_4 Neg\Delta GovR_{i,t} + \beta_5 \Delta InstOwn_{i,t-1} + \varepsilon_{i,t} \quad (2.6)$$

The variables are described in Table 2.6 and the Bayes-adjusted critical t-value is ±3.24. The results generated by using a panel regression model with period fixed effects and White diagonal standard errors are displayed in Panel A while those obtained with a dynamic system GMM panel model (for robustness purposes) are shown in Panel B.

Panel A - Estimation Method with Period Fixed Effects				
Variable	Coefficient	Std. Error	t-statistic	p-value
C	-0.4239	0.0251	-16.85	0.0000
$\Delta logShortCost_{i,t-1}$	-0.8880	0.0474	-18.72	0.0000
$\Delta Utilization_{i,t-2}$	0.0880	0.0101	8.63	0.0000
$Pos\Delta GovR_{i,t}$	0.0331	0.0065	5.01	0.0000
$Neg\Delta GovR_{i,t}$	-0.0533	0.0080	-6.65	0.0000
$\Delta InstOwn_{i,t-1}$	15.893	1.4902	10.66	0.0000
Adj. R-square		0.03		
F-statistic		104		
Prob(F-statistic)		0.0000		
Durbin-Watson statistic		2.05		

Panel B - Dynamic System GMM Panel Model				
Variable	Coefficient	Std. Error	t-statistic	p-value
$\Delta logShortCost_{i,t-1}$	1.0308	0.0931	11.06	0.0000
$\Delta Utilization_{i,t-2}$	-0.0466	0.0077	-6.01	0.0000
$\Delta Utilization_{i,t-3}$	-0.0325	0.0062	-5.16	0.0000
$Pos\Delta GovR_{i,t}$	-0.0073	0.0171	-0.42	0.6681
$Neg\Delta GovR_{i,t}$	-0.1768	0.0234	-7.53	0.0000
$\Delta InstOwn_{i,t-1}$	31.649	3.3799	9.36	0.0000
J-statistic		615		

Table 2.8 Summary regression results for a robustness test of whether the positions of short-sellers change prior to governance changes

This table reports the summary results for a test of robustness for the third hypothesis that short-sellers adopt a position in expectation of changes in governance. A sample of 37,677 events is used to test if the lagged excess in short-sale utilization is related to contemporaneous positive and negative changes in CGQ rating. The following regression model is estimated using a panel regression with period fixed-effects and White diagonal standard errors:

$$XsUtilization_{i,t-1} = \beta_0 + \beta_1 logShortCost_{i,t-1} + \beta_2 Utilization_{i,t-2}$$
$$+\beta_3 Pos\Delta GovR_{i,t} + \beta_4 Neg\Delta GovR_{i,t} + \beta_5 InstOwn_{i,t-1} + \varepsilon_{i,t} \quad (2.6)$$

$XsUtilization_{i,t-1}$ is the excess utilization for stock *i* for month *t-1*; $logShortCost_{i,t-1}$ is the log of the value-weighted average shorting fee for stock *i* for month *t-1*; $Utilization_{i,t-2}$ is the average ratio of shares borrowed to shares lendable for stock *i* for month *t-2; $Pos\Delta GovR_{i,t}$* is the change in the CGQ rating for stock *i* from month *t-1* to *t* multiplied by a dummy variable that is equal to 1 if the change is positive and zero otherwise; $Neg\Delta GovR_{i,t}$ is the change in the CGQ rating for stock *i* from month *t-1* to *t* multiplied by a dummy variable that is equal to 1 if the change in negative and zero otherwise; and $InstOwn_{i,t-1}$ is the percentage of the free float of stock *i* owned by institutional entities during month *t-1*. The Bayes-adjusted critical t-value is ±3.25.

Variable	Coefficient	Std. Error	t-statistic	p-value
C	-10.1374	0.2603	-38.93	0.0000
$logShortCost_{i,t-1}$	0.6936	0.0551	12.58	0.0000
$Utilization_{i,t-2}$	0.2529	0.0035	71.07	0.0000
$Pos\Delta GovR_{i,t}$	0.0207	0.0079	2.60	0.0091
$Neg\Delta GovR_{i,t}$	-0.0349	0.0081	-4.30	0.0000
$InstOwn_{i,t-1}$	2.6614	0.2385	11.15	0.0000
Adj. R-square		0.22		
F-statistic		2242		
Prob(F-statistic)		0.0000		
Durbin-Watson statistic		1.87		

Table 3.1. Sample sizes and attritions.

This table reports the size of the original and final datasets as well as the various reasons for the loss of observations. Each stock-month requires over twenty different types of data to be part of the sample. DC represents the intrinsic value output for the model detailed in Dechow *et al*. (2001). EA provides the same for Easton (2004), OJ for Ohlson and Juettner (2005), CT for Claus and Thomas (2001), LN for Lee *et al*. (2003) and AV is the average of all five models. The RRV model is used for tests of robustness and originates from Rhodes-Kropf, Robinson and Viswanathan (2004). Our final sample AVG (RRV) contains 41,468 (27,204) observations where 29,290 or 70.6% (16,622 or 61.1%) of the firm-months display positive mispricing and 12,178 or 29.4% (10,582 or 38.9%) observations show underpricing.

All data points are composed of one stock-month	Number of observations	
	lost	remaining
Original dataset		141,528
Missing at least one data entry for short-sales constraints	44,914	
Change in CUSIP/delisting	11,662	
Negative beta	9,380	
Illiquid stock or lack of market price	7,534	
Remaining observations before model evaluation		68,038
DC model sample		
Missing or negative book value	11,304	
Negative intrinsic value	6,312	
More than 100% deviation from mean $MP_{i,t}/IV^{DC}_{i,t}$ ratio or negative $IV^{DC}_{i,t}$	16,794	33,628
CT model sample		
Missing or negative book value	9,303	
Negative EPS estimates, dividend payout ratio, growth	8,360	
No analyst estimates for expected EPS, growth	18,524	
$r_e < g_{LT}$	19,828	
More than 100% deviation from mean $MP_{i,t}/IV^{CT}_{i,t}$ ratio or negative $IV^{CT}_{i,t}$	10,557	1,466
LN model sample		
Negative EPS estimates, dividend payout ratio, growth	8,360	
No analyst estimates for expected EPS, growth	18,524	
$0< g_{ST}, g_{LT} >100\%$	10,247	
$g_{ST} < g_{LT}$	21,321	
Trim more than 100% deviation from mean $MP_{i,t}/IV^{LN}_{i,t}$ ratio or negative $IV^{LN}_{i,t}$	7,176	2,410
OJ model sample		
Negative growth, dividend payout ratio	4,573	
$g_{ST} < g_{LT}$	14,405	
$r_e < g_{LT}$	19,828	
No analyst estimates for expected EPS, growth	18,524	
More than 100% deviation from mean $MP_{i,t}/IV^{OJ}_{i,t}$ ratio or negative $IV^{OJ}_{i,t}$	6,543	4,165
EA model sample		
Negative EPS estimates, dividend payout ratio	8,149	
No analyst estimates for expected EPS, growth	18,524	
$0< g_{ST}>100\%$	11,951	
More than 100% deviation from mean $MP_{i,t}/IV^{EA}_{i,t}$ ratio or negative $IV^{EA}_{i,t}$	15,974	13,440
Final Sample $IV^{Avg}_{i,t}$ (mean of all five models above)		**46,418**
RRV model intrinsic value		
Negative book values	699	
Change in industry or CUSIP	2,412	
Missing or incomplete fundamental data required for RRV model since 1995	9,088	
More than 100% deviation from mean $MP_{i,t}/IV^{RRV}_{i,t}$ ratio	7,015	
Final Sample $IV^{RRV}_{i,t}$ (model for robustness tests)		**27,204**

Table 3.2. Descriptive statistics for short-sales constraints, overpricing and excess overpricing.

This table provides basic statistics for the different types of tangible short-sales constraints as well as our results for overpricing and excess overpricing, calculated by using the tax loss offset assumption and the average of all five intrinsic value models (IV^{AVG}) as the fundamental price for panel A. The results for the Rhodes-Kropf, Robinson and Viswanathan (2004) model (IV^{RRV}) are reported in panel B. All the constraint variables are described in section 3.6. We use the tax loss offset assumption that supposes a trader can write off losses against other gains. SSP is the short-sale price, OP is the overpricing defined as $OP_{i,t} = SSP_{i,t} - IV_{i,t}$. XSOP is the excess overpricing after removing the tangible short-sales constraints from OP, $XSOP_{i,t} = SSP_{i,t} - IV_{i,t} - SSC_{i,t}^{T}$. The numbers in parentheses refer to the various statistics for the same data when expressed as a percentage of overpricing (SSCL, SSCTc, SSCTx and SSCT) or a percentage of the short sales price for OP and XSOP. N refers to the number of observations in the sample. The reduced sample excludes financial firms (SIC codes 6000-6999) and is shown for robustness purposes.

Panel A - IV^{AVG}	**All sample**			**Reduced sample (no financial industry)**		
	Mean	**Median**	**Std. Dev.**	**Mean**	**Median**	**Std. Dev.**
SSCL (% OP)	$0.0094 (0.50%)	$0.0022 (0.07%)	$0.0401	$0.0080 (0.68%)	$0.0021 (0.08%)	$0.0366
SSCTc (% OP)	$0.0620 (3.31%)	$0.0200 (0.69%)	$0.6654	$0.0473 (4.05%)	$0.0200 (0.80%)	$0.7377
SSCD (% OP)	$0.0036 (0.19%)	$0.0000 (0.00%)	$0.0608	$0.0025 (0.21%)	$0.0000 (0.00%)	$0.0066
SSCTx (% OP)	$0.5166(27.61%)	$0.8155 (27.96%)	$4.6292	$0.3204 (27.43%)	$0.6986 (27.89%)	$4.5808
SSCT (% OP)	$0.5915 (31.61%)	$0.8775 (30.08%)	$4.6339	$0.3781 (32.36%)	$0.7419 (29.70%)	$4.5687
OP (% SSP)	$1.8709 (6.39%)	$2.9170 (12.70%)	$16.1202	$1.1682 (4.04%)	$2.4979 (10.65%)	$15.9270
XSOP (% SSP)	$1.2794 (4.37%)	$2.0324 (8.84%)	$11.5255	$0.8524 (2.95%)	$1.7521 (6.50%)	$10.3787
SSP	$29.2589	$22.9654	$32.3430	$28.9152	$23.3778	$31.2331
N	41,468	41,468	41,468	32,342	32,342	32,342

Panel B - IV^{RRV}						
SSCL (% OP)	$0.0110 (0.30%)	$0.0027 (0.10%)	$0.0425	$0.0094 (0.49%)	$0.0026 (0.27%)	$0.0409
SSCTc (% OP)	$0.0712 (1.97%)	$0.0300 (1.12%)	$0.8162	$0.0525 (2.74%)	$0.0200 (2.07%)	$0.9244
SSCD (% OP)	$0.0042 (0.11%)	$0.0000 (0.00%)	$0.0741	$0.0029 (0.15%)	$0.0000 (0.00%)	$0.0833
SSCTx (% OP)	$1.0079(27.95%)	$0.7348 (27.49%)	$4.9155	$0.5320 (27.77%)	$0.2608 (27.06%)	$4.5503
SSCT (% OP)	$1.1699 (32.44%)	$0.8669 (34.48%)	$5.1487	$0.6524 (34.06%)	$0.3447 (35.77%)	$4.8120
OP (% SSP)	$3.6060 (11.38%)	$2.6730 (10.63%)	$17.2418	$1.9151 (6.03%)	$0.9636 (3.66%)	$15.9305
XSOP (% SSP)	$2.4361 (7.69%)	$1.8034 (7.17%)	$12.3740	$1.2627 (3.98%)	$0.6189 (2.35%)	$11.5062
SSP	$31.6667	$25.1419	$31.9281	$31.7249	$26.2821	$30.7220
N	27,204	27,204	27,204	20,423	20,423	20,423

Table 3.3. Summary regression results for the determinants of overpricing

This table reports the summary regression results for the determinants of absolute and relative before-tax overpricing calculated with our average of five intrinsic value models (IV^{AVG}) and, for robustness purposes, the Rhodes-Kropf, Robinson and Viswanathan (2005) model (IV^{RRV}). We use a panel EGLS regression with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariances to account for clustered errors. The variables are described in section 3.7.2.1 and the sample sizes are reported below. Specifically, we estimate:

$$OP_{i,t} \text{ or } \%OP_{i,t} = \beta_0 + \beta_1 BETA_{i,t-1} + \beta_2 CGQ_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 EPS_{i,t-1} + \beta_5 logMCAP_{i,t-1} + \beta_6 OPT_{i,t-1} + \beta_7 PE_{i,t-1} + \beta_8 IO_{i,t-1} + \beta_9 MB_{i,t-1} + \beta_{10} SSP_{i,t-1} + \beta_{11} SSC^T_{i,t-1} + \beta_{12} SSVOL_{i,t-1} + \beta_{13} UTIL_{i,t-1} + \beta_{14} SPXLVL_{t-1} + \beta_{15} SPXRET_{t-1} + \varepsilon_{i,t} \quad (3.7)$$

*, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level based on traditional critical t-values, while # indicates significance based on Bayes-adjusted critical t-values of ±3.12 and ±3.10 for the AVG and RRV models for OP and %OP, respectively.

Potential determinant	**Ind. lagged variable**	**AVG model (IV^{AVG})**		**RRV Model (IV^{RRV})**	
		$OP^{AVG}_{i,t}$	$\%OP^{AVG}_{i,t}$	$OP^{RRV}_{i,t}$	$\%OP^{RRV}_{i,t}$
Intercept	c	1.4280**	0.2303***,#	-5.1242**	-0.0697*
Systematic risk	BETA	0.0829	0.0078**	-0.1036	-0.0158***,#
Level of governance	CGQ	-0.0014	-0.0002***,#	0.0092	-0.0005***,#
Dividends	DIV	0.9258	-0.0036	1.2612	0.1878***
Earnings per share	EPS	0.1172	-0.0285***,#	-0.0518	-0.0036
Size (market capitalization)	logMCAP	-0.1029**	-0.0087***,#	0.4508**	0.0172***,#
Existence of options	*OPT*	-0.0839	-0.0015	0.1157	-0.0160
Price-earnings ratio	PE	0.0002	0.0001**	0.0004	0.0001
Institutional ownership %	IO	0.0111	-0.0966***,#	-1.1088	-0.1530***,#
Market-to-book ratio	MB	-0.0257***,#	-0.0055***,#	0.0975*	0.0070***,#
Short-sales price	SSP	-0.0307	0.0008**	0.0018	-0.0027***,#
Short-sales constraints	SSC^T	3.0895***,#	0.0510***,#	2.8533***,#	0.0547***,#
Short-sales volume (x 10^{-9})	SSVOL	0.0448	-0.0105***	-0.0711	0.0345***,#
Utilization	UTIL	0.0040	0.0001	0.0102	0.0004***
S&P index level (x 10^{-3})	SPXLVL	-0.0447	-0.0630	0.0016*	0.0610***,#
S&P index return	SPXRET	17.087***,#	0.3699***,#	15.689***,#	0.4349***,#
Adjusted R-squared		0.7953	0.4850	0.8078	0.5284
F-statistic (prob)		4414(0.000)	1070 (0.000)	4104 (0.000)	1096 (0.000)
Number of observations		17,036	17,036	14,659	14,659

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Table 3.4. Explanatory power for the subsets of determinants for before and after-tax OP^{AVG} and OP^{RRV}

This table reports the explanatory power (R^2 values) for subsets of the determinants of absolute and relative overpricing calculated with our average of five intrinsic value models and with the RRV model. Panel A refers to before-tax overpricing while panel B displays the results for after-tax mispricing. We use panel EGLS regressions with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariances to account for clustered errors. The firm-based subset is composed of the variables *BETA*, *CGQ*, *OPT* and *SSP* and the fundamentals subset of *DIV*, *EPS*, *logMCAP*, *PE*, *IO* and *MB*. The market-related predictor variables are *SSVOL*, *UTIL*, *SPXLVL* and *SPXRET*, and the tangible constraints are *SSCTx*, *SSCD*, *SSCL* and *SSCTc* except for panel B where the tax constraint is omitted. All independent variables are lagged one period and are defined in section 3.6 for the constraints and section 3.7.2.1 for all other variables. Specifically, we use variants of generic equation (3.7) for regressions of before- and after-tax $OP_{i,t}$ and $\%OP_{i,t}$ on each subset of independent variables and report the adjusted coefficients of determination.

	Panel A - Explanatory power (R^2) before-tax			
	AVG Model		RRV Model	
Subset of determinants	$OP_{i,t}^{AVG}$	$\%OP_{i,t}^{AVG}$	$OP_{i,t}^{RRV}$	$OP_{i,t}^{RRV}$
Firm-based	0.0334	0.0532	0.1542	0.0226
Fundamentals	0.0379	0.0701	0.1286	0.1040
Market-related	0.0044	0.0132	0.0239	0.0343
Tangible constraints	0.8434	0.3965	0.9414	0.4931

	Panel B - Explanatory power (R^2) after-tax			
	AVG Model		RRV Model	
Subset of determinants	$OP_{i,t}^{AVG}$	$\%OP_{i,t}^{AVG}$	$OP_{i,t}^{RRV}$	$OP_{i,t}^{RRV}$
Firm-based	0.0365	0.0549	0.1494	0.0222
Fundamentals	0.0380	0.0695	0.1318	0.1038
Market-related	0.0044	0.0133	0.0237	0.0340
Tangible constraints	0.0064	0.0003	0.0123	0.0057

Table 3.5. Summary regression results for the test of the second hypothesis

This table reports summary regression results for tests of the second alternative hypothesis, namely that overpricing increases as the tangible short-sales constraints increase for OP and %OP for the AVG and RRV models. The regression equations and the appropriate determinants for each sample are described in sections 3.7.3 and 3.7.4. The hypothesis is tested by estimating variants of regression (3.7) using a panel EGLS regression with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariances to account for clustered errors. The sample sizes are reported in the table below. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level based on traditional critical t-values, while # indicates significance based on Bayes-adjusted critical t-values of ±3.18 and ±3.12 for the AVG and RRV models for OP and %OP, respectively.

		AVG model (IV^{AVG})		RRV Model (IV^{RRV})	
	Ind. lagged variable	$OP_{i,t}^{AVG}$	$\%OP_{i,t}^{AVG}$	$OP_{i,t}^{RRV}$	$\%OP_{i,t}^{RRV}$
Intercept	c	0.2431 **	0.2527$^{***,\#}$	0.2464 **	0.0356
Systematic risk	BETA				-0.0171$^{***,\#}$
Level of governance	CGQ		-0.0002$^{***,\#}$		-0.0003$^{***,\#}$
Earnings per share	EPS		-0.0164$^{***,\#}$		
Size (market capitalization)	logMCAP		-0.0108$^{***,\#}$		0.0091$^{***,\#}$
Institutional ownership %	IO		-0.0923$^{***,\#}$		-0.1569$^{***,\#}$
Market-to-book ratio	MB	-0.0425$^{***,\#}$	-0.0052$^{***,\#}$		-0.0058$^{***,\#}$
Short-sales price	SSP				-0.0030$^{***,\#}$
Taxes SSC	SSC^{Tx}	3.1749$^{***,\#}$	0.0511$^{***,\#}$	3.3748$^{***,\#}$	0.0648$^{***,\#}$
Lending fee SSC	SSC^{L}	1.6226	-0.0062	0.4857	0.0368
Dividends SSC	SSC^{D}	0.7339***	0.0400$^{***,\#}$	0.3961	0.0735
Transaction cost SSC	SSC^{Tc}	0.2363$^{***,\#}$	0.0324$^{***,\#}$	0.4857$^{***,\#}$	0.0286$^{***,\#}$
Short-sales volume (x $10^{-9)}$	SSVOL				0.0405$^{***,\#}$
S&P index level	SPXLVL				0.4154$^{***,\#}$
S&P index return	SPXRET	14.447$^{***,\#}$	0.3761$^{***,\#}$	14.719$^{***,\#}$	0.1569$^{***,\#}$
Adjusted R-squared		0.8365	0.4866	0.9415	0.5862
F-statistic (prob)		21528(0.00)	1626(0.00)	77409(0.00)	1829(0.00)
Number of observations		25,250	17,151	24,070	16,778
Bayes-adjusted critical t-values		±3.18	±3.12	±3.18	±3.12

Table 3.6. Test of robustness for the second hypothesis

This table reports summary regression results for a test of robustness of the second alternative hypothesis, namely that overpricing increases as the tangible short-sales constraints increase for after-tax mispricing, which are calculated using our average of five intrinsic value models and the RRV model. After-tax (Atax) overpricing is defined as $AtaxOP_{i,t} = BtaxOP_{i,t} - SSC_{i,t}^{Tx}$, the before-tax (*Btax*) overpricing for stock *i* at time *t* minus the taxes payable for that same stock-month. We use the tax-loss offset assumption. The equations and the appropriate determinants for each regression are described in section 3.7.5. All regressors are lagged one period. The hypothesis is tested by estimating variants of equation (3.7) using a panel EGLS regression with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariances to account for clustered errors. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 level based on traditional critical t-values, while # indicates significance based on Bayes-adjusted critical t-values of ±3.18 and ±3.12 for the AVG and RRV models for OP and %OP, respectively.

		AVG model (IV^{AVG})		RRV Model (IV^{RRV})	
	Ind. lagged variable	$ATAXOP_{i,t}^{AV}$	$\%ATAXOP_{i,t}^{AVG}$	$ATAXOP_{i,t}^{RRV}$	$\%ATAXOP_{i,t}^{RRV}$
Intercept	c	2.1002 **	0.3348$^{***,\#}$	2.1413$^{***,\#}$	-0.1726
Systematic risk	BETA				-0.0161$^{***,\#}$
Level of governance	CGQ		-0.0003$^{***,\#}$		-0.0008$^{***,\#}$
Earnings per share	EPS		-0.0103$^{***,\#}$		
Size (market capitalization)	logMCAP		-0.0216$^{***,\#}$		0.0258$^{***,\#}$
Institutional ownership %	IO		-0.1047$^{***,\#}$		-0.2566$^{***,\#}$
Market-to-book ratio	MB	-0.3160$^{***,\#}$	-0.0071$^{***,\#}$		-0.0094$^{***,\#}$
Short-sales price	SSP				-0.0007$^{***,\#}$
Lending fee SSC	SSC^{L}	9.2965 $^{***,\#}$	0.0929**	31.368$^{***,\#}$	0.3600 $^{***,\#}$
Dividends SSC	SSC^{D}	1.4604**	0.0485$^{***,\#}$	4.6600*	0.0851
Transaction cost SSC	SSC^{Tc}	1.2671$^{***,\#}$	0.0018**	0.0979	0.0034$^{***,\#}$
Short-sales volume (x 10^{-9})	SSVOL				0.0465$^{***,\#}$
S&P index level	SPXLVL				0.0001$^{***,\#}$
S&P index return	SPXRET	1.4641	0.1201**	3.2450	0.1068***
Adjusted R-squared		0.0308	0.0727	0.0122	0.1312
F-statistic (prob)		159 (0.000)	149 (0.000)	75(0.000)	212(0.000)
Number of observations		25,250	17,151	24,070	16,778
Bayes-adjusted critical t-values		±3.18	±3.12	±3.18	±3.12

Table 4.1. Summary statistics of the top and bottom deciles of events and the complete sample

This table reports the monthly mean values for the characteristics of the complete sample and our four key deciles for the AVG and RRV models. The deciles AI and AX contain the top and bottom trades when the complete sample is ranked by mean absolute excess overpricing (XSOP) while RI and RX represent the same when classified by relative excess overpricing (%XSOP). The numbers in parentheses refer to the values using the RRV model. The variables are as described in sections 4.5.1 and 4.5.2. We compare the different attributes for each pair of portfolios (AI and AX, RI and RX) using a one-tail t-test with the null hypothesis that the difference is greater or smaller than 0 depending on the variable tested.

	Top decile portfolios		**Bottom decile portfolios**		**T-test significance level AVG (RRV)**				**Complete sample AVG (RRV)**
Firm-specific attributes	Portfolio AI AVG (RRV)	Portfolio RI AVG (RRV)	Portfolio AX AVG (RRV)	Portfolio RX AVG (RRV)	$\mu_{AI}>\mu_{AX}$	$\mu_{AI}<\mu_{AX}$	$\mu_{RI}>\mu_{RX}$	$\mu_{RI}<\mu_{RX}$	
Absolute excess overpricing	$15.33 ($20.88)	$9.02 ($12.98)	-$13.66 (-$13.22)	-$11.98 (-$9.90)	*** (***)		*** (***)		$2.11 ($2.39)
Relative excess overpricing	28.06% (32.62%)	33.35% (40.47%)	-28.56% (-32.51%)	-32.51% (-39.12%)	*** (***)		*** (***)		9.87% (6.04%)
Systematic risk - beta	1.10 (1.12)	1.15 (1.18)	1.01 (1.03)	1.10 (1.16)	*** (***)		*** *(Insignif.)*		1.15
Level of governance - CGQ	49.35 (49.65)	52.67 (51.32)	56.42 (55.69)	55.01 (54.10)	*** (***)		*** (**)		52.77
Dividends	$0.051 ($0.076)	$0.027 ($0.050)	$0.049 ($0.028)	$0.038 ($0.017)	*Insignif.* (***)		(***)	***	$0.033
Earnings per share	$2.99 ($3.44)	$1.36 ($1.77)	$2.81 ($2.43)	$1.97 ($1.33)	*** (***)		*** (***)		$1.55
Size - mkt cap. millions	$3474 ($3490)	$2545 ($3206)	$7282 ($9033)	$6683 ($8144)	** (***)		*** (***)		$4665
Book value per share	*$21.51* *($23.20)*	$16.30 ($17.13)	$19.79 ($19.40)	$13.37 ($14.12)	** (***)		*** (***)		$16.17
Price-earnings ratio	27.49 (26.28)	24.63 (21.07)	21.48 (25.97)	19.58 (20.90)	*** *(Insignif.)*		*** *(Insignif.)*		15.91
Institutional ownership	75.94% (75.43)	69.36% (71.78%)	79.89% (82.58%)	78.94% (76.60%)		*** (***)		*** (***)	71.38%
Market-to-book ratio	1.91 (2.03)	1.72 (1.85)	3.18 (3.02)	2.87 (2.10)		*** (***)		*** (***)	1.86
Utilization	23.94% (23.51%)	24.22% (26.72%)	22.41% (23.43%)	23.81% (23.44%)	*** *(Insignif.)*		*Insignif.* (***)		23.60%
Trading volume - millions	28.12 (30.94)	22.52 (30.14)	65.28 (57.58)	67.43 (72.36)		*** (***)		*** (***)	40.72
Market-wide attributes									
S&P 500 monthly return	-0.19%	-0.40%	0.30%	0.39%		***		***	-0.15%
Volatility (S&P VIX)	22.07	23.07	22.73	24.33	*Insignif.*	*Insignif.*		***	24.85
Market sentiment	0.057	0.042	0.034	0.007	*		***		0.017
Existence of options	0.851	0.807	0.974	0.953		***		***	0.841

Table 4.2. Summary regression results for the determinants of excess overpricing.
This table reports the summary regression results for the determinants of absolute and relative excess overpricing ($XSOP_{i,t}$ and $\%XSOP_{i,t}$, respectively) using a panel EGLS regression with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariances. The variables are described in section 5.2. The regression model is:

$$XSOP_{i,t}\ or\ \%XSOP_{i,t} = \beta_0 + \beta_1 BETA_{i,t} + \beta_2 CGQ_{i,t} + \beta_3 DIV_{i,t}$$
$$+\beta_4 logMCAP_{i,t} + \beta_5 OPT_{i,t} + \beta_6 IO_{i,t} + \beta_7 VWAF_{i,t} + \beta_8 SPXRET_t + \beta_9 SPXVIX_t + \beta_{10} SSVOL_{i,t} + \beta_{11} SSP_{i,t} + \varepsilon_{i,t} \quad (6)$$

*, * and *** indicate significance at the 0.10, 0.05 and 0.01 levels based on traditional critical t values. # indicates significance based on a Bayes-adjusted critical t-value of ± 3.12 (AVG) and ± 3.10 (RRV) to account for the effect of a large sample size on standard errors. AVG refers to the data calculated using our composite valuation model while RRV denotes the same using the model developed by Rhodes-Kropf, Robinson and Viswanathan (2004, 2005).

		Panel EGLS Method				**Dynamic Panel System GMM Method**			
Potential Determinant	Lagged Ind. Variable	AVG $XSOP_{i,t}$	AVG $\%XSOP_{i,t}$	RRV $XSOP_{i,t}$	RRV $\%XSOP_{i,t}$	AVG $XSOP_{i,t}$	AVG $\%XSOP_{i,t}$	RRV $XSOP_{i,t}$	RRV $\%XSOP_{i,t}$
Intercept or (%)XSOP$_{t-2}$	c	9.9038$^{***,\#}$	0.3470$^{***,\#}$	-5.9840$^{***,\#}$	-0.0183$^{***,\#}$	4.7554$^{***,\#}$	0.6641$^{***,\#}$	-3.2225$^{***,\#}$	-0.0431$^{***,\#}$
Systematic risk	BETA	0.7360$^{***,\#}$	0.0185$^{***,\#}$	0.3148	0.0163$^{***,\#}$	0.9879$^{***,\#}$	0.0703$^{***,\#}$	0.5697$^{***,\#}$	0.0499$^{***,\#}$
Level of governance	CGQ	-0.0105$^{***,\#}$	-0.0003$^{***,\#}$	-0.0309$^{***,\#}$	-0.0008$^{***,\#}$	-0.1170$^{***,\#}$	-0.0006$^{***,\#}$	-0.1264$^{***,\#}$	-0.0005$^{***,\#}$
Dividends	DIV	2.0991	-0.0145	0.2204	0.1184**	3.4948*	-0.0194**	-0.6452*	-0.0086*
Size (mkt capitalization)	logMCAP	-0.8551$^{***,\#}$	-0.0203$^{***,\#}$	-1.2619$^{***,\#}$	-0.0318$^{***,\#}$	-0.7081$^{***,\#}$	-0.0056$^{***,\#}$	-1.3604$^{***,\#}$	-0.0048$^{***,\#}$
Existence of options	OPT	-1.6977$^{***,\#}$	-0.0352$^{***,\#}$	-1.6734$^{***,\#}$	-0.0339$^{***,\#}$				
Institutional ownership	IO	-0.2953	-0.0687$^{***,\#}$	-0.5128$^{***,\#}$	-0.1120$^{***,\#}$	-0.7106$^{***,\#}$	-0.0816$^{***,\#}$	-0.7188$^{***,\#}$	-0.0988$^{***,\#}$
Lending fee	VWAF	0.0004	0.0001	-0.0020**	0.0001***	0.0015***	0.0002**	0.0011***	0.0001***
S&P 500 index return	SPXRET	2.1271	0.0930***	2.1460	0.0094	2.487$^{***,\#}$	0.3890**	1.728***	0.2870*
S&P index volatility VIX	SPXVIX	-0.0066	-0.0004***	-0.0569$^{***,\#}$	-0.0021$^{***,\#}$	-0.0469$^{***,\#}$	-0.0001$^{***,\#}$	-0.0807$^{***,\#}$	-0.0006$^{***,\#}$
Short-sales volume (x 10^{-12})	SSVOL	4.2901$^{***,\#}$	0.0023	8.8256$^{***,\#}$	0.4416$^{***,\#}$	7.3124$^{***,\#}$	0.3517$^{***,\#}$	6.2527$^{***,\#}$	0.1785$^{***,\#}$
Short-sales price	SSP	-0.0093	0.0007$^{***,\#}$	0.1305$^{***,\#}$	0.0007$^{***,\#}$	0.0598$^{***,\#}$	0.0001$^{***,\#}$	0.3762$^{***,\#}$	0.0008$^{***,\#}$
Adjusted R-squared		0.0365	0.0799	0.1671	0.1074				
F-stat or J-stat (prob)		59(0.000)	135(0.000)	270(0.000)	162(0.000)	698	706	642	670
Number of observations		17,215	17,215	14,813	14,813	17,215	17,215	14,813	14,813

Table 4.3. Ex-Post Returns.

This table provides the details of the 15, 30, 45 and 60-day mean and median ex-post returns for our complete sample and four key deciles. We calculate the actual monthly-equivalent returns for each of the described holding periods and verify if the returns for period t are higher than that of period $t+1$. The asterisks indicate the level of significance ($r_t > r_{t+1}$) for the one-tail t-test of equality of the means and the Wilcoxon signed rank test for the medians. The moniker AVG refers to the data calculated using our composite valuation model while RRV denotes the same using the model developed by Rhodes-Kropf, Robinson and Viswanathan (2004, 2005).

	Top Deciles				**Bottom Deciles**				**Complete Sample**
	AVG XSOP (AI)	AVG %XSOP (RI)	RRV XSOP (AI)	RRV %XSOP (RI)	AVG XSOP (AX)	AVG %XSOP (RX)	RRV XSOP (AX)	RRV %XSOP (RX)	AVG
15 day holding period mean gross profit (median)	$1.05 ($0.61)	$0.89 ($0.49)	$1.08 ($0.63)	$0.69 ($0.32)	$0.10 (-$0.02)	-$0.09 (-$0.11)	$0.05 ($0.01)	-$0.01 ($0.01)	$0.29 ($0.15)
Mean monthly return (median)	4.11% *** (2.57%)***	7.05% *** (4.80%)***	3.40% *** (2.33%)***	3.90% *** (2.57%)***	-0.11% *** (-0.10%)***	-1.53% *** (-0.78%)***	0.25% *** (0.09%)*	-0.33% (0.07%)	1.84% *** (1.54%) ***
30 day holding period mean gross profit (median)	$1.59 ($1.04)	$1.39 ($0.84)	$1.38 ($0.72)	$0.91 ($0.40)	-$0.28 (-$0.31)	-$0.47 (-$0.33)	-$0.06 (-$0.04)	-$0.09 (-$0.05)	$0.31 ($0.15)
Mean monthly return (median)	2.99% *** (2.29%)***	5.47% *** (4.19%)***	2.10% *** (1.29%)***	2.30% *** (1.95%)***	-0.88% ** (-0.76%)***	-2.39% ** (-1.38%)**	-0.09% (-0.14%)	-0.59% (-0.24%)	0.76% *** (0.77%) ***
45 day holding period mean gross profit (median)	$2.02 ($1.27)	$1.83 ($1.07)	$1.53 ($0.73)	$1.03 ($0.50)	-$0.76 (-$0.69)	-$0.93 (-$0.64)	-$0.23 (-$0.17)	-$0.21 (-$0.09)	$0.25 ($0.10)
Mean monthly return (median)	2.48% * (1.88%)*	4.77% *** (3.66%)**	1.48% (0.84%)	1.54% * (1.37%)**	-1.27% (-1.01%)	-2.81% (-1.78%)	-0.31% (-0.29%)	-0.82% (-0.41%)	0.22% ** (0.33%) *
60 day holding period mean gross profit (median)	$2.39 ($1.50)	$2.09 ($1.27)	$1.74 ($0.81)	$1.22 ($0.56)	-$0.96 (-$0.83)	-$1.14 (-$0.84)	-$0.29 (-$0.27)	-$0.31 (-$0.19)	$0.29 ($0.11)
Mean monthly return (median)	2.15% (1.77%)	4.05% (3.21%)	1.27% (0.82%)	1.23% (1.24%)	-1.17% (-0.98%)	-2.55% (-1.62%)	-0.39% (-0.39%)	-0.88% (-0.54%)	0.12% (0.29%)

Table 4.4. Summary regression results for the tests of all hypotheses.

This table reports summary regression results for a test of all seven alternative hypotheses, namely that excess overpricing is positively related to the recall risk as proxied by lagged utilization, to market opacity and search frictions as proxied by the lagged borrower/lender ratio, to firm-based restrictive tactics as proxied by $PROBF_{i,t-1}$, to the existence of the uptick rule and to lagged market sentiment while being negatively related to lagged institutional ownership and the existence of an options market for the stock. AVG refers to the data calculated using our composite valuation model while RRV denotes the same using the model developed by Rhodes-Kropf, Robinson and Viswanathan (2004, 2005). The hypotheses are tested by estimating the following panel EGLS regressions with period random effects, Swamy and Arora component variances and White diagonal standard errors and covariance for the sample sizes reported below:

$$XSOP_{i,t} \text{ or } \%XSOP_{i,t} = \beta_0 + \beta_1 UTIL_{i,t-1} + \beta_2 IO_{i,t-1} + \beta_3 BLNDR_{i,t-1} + \beta_4 UPT_{t-1} + \beta_5 SENT_{t-1} + \beta_6 PROBF_{i,t-1} + \beta_7 OPT_{i,t-1} + \beta_8 CGQ_{i,t-1} + \beta_9 BETA_{i,t-1} + \beta_{10} SPXVIX_{t-1} + \beta_{11} SSP_{t-1} + \varepsilon_{i,t} \quad (4.7)$$

The variables and sample sizes are described in section 4.6.2. *, * and *** indicate significance at the 0.10, 0.05 and 0.01 levels based on traditional t values. # indicates significance based on a Bayes-adjusted critical t-value of ±3.12 and ±3.10 to account for the effect of a large sample size on standard errors.

				Panel EGLS Method				Dynamic Panel System GMM Method			
	Lagged Ind. Variable	AVG VIF	RRV VIF	AVG $XSOP_{i,t}$	AVG $\%XSOP_{i,t}$	RRV $XSOP_{i,t}$	RRV $\%XSOP_{i,t}$	AVG $XSOP_{i,t}$	AVG $\%XSOP_{i,t}$	RRV $XSOP_{i,t}$	RRV $\%XSOP_{i,t}$
Intercept or lagged (%)XSOP	c, (%)XSOP	8.91	6.87	5.9743	0.2594$^{***,\#}$	-0.5283	-0.1218$^{***,\#}$	0.7443$^{***,\#}$	0.6227$^{***,\#}$	-0.1898$^{***,\#}$	-0.3172$^{***,\#}$
Utilization	UTIL	2.50	4.08	0.0053***	0.0003$^{***,\#}$	0.0344$^{***,\#}$	0.0009$^{***,\#}$	0.0741$^{***,\#}$	0.0003$^{***,\#}$	0.2872$^{***,\#}$	0.0001$^{***,\#}$
Institutional ownership	IO	4.31	7.92	0.3877*	-0.0429$^{***,\#}$	-7.4658$^{***,\#}$	-0.2796$^{***,\#}$	-2.3851$^{***,\#}$	-0.1530$^{***,\#}$	-0.1570***	-0.0302$^{***,\#}$
Borrower/ lender ratio	BLNDR	2.54	3.82	0.0025***	0.0001	0.0013***	0.0001$^{***,\#}$	0.0067$^{***,\#}$	0.0002$^{***,\#}$	0.0002$^{***,\#}$	0.0001$^{***,\#}$
Uptick rule	UPT	2.40	2.70	-0.3496	-0.0154*	0.0340	-0.0016**				
Investor sentiment	SENT	1.54	1.56	-0.1966***	-0.0052	1.1472***	0.0260$^{***,\#}$	3.4528$^{***,\#}$	0.0385$^{***,\#}$	3.7876$^{***,\#}$	0.0047$^{***,\#}$
Prob. of firm-based tactics	PROBF	2.66	7.95	6.6069$^{***,\#}$	0.2294$^{***,\#}$	8.4571$^{***,\#}$	0.2709$^{***,\#}$	12.5283$^{***,\#}$	0.5156$^{***,\#}$	2.0431$^{***,\#}$	0.3760$^{***,\#}$
Existence of option	OPT	3.49	8.85	-0.7003***	0.0111***	-2.1354$^{***,\#}$	-0.0608$^{***,\#}$				
Level of governance	CGQ	1.91	4.42	-0.0090$^{***,\#}$	-0.0003$^{***,\#}$	-0.0317$^{***,\#}$	-0.0008$^{***,\#}$	-0.1023$^{***,\#}$	-0.0004$^{***,\#}$	-0.1281$^{***,\#}$	-0.0003$^{***,\#}$
Systematic risk	BETA	2.51	5.31	0.5560$^{***,\#}$	0.0123$^{***,\#}$	-0.2494	0.0149***	1.8674$^{***,\#}$	0.0472$^{***,\#}$	0.5277$^{***,\#}$	0.0294$^{***,\#}$
S&P 500 index volatility	SPXVIX	7.89	9.02	-0.0197***	-0.0009$^{***,\#}$	-0.0367$^{***,\#}$	-0.0016$^{***,\#}$	-0.0341$^{***,\#}$	-0.0015$^{***,\#}$	0.0296$^{***,\#}$	-0.0013$^{***,\#}$
Short-sales price	SSP	1.40	2.26	0.0013	0.0003$^{***,\#}$	0.1219$^{***,\#}$	0.0004$^{***,\#}$	0.0369$^{***,\#}$	0.0003$^{***,\#}$	0.3833$^{***,\#}$	0.0006$^{***,\#}$
Adjusted R-squared				0.0475	0.1236	0.1645	0.1056				
F-stat. (prob)or J-stat.				79(0.000)	221(0.000)	265(0.000)	156(0.000)	692	691	641	640
Number of observations				17,215	17,215	14,813	14,813	17,215	17,215	14,813	14,813

Table 4.5. Summary regression results for the robustness tests of all hypotheses.

This table reports summary regression results for the robustness tests for all seven alternative hypotheses as described in section 6.1 AVG refers to the data calculated using our composite valuation model while RRV denotes the same using the model developed by Rhodes-Kropf, Robinson and Viswanathan (2004, 2005). The hypotheses are tested by estimating the following regressions with panel EGLS period random effects, Swamy and Arora component variances and White diagonal standard errors and covariances for the reduced sample NOFIN (excludes financial firms, SIC code 6000-6999) and the complete sample using the Fama MacBeth approach:

$$XSOP_{i,t} \text{ or } \%XSOP_{i,t} = \beta_0 + \beta_1 UTIL_{i,t} + \beta_2 IO_{i,t} + \beta_3 BLNDR_{i,t} + \beta_4 UPT_t + \beta_5 SENT_t + \beta_6 PROBF_{i,t} + \beta_7 OPT_{i,t} + \beta_8 CGQ_{i,t} + \beta_9 BETA_{i,t} + \beta_{10} SPXRET_t + \beta_{11} SPXRET_{t-1} + \varepsilon_{i,t} \quad (4.7)$$

The variables and sample sizes are described in section 4.6.2. *, * and *** indicate significance at the 0.10, 0.05 and 0.01 levels based on traditional t values. # indicates significance based on a Bayes-adjusted critical t-value of ± 3.12 (AVG) and ± 3.10 (RRV) to account for the effect of a large sample size on standard errors.

		NoFIN Panel EGLS Method				**Fama MacBeth Method**			
Potential Determinant	Lagged Ind. Variable	AVG $XSOP_{i,t}$	AVG $\%XSOP_{i,t}$	RRV $XSOP_{i,t}$	RRV $\%XSOP_{i,t}$	AVG $XSOP_{i,t}$	AVG $\%XSOP_{i,t}$	RRV $XSOP_{i,t}$	RRV $\%XSOP_{i,t}$
Intercept	c	6.2546***,#	0.2391***,#	-2.1235***,#	-0.1622***,#	4.4979	0.2305	-0.8585	-0.0666
Utilization	UTIL	0.0101**	0.0003***,#	0.0282***,#	0.0004***	0.0140	0.0004	0.0251	0.0007
Institutional ownership	IO	-1.3682***,#	-0.0003***	-0.8142**	0.0123	-0.0613	-0.0366	-0.8506	-0.3189
Borrower/ lender ratio	BLNDR	0.0014**	0.0001	0.0058***,#	0.0002***,#	0.0014	0.0001	0.0002	0.0001
Uptick rule	UPT	-0.6062*	-0.0221	-0.0848	0.0014				
Investor sentiment	SENT	-0.5752	-0.0125	0.9716***	0.0253***				
Prob. of firm-based tactics	PROBF	6.4600***,#	0.2552***,#	10.740***,#	0.3393***,#	6.5761	0.2151	8.5599	0.2373
Existence of option	OPT	-0.7648***	0.0151***	-0.6622	-0.0324***	-0.8425	-0.0178	-0.7412	-0.0296
Level of governance	CGQ	-0.0118***,#	-0.0004***,#	-0.0350***,#	-0.0008***,#	-0.0077	-0.0003	-0.0275	-0.0009
Systematic risk	BETA	0.5891***,#	0.0094***	0.5116***	0.0304***,#	0.6414	0.0079	0.6994	0.0183
S&P 500 index volatility	SPXVIX	-0.0267	-0.0009***	-0.0457***,#	-0.0017***,#				
Short-sales price (lag)	SSP	0.0299	0.0002***,#	0.07807***,#	0.0003***,#	0.0170	0.0003	0.1127	0.0007
Adjusted R-squared		0.0365	0.0799	0.1671	0.1074				
F-stat (prob)		79(0.000)	160(0.000)	174(0.000)	127(0.000)				
Number of observations		12,994	12,994	11,566	11,566	17,215	17,215	14,813	14,813

Table A.1. Summary details of the results for the intrinsic value models estimations

This table provides summary details from the five intrinsic value models. DC represents the intrinsic value output for stock *i* and month *t* for the model detailed in Dechow *et al*. (2001). EA provides the same for Easton (2004), OJ for Ohlson and Juettner (2005), CT for Claus and Thomas (2001) and LN for Lee *et al*. (2003). AV is the average of all five models. RRV refers to Rhodes-Kropf, Robinson and Viswanathan (2005) and is illustrated for robustness purposes. The datasets contain 33,628 (DC), 13,440 (EA), 4,165 (OJ), 1,466 (CT), 2,410 (LN), 46,418 (AV) and 27,204 (RRV) observations, respectively.

Model	Correlation Coefficient with Market Price	Mean of $\%OP_{i,t}$	Standard Deviation of $\%OP_{i,t}$	Feasibility Portion of Sample
DC	0.94	17.4%	28.8%	0.73
EA	0.90	-23.9%	39.5%	0.29
OJ	0.81	-9.1%	40.9%	0.09
CT	0.77	-4.4%	38.4%	0.03
LN	0.81	-2.9%	41.0%	0.05
AV	0.89	6.4%	35.0%	1.00
RRV	0.85	11.4%	42.2%	0.59

Table B.1. Excess overpricing by industry (proportion) for our four key deciles .
This table reports the top ten industries by proportion of events in each of our AVG key deciles. The aggregate of all short-sales for a specific stock *i* and month *t* are considered a single event and the values of XSOP and %XSOP represent the mean excess overpricing of the short trades for that specific stock-month. The percentages reported represent the event ratio obtained by calculating the number of industry events in the specific decile (AI, AX, RI or RX) over the same for the complete sample. The number of events is in brackets below the ratio. For example, 78.3% of all tobacco events in our sample are in the bottom decile AX.

Top decile						Bottom decile					
As ranked by XSOP (AI)			As ranked by %XSOP (RI)			As ranked by XSOP (AX)			As ranked by %XSOP (RX)		
Industry	Proportion of industry events (# events)	XSOP (%XSOP)	Industry	Proportion of industry events (# events)	XSOP (%XSOP)	Industry	Proportion of industry events (# events)	XSOP (%XSOP)	Industry	Proportion of industry events (# events)	XSOP (%XSOP)
Maritime	57.9% (11)	\$11.64 (31.6%)	Water Utility	44.3% (47)	\$7.74 (33.5%)	Tobacco	78.3% (18)	-\$37.06 (-50.6%)	Tobacco	43.5% (10)	-\$49.56 (-66.6%)
Railroad	34.4% (55)	\$14.65 (31.1%)	Maritime	36.8% (7)	\$12.49 (32.9%)	Aerospace/Def.	40.4% (184)	-\$29.35 (-43.7%)	Educational Services	40.3% (31)	-\$28.18 (-73.5%)
Metals & Mining (Div.)	34.0% (16)	\$17.38 (28.3%)	Railroad	23.7% (38)	\$14.18 (33.6%)	Precious Metals	40.0% (16)	-\$19.51 (-39.8%)	Telecom. Utility	34.3% (24)	-\$8.73 (-62.5%)
Newspaper	31.7% (26)	\$121.31 (23.5%)	Toiletries/Cosmetics	23.5% (25)	\$10.64 (33.4%)	Educational Services	37.7% (29)	-\$30.76 (71.0%)	Information Services	26.2% (51)	-\$33.92 (-69.8%)
Petroleum (Integrated)	31.5% (47)	\$17.35 (23.4%)	Advertising	23.4% (26)	\$11.11 (33.1%)	Beverage	37.1% (49)	-\$26.72 (-46.2%)	IT Services	25.7% (55)	-\$21.57 (-73.6%)
Insurance (Prop/Cas.)	27.9% (43)	\$35.26 (21.5%)	Coal	23.0% (6)	\$9.92 (33.3%)	Securities Brokerage	35.9% (28)	-\$60.18 (-42.8%)	Drug	25.1% (114)	-\$19.14 (-65.9%)
Telecom. Utility	24.3% (17)	\$12.93 (28.9%)	Educational Services	19.4% (15)	\$4.38 (33.1%)	Information Services	34.4% (67)	-\$29.38 (-60.7%)	Aerospace / Defense	23.3% (106)	-\$35.59 (-58.9%)
Coal	23.1% (6)	\$11.90 (31.2%)	Metals & Mining (Div.)	19.1% (9)	\$14.10 (33.2%)	Chemical (Basic)	33.3% (10)	-\$16.58 (-33.1%)	Restaurant	22.3% (75)	-\$18.09 (-60.9%)
Building Materials	22.7% (45)	\$13.11 (29.1%)	R.E.I.T.	17.2% (76)	\$7.96 (33.1%)	IT Services	28.0% (60)	-\$23.59 (-60.4%)	Med Supp Invasive	21.8% (108)	-\$24.90 (-61.4%)
Homebldg	22.0% (50)	\$28.88 (28.4%)	Building Materials	17.1% (34)	\$9.82 (33.1%)	Internet	27.8% (81)	-\$100.01 (-50.9%)	Internet	21.0% (61)	-\$98.66 (-65.2%)

Figure 3.1. Excess overpricing indexes (absolute and relative) versus market index (absolute and relative)

The period of June 2006 to December 2010 is depicted in both figures for equally weighted indexes. The top figure shows the time series of the mean excess overpricing index XSOP^{IND} overlaid with the lagged S&P 500 monthly closing prices. Excess overpricing is defined as the difference between the short-sales price and the sum of the expected value of stock i for month t and the corresponding tangible short-sales constraints, $\text{XSOP}_{i,t} = \text{SSP}_{i,t} - \text{IV}_{i,t} - SSC_{i,t}^{T}$. The bottom figure depicts the time series of mean relative or percentage excess overpricing index %XSOP^{IND} for each month included in our sample, overlaid with the lagged S&P 500 monthly returns. Percent excess overpricing is given by: $\%\text{XSOP}_{i,t} = \text{XSOP}_{i,t} / \text{SSP}_{i}$.

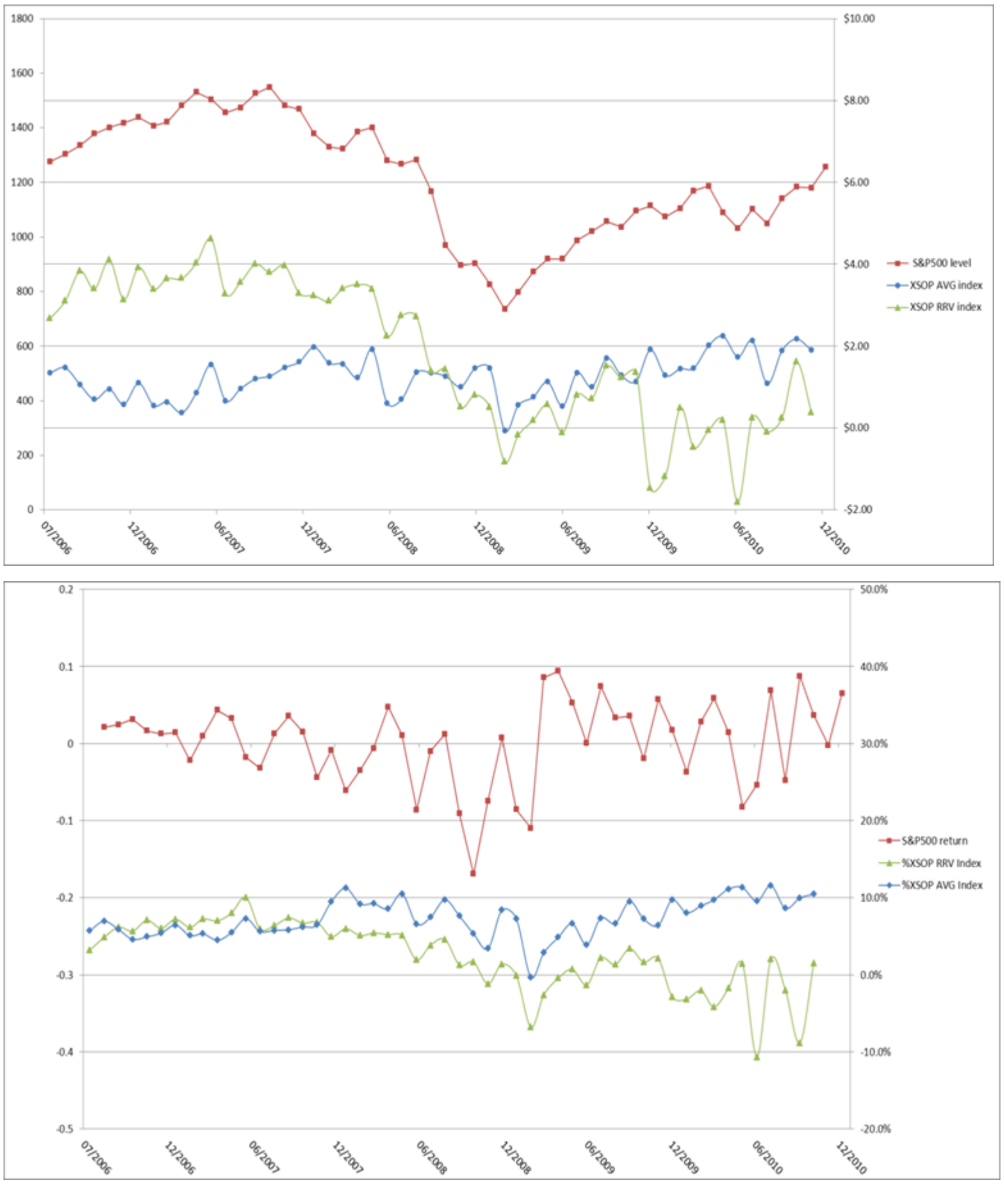

Figure 4.1. Ex-Post monthly returns for all key deciles.

This figure depicts the monthly mean ex-post returns for our four key (extreme) deciles and the complete sample. Shorting periods range from 15 to 60 days and returns generally diminish as the holding period lengthens. The first graph represents the results obtained using our AVG composite valuation method while the second shows the outcome for deciles based on the RRV intrinsic value model.