

A very relevant article ("Shorting Down Value: The Toxic Effect of Insufficient Internal Liquidity" presented at the 2005 Southern Finance Association meeting and at the 2006 WHU Conference in Germany) on the effects of unrestricted short selling is attached. Based on that research, restricting short sales after large price drops might have a significantly positive effect in allowing viable firms to raise new capital. On the other hand, the ways around the uptick rule (explained in Scientific Investment Analysis, 5th edition published in 2008 by SIA) imply that reimposition of that rule would be useless. In any event, the SEC needs to start enforcing the rules, such as the ones requiring delivery of shares borrowed under short sales.

Sincerely,
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Shorting Down Value

The Toxic Effect of Insufficient Internal Liquidity

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Shorting Down Value

The Toxic Effect of Insufficient Internal Liquidity

Abstract This paper demonstrates analytically how short sellers can put non-transitory downward pressure on the stock market prices and intrinsic values of companies that need to raise external capital because of insufficient internal liquidity. The model helps explain anomalous empirical findings in the extant literature on negative returns to stocks subjected to heavy shorting activity. The implications of the model also supply normative justification for the sizable cash reserves held by corporations and their reluctance to raise external capital. The equity pricing effects implied by the model are illustrated for a large empirical sample of companies negatively impacted by heavy short sales. Empirical tests are also conducted in this research that provide evidence consistent with the theory.

Keywords short sales, liquidity, new issue, equity, bankruptcy

JEL Classification: G12

1 Introduction

Short sales have been the focus of recent empirical research, much of which has indicated significantly negative returns to long positions on stocks that have been heavily shorted (Desai et al. 2002). Dechow et al. (2001), Christophe et al. (2004), and Asquith et al. (2005) have hypothesized that short sellers are able to pick out stocks that are overpriced. They base their conjecture on empirical findings of a significant relationship between short sales and fundamental ratios such as the book to market ratio.

The overvaluation hypothesis implies that (i) investors bid up the prices of particular equities above their intrinsic values, (ii) shareholders do not prevent the

hypothesized pricing bubbles by selling their overpriced stocks (Nagel 2005), (iii) investors continue to buy and hold stocks for which high ratios for market/book and shorts/shares allegedly indicate overpricing, (iv) investors are not able to circumvent short sale restrictions/costs,¹ and (v) investors are unable to synthetically short equities such as by buying puts and selling calls on exchanges or in the over-the-counter market.² The overvaluation hypothesis might therefore require an assumption of irrational investors and shareholders that would be inconsistent with the efficient markets hypothesis advanced by Fama (1970) that security prices reflect all fundamental information.

In addition, the overvaluation hypothesis does not explain claims that short sales have destroyed \$100 billion in value on a thousand small firms (Wherry 2003). Some “experts” have even estimated that “as much as \$1 trillion to \$3 trillion has been lost” through the “shorting” of companies “out of existence” over the past six years alone (Financial Wire 2005).

Hillion and Vermaelen (2004) model how short sales could drive down both stock prices and intrinsic values in cases where companies have issued a special type of convertible with a conversion price that varies with the stock price instead of being fixed. Since the number of shares of stock that must be issued under the terms of such a “death spiral” convertible rises as the stock price drops, any shorting down of the stock price will result in increased dilution, lowering the intrinsic value per share of the stock. Hillion and Vermaelen (2004) report empirical results consistent with their theory.

The current paper develops a model of short sales to generalize Hillion and Vermaelen’s (2004) theory to the case of any company that must, for *any* reasons, issue

additional shares of stock at a price which is determined in the future by the market. This research demonstrates analytically that it is possible to short down both the price and intrinsic value of the stock of any company in need of equity capital including to pay off liabilities that are due or to fund real investment projects. Companies with insufficient cash to fund new investments or to pay their liabilities as they come due need to raise external capital, thereby creating an opportunity for short sellers to profit by driving down the stock value of those firms prior to an issue of new equity. In particular, once the stock price of a firm needing to offer new shares in the future is shorted down, the intrinsic value also falls due to the need to issue equity at the lower market price, thereby causing the stock price drop to be non-transitory and resulting in negative abnormal stock returns.

Empirical tests in this research provide significant evidence in support of the shorting-down-value model. For a sample of 166 firms over a 15-year interval obtained from a database assembled by Lamont (2003), heavily shorted stock is found to suffer losses equal to 50% of their market-adjusted value times the estimated probability of running out of cash (and thus needing to raise external capital). In addition, a preliminary examination of the database indicates that returns to short sellers on such stock are unrelated to high book to market ratios, which may have merely represented an average characteristic of firms that are short of internal sources of cash in prior studies of the short sales phenomenon.

The shorting-down-value model presented in this study has the theoretical advantage of explaining the shorting anomalies while avoiding any assumption that investors are irrational or that public markets are fundamentally inefficient. For instance,

the model provides an alternative explanation for other empirically observed phenomena in the finance literature such as the drop in stock prices upon the announcement of new equity issues (Mikkelson and Partch 1986) and the reluctance of firms to operate with funds obtained externally (Cleary 1999).

Rational justification to shareholders for the propensity of companies to have extensive cash resources (Jensen 1986) is also provided by the shorting-down-value model since it indicates the dire results that occur when firms run out of cash. Companies with insufficient internal liquidity to pay creditors can be driven into bankruptcy due to an inability to raise the needed funds externally when the stock price has been driven down to zero, and even firms with sufficient cash to pay their due liabilities may lose the entire net present value (NPV) of future investment projects if they have to fund those projects with external equity whose price short sellers are motivated to short down prior to an anticipated equity issue.

The remainder of the paper is organized as follows. The basic assumptions and implications are listed in subsections 2.1 and 2.2, respectively, while the additional condition required to completely reduce the stock value to zero is listed and evaluated in subsection 2.3. An analysis of relaxing the model assumption is provided in Section 3. The consistency of the model with the empirical findings of other research is analyzed in Section 4. Section 5 describes empirical tests and results, while conclusions are summarized in Section 6.

2 Modeling a Need for an Equity Capital Infusion to Survive

The shorting-down-value model in this paper utilizes a set of reasonable assumptions to show how an urgent need for external capital can motivate short sales that destroy the value of the firm's equity. Four general assumptions and their implications are listed first, followed by a specific boundary condition that determines when and if the model holds.

2.1 Basic Model Assumptions

Assume (A1) public security markets to be fundamentally efficient, where all fundamental information on the present value of expected cash flows from corporate assets is incorporated into prices offered to buy or sell securities in the market. Defining $t=0, \dots, T$ as the time period for share transactions, a common stock with X shares outstanding has an estimated fundamental per-share intrinsic value of $v_t = v_0$ at the initial period $t=0$. The maximum bid price per share, p_t , then must initially equal

$$p_0 = v_0. \quad (2.1)$$

Assume (A2) there is only a limited number of shares being bid at v_t for a particular stock at time period t . The finite amount of buy orders might reasonably originate from investors who blindly purchase an index of the market portfolio of all assets at the going market price. The number of shares being bid at this price can be assumed to differ by a finite amount x_t from the number of shares being offered for sale at that price by liquidating shareholders in need of cash. All other buyers and sellers trade only if they perceive an opportunity for abnormally high profits. Since there are no abnormal return opportunities for transactions at the stock's intrinsic value, it would take a decline in price of $d_t \leq v_t$ below the intrinsic value v_t to attract additional buyers into the shares in the case of excessive sales of the stock. Here, d_t might initially represent the spread below the

midpoint market value for dealers to engage in buying transactions and, in any event, would have to be high enough to compensate buyers for transaction costs including time and effort in trading/analysis, and risk.

Assume (A3) that the company needs to raise Y dollars in common equity capital in the public markets in the near future to avoid bankruptcy, as typically might occur due to a lack of internal liquidity (Uhrig-Homburg 2005). Bankruptcy here can be defined as an inability to make payments on the company's liabilities resulting in the firm's assets/operations being divided up among the creditors

Assume (A4) that investors rationally expect any seasoned offering of common stock to take place at the current market bid price of p_t , less issuance costs, which can include warrant sweeteners as well as direct expenses and underpricing (Ng and Smith 1996), Total issuance costs are specified to equal f expressed as a decimalized percentage of the expected issue price.

2.2 Basic model implications

Defining V to be the aggregate value of the existing equity before considering the costs and effects of the need for a new issue, the intrinsic value per share would equal in period t

$$v_t = \frac{[V+Y]}{\left[X + \left\{ \frac{Y}{(p_t(1-f))} \right\} \right]}, \quad (2.2)$$

so that initially in period 0 , the market price would be

$$p_0 = v_0 = \frac{[V+Y]}{\left[X + \left\{ \frac{Y}{(p_0(1-f))} \right\} \right]}. \quad (2.3)$$

Short sellers seeing this opportunity will optimally sell short at least x_0+I shares, enabling them to drive the market price down by the amount defined as d_0 necessary to attract bargain hunters at a price equal to

$$p_1 = (v_0 - d_0). \quad (2.4)$$

While the stock price of a company not needing to issue new equity might be expected to rebound up to v_0 when the shorts buy back to cover, such a non-profitable scenario for the short sellers will not happen in this case where the lower price affects the number of future shares that must be issued. In particular, with a lower secondary market price v_0-d_0 , the expected offering price for the new issue would fall, so that

$$v_1 = \frac{[V+Y]}{\left[X + \left\{ \frac{Y}{[(v_0 - d_0)(1-f)]} \right\} \right]} \quad (2.5)$$

by substituting Eq. (2.4) into Eq. (2.2). With the stock issued at a lower price, the dilution will be greater, and

$$v_1 < v_0 = p_0 \quad (2.6)$$

as can be seen from comparing the denominators of Eq. (2.3) and (2.5). Thus, if the shorts sought to buy back their borrowed shares at this time ($t=1$), they could do so at v_1 , if there were an excess of market sell orders at that price (i.e., if $x_1 < 0$), yielding a profit of v_0-v_1 , which exceeds zero from inequality (2.6).

However, shorts seeking to maximize profits would not optimally cover at this point. Instead, since there would only be x_1 shares bid at the new intrinsic value v_1 , further short sales of at least x_1+I shares would enable them to drive the market bid price down to

$$p_2 = v_1 - d_1 \quad (2.7)$$

in period $t=2$ before new bargain hunters are enticed to buy at the d_1 discount to intrinsic value. The new stock value given an expected sale of new equity at the lower market price would be

$$v_2 = \frac{[V+Y]}{\left[X + \left\{ \frac{Y}{[(v_1 - d_1)(1-f)]} \right\} \right]} \quad (2.8)$$

by inserting Eq. (2.7) into (2.2).

2.3 Model boundary condition

It seems reasonable to believe that d_1 would normally not be materially less than d_0 , so that $v_2 < v_1$. Eq. (2.5) and (2.8) indicate how much less d_1 would have to be than d_0 in order to make the opposite case, $v_2 \geq v_1$, hold. These two equations indicate that $v_2 \geq v_1$ would practically mean that bargain hunters raised their bid price after the drop in value. The latter actions would intuitively seem to be irrational. In addition, market maker behavior that has been empirically observed to rationally raise spreads (and not lower them) in the face of informed trading (Heidle and Huang 2002) would seem to be inconsistent with d_1 being less than d_0 by any amount, much less enough to make $v_2 \geq v_1$.

Upon seeing another opportunity to short down value whenever $v_2 < v_1$, short sellers could continue to sell $x_t + I$ shares in each subsequent period t in order to drive down the price to

$$p_t = v_{t-1} - d_{t-1}. \quad (2.9)$$

By inserting Eq. (2.9) into (2.2), the new intrinsic value is

$$v_t = \frac{[V+Y]}{\left[X + \left\{ \frac{Y}{[(v_{t-1} - d_{t-1})(1-f)]} \right\} \right]}. \quad (2.10)$$

Having seen the stock value fall in a prior period when the bid price was set at p_{t-1} , bargain hunters or dealers seeking to profit from a decline in the bid price below fundamental value might rationally set their new bid price below the prior one, as before. Even if $v_t \geq v_{t-1}$ for some length of time, short sellers potentially could simply wait until bargain hunters or dealers no longer required significantly lower compensation d_t than in period $t-1$ before shorting further. It is therefore possible to generalize for all periods t with the following assumption:

Assume (A5),

$$d_{t-1} > v_{t-1} - p_{t-1}, \quad (2.11)$$

which implies $p_t < p_{t-1}$ from Eq. (2.9).³ The boundary condition assumption in inequality (2.11), which is actually less restrictive than $d_{t-1} \leq d_{t-2}$ ensures that the price continues to fall to zero,⁴ so that in the terminal period T

$$v_T = 0. \quad (2.12)$$

In particular, the number of shares necessary to provide the needed Y funds would, in general, become infinite when $p_T = v_{T-1} - d_{T-1}$ became infinitesimally small, because $v_t \rightarrow 0$ as $p_t \rightarrow 0$.

Because the existing equity would be worthless at the terminal point T , any sole (colluding) investor(s) wishing to save the company by providing the needed Y in new capital could optimally buy up all the existing shares for an infinitesimally small price at that point. The sole (colluding) owner(s) could then access the entire value $V+Y$ upon providing the needed external funding Y . However lucrative or feasible such an action might be, it remains impossible to raise capital via a competitive seasoned offering of

additional common shares, for which no competitive investor would be willing to pay more than the secondary market price of zero.⁵

The model then implies that short sellers can drive down both the stock price and value of companies needing external equity capital. Falling stock prices and values of firms needing to raise external funds due to inadequate internal liquidity would therefore result in negative abnormal returns on the equities of those companies.

3 Relaxing a Model Assumption

While the model developed in Section 2 is based on a set of assumptions that may be generally applicable to the real world, Assumption A3 is somewhat constraining. In particular, it does not allow for a venture capital rescue of the firm via a private placement of securities, it assumes a 100% certainty of needing extra cash, and it ignores cases where any cash need is strictly related to financing profitable company investments as opposed to avoiding bankruptcy. The model in Section 2 may apply to many firms, but it can be adapted to a wider variety of situations by replacing Assumption A3 with a less restrictive set of two alternatives.

In particular, to permit private placements with competing venture capitalists, *assume (Assumption A3a) that financing alternatives to public equity offering exist (such as private placements via venture capitalists), but that these outside sources of funds wait $T-n$ periods to expropriate a value of $H_{T-n} \leq X(v_0 - v_{T-n})$ from the firm.* The maximum value that can be taken would, from Eq. (2.10), equal

$$H_{T-n} \leq V - \frac{X[V+Y]}{\left[X + \left\{Y / [(v_{T-n-1} - d_{T-n-1})(1-f)]\right\}\right]}. \quad (3.1)$$

The terminal maximum for H_{T-n} would occur when all possible wealth is expropriated from existing owners in period $T-0$, i.e., by inserting Eq. (2.12) into inequality (3.1),

$$H_T \leq V. \quad (3.2)$$

Note that equation (2.12) is a special case of (3.2) where $n=0$, as might arise whenever venture capitalists avoid taking any action due to the uncertainty of the true value of v and the related costs of investigating that intrinsic value.⁶ The fact that the demand for venture capital exceeds the supply can put venture capitalists in the position (with or without collusion) of being able to optimally wait until $p=0$ and then extract the full amount.⁷ In any event, any new providers of capital would require time to analyze the company's intrinsic value before advancing funds, thereby ensuring that $n < T$, which implies $H_{T-n} > 0$ from the model's implication of a falling intrinsic value as shorting drives the price down over time.⁸

To incorporate the uncertainty of future cash needs, also *assume (Assumption A3b) that M_t denotes the probability of being able to satisfy all financing needs with internally generated funds, and that B_t denotes the period t probability of bankruptcy without outside funds*, so that there is a probability of $1-B_t-M_t$ that the firm has sufficient funds to survive but insufficient internally generated funds to finance all operations and all positive NPV investments. Specifying the expected value of the loss to the corporation in the latter case to equal C from not being able to access external funds to finance all operations and positive NPV projects, the company would conduct a seasoned offering only if the stock value per share measured in Eq. (2.10) did not fall below $[V-C]/X$ for the non-bankruptcy case of needing external equity. If the shorts drove the value below that point, so that, from Eq. (2.10),

$$\frac{[V + Y]}{\left[X + \left\{ \frac{Y}{[(v_{T-1} - d_{T-1})(1 - f)]} \right\} \right]} \leq \left[\frac{(V - C)}{X} \right], \quad (3.3)$$

the company would optimally forego raising external capital and abandon any related investments dependent thereon.

Given the value of the equity defined previously as V for the firm needing no external capital, given the equity value defined in Section 3 as $V - H_{T-n}$ (i.e., V less the amount of expropriation by external capital providers) for the firm requiring external capital to survive, and given the minimum equity value $V - C$ of the firm needing external capital to finance operations but not to prevent bankruptcy, the lower boundary for the stock value in any terminal period T is

$$v_T \geq \left[\frac{\{ B_T [V - H_T] + M_T V + (1 - B_T - M_T)(V - C) \}}{X} \right]. \quad (3.4)$$

It is possible to denote $C^* \leq C$ as the amount of equity value that short sellers drive down in cases where bankruptcy does not exist. Here, $C^* < C$ when outside financiers provide private financing without full expropriation of C , or where boundary condition (2.11) is violated. The inequality (3.4) can then be rewritten as an equation

$$v_T = \left[\frac{\{ B_T [V - H_T] + M_T V + (1 - B_T - M_T)(V - C^*) \}}{X} \right]. \quad (3.5)$$

Eq. (3.5) is derived by replacing Assumption 3 with the combined Assumptions 3a and 3b. This equation is especially important for indicating that even for firms with only a negligible (or zero) probability of bankruptcy B_T , the effect on the stock value can be significant if the value of C^* (which can be due to NPV foregone because of the inability to fund projects) is nontrivial.

Note that equation (2.12) is a special case of equation (3.5) where $B_T=1$.⁹ As indicated in the prior section, companies definitely needing to issue stock to avoid bankruptcy can have their share prices shorted down without limit and can therefore be expected to suffer abnormal stock returns of the largest magnitude. On the other hand, firms with a need to issue equity to merely finance positive NPV projects can only suffer stock market losses equal to the NPV of those projects.

4 Consistency of the Model with the Empirical Findings of Other Studies

The model provides a general explanation for the negative abnormal returns to stocks of heavily shorted firms. It is also consistent with the allegations of large-scale bankruptcies caused by short sales. Moreover, it helps explain other empirical observations and financial behavior.

For instance, the empirically observed reluctance of firms to finance projects with external capital (Cleary 1999) may be explained by the generalization of the shorting-down-value model in Section 3. In particular, to the extent that short sellers drive down the market price of a company needing external funding, the firm loses some of the NPV of the projects. Even if only a portion of externally financed projects' NPV is expropriated, the firm still has an incentive to wait until sufficient internal funding is available in order to enable the firm's existing owners to access the entire NPV.

The generalized form of the shorting-down-value model also provides an alternative explanation for the price declines empirically observed upon the announcement of a seasoned equity offering for firms that are solvent (Mikkelson and Partch 1986). The price drop may simply reflect the market anticipation that short sellers

will drive the stock price and value down (at least slightly) before the actual offering. The subsequent increase in effective short interest prior to the dates of actual seasoned equity offerings that have been found to reduce the selling prices of the new issues (Safieddine and Wilhelm 1996) provides some empirical evidence that is consistent with this explanation of the new issue effect. While Myers and Majluf (1984) have earlier demonstrated that managers' inside information on their stock's intrinsic value can cause a new stock issue to have a negative announcement effect, this article shows that illiquid companies have a stronger incentive to avoid external financing. In particular, short sellers can effectively drive down the stock price and profit potentially up to the extent of any benefits (or costs avoided) that a company short of cash generates from a new security issue.

The shorting-down-value model has the added advantage of yielding important implications that help explain the actual propensity of companies to have extensive cash resources (Jensen 1986). Murphy (1998) had previously shown that the need to obtain new external equity capital in the future increases the beta of a firm, thereby raising the required return on the stock and lowering the present value of the expected cash flows from it. However, as shown in the current research, short selling can have a more powerful effect on the value of companies requiring external capital. In the extreme case of financial distress, short sellers can theoretically short both a stock price and its intrinsic value all the way to zero. To avoid such a short death and similar adverse events, companies are motivated to have sufficient internal liquidity to reduce the chance of needing to raise external funds.

The model's implication of investors being able to short a company into oblivion is consistent with the empirical findings of Desai et al. (2002), who have found a higher chance of company failure as well as significantly negative abnormal returns for equities with especially high short interest. The empirical findings of Fama and French (2005) indicating only a small portion of equity issues is undertaken by distressed firms are also consistent with the shorting-down-value model. In addition, the latter authors' finding of widespread violations of the pecking order hypothesis implied by Meyers and Majluf (1984) theory (that would typically have firms issue equity only as a last resort) can be rationally explained by the shorting-down-value model insofar as equity issues may be most typically made by financially healthy firms at least partially as a precaution against the risks of being unable to issue equity when short of cash.

The shorting-down-value model can also help explain the empirical findings of D'Avolio (2002), who discovered S&P 500 stocks to have both lower short interest and lower shorting costs than equities not in that blue chip index of larger companies. Given that larger blue chip firms might be more likely to have sufficient internal liquidity to avoid the need to raise external capital at market prices, they would be less likely to be victimized by the process of shorting down value than smaller firms. The lower shorting costs on such stocks may therefore reflect the fact that demand for borrowing their shares is low because short sellers recognize their inability to drive down the intrinsic values of such stocks. In addition, with the transaction costs of trading large S&P500 equities typically being lower, the boundary conditions in inequalities (2.11) and (3.3) necessary for larger shorting down of value might less often apply. The finding by Asquith et al.

(2005) that returns tend to be more negative on smaller firms that are heavily shorted than on larger ones is consistent with this hypothesis.

The shorting-down-value model is also consistent with the empirical results of Jones and Lamont (2002) and Lamont (2003), who have discovered lower returns on stocks with higher shorting costs. According to the model, the shorting down of stocks with a need for equity financing would raise the demand for borrowed shares, thereby possibly bidding up shorting costs on those stocks that would be heavily shorted down. Shorting costs include not only the holding costs of borrowing shares but also the expenses short sellers incur related to various legal actions employed by companies to stop heavy shorting of their stock (Lamont 2003).

5 Separate Empirical Analysis of Shorting Down Value

The theory developed here implies that stocks of companies with insufficient internal liquidity will have negative abnormal returns when they are targeted by short sellers. To test this implication, the relationship between the abnormal returns after controlling for bankruptcy risk, on heavily shorted firms can be evaluated to determine if negative returns are more concentrated in the short-pressured equities of companies in need of external cash that are more financially distressed, as hypothesized by the model in Eq. (3.5) of Section 3.¹⁰

5.1 *Testing procedure*

To empirically test the hypothesis, it is possible to employ Lamont's (2003) public database of 270 firms taking legal action or making statements against excessive shorting pressure in their stock between 1977 and 2002. Use of this database is ideal since it

focuses on shorting that is perceived by the victimized companies themselves to be manipulative and damaging. In contrast, reported domestic statistics on official short interest distort measures of shorting pressure because they include shorting related to hedging (Christophe et al. 2004), and because they exclude naked shorting in foreign markets that can be quite potent (Brown 2002).

The event date for this sample is specified to be the day on which Lamont (2003) records a company first publicly engaging in acts to inhibit the targeted short selling. The compounded abnormal return in the subsequent year for each stock is computed by subtracting out the compounded total return on an index of similar stocks from the compounded total return on each stock subsequent to the event date.

The hypothesis implies that the direst consequences to occur in cases where companies urgently need external capital to fund a cash shortage in order to avoid bankruptcy and/or costly asset liquidations (thereby making the values of B and or C in our model very large). To measure such liquidity emergencies, it is possible to utilize Emery and Cogger's (1982) general theoretical concept of applying statistical analysis to internal liquidity data for purposes of forecasting company failure. The Callaghan and Murphy (1998) present an empirical estimate of a statistical probability of the company running out of cash without external financing. Callaghan and Murphy (1998) that their estimate of statistical probability of running out of cash to be empirically superior to credit ratings in explaining corporate bond spreads, as well as fairly accurate in predicting the likelihood of bankruptcy. Callaghan and Murphy (1998) compute the probability of running out of cash in one year as

$$\text{ProbabilityOfCashless} = 1 - N \left\{ 4J \left[0.25 \frac{J}{\frac{E(\text{Cash})}{\sigma(\text{EBD})}} \right] \right\}, \quad (5.1)$$

where N is the cumulative normal distribution function, J is a sign adjustment variable equaling 1 if $E(\text{Cash}) < 0$ but -1 otherwise, $\sigma(\text{EBD})$ is the standard deviation of recurring cash flows over the prior 5 years, and $E(\text{Cash})$ is the expected ending cash from an assumption of a need to rely on internal cash flows and liquid assets to pay all current liabilities. Assuming accruals automatically refinance, ending cash is computed as

$$E(\text{Cash}) = \text{Cash}_0 + \text{EBD}_0 + 0.9 * \text{AR}_0 - \text{CL}_0 + \text{Accruals}_0, \quad (5.2)$$

where Cash is current cash and unused lines of credit, EBD_0 is Recurring Earnings before Depreciation over the prior year, AR is Accounts Receivables not used as collateral for company debts, CL is Current Liabilities, and Accruals are Current Liability Accruals. While Callaghan and Murphy (1998) suggested raising the value in Eq. (4.1) to a power that incorporates information in the company's stock price (when available) into the future outlook for the firm, this adjustment is not made in the initial tests in order to avoid the possibility of the results being biased by any price effects of prior short selling.

The regression to test the hypothesis is specified as

$$\text{Market_Adjusted Return} = g_0 + g_1 \text{ProbabilityOfCashless} + g_2 Z + \varepsilon, \quad (5.3)$$

where the independent variable Z , the Altman's Z score is included to allow for the possibility of needing external capital due to financial distress being caused by factors other than internal liquidity problems. The dependent variable is defined as

$$\text{Market_Adjusted Return}_i = \left(\prod_{w=1}^{12} (1 + r_{iw}) - 1 \right) - \left(\prod_{w=1}^{12} (1 + r_{mw}) - 1 \right), \quad (5.4)$$

where r is the total return on the subscribed asset, subscripts i and m denote the i^{th} stock and an appropriate stock market index, respectively, and the subscript w denotes the number of months since the event date and is truncated at 12 because the ProbabilityOfCashless estimated by Eq. (4.1) is for a 12-month horizon. The hypothesis predicts g_l to be negative and significantly different from zero.

Given the $B_T(V-H_T)$ component of v_T in Eq. (3.5), the parameter coefficient for g_l (which measures declines in value from v_0 to v_T) can provide an estimate of H_T/V . For instance, an estimate of 1.0 for g_l implies that $H_T=V$ (i.e., it would imply that $v_T=0$ in cases of companies running out of cash) and that outside providers of capital can expropriate all wealth from firms that need external equity capital to survive.

In addition, if there are a significant number of firms in the sample that are not in financial distress but would optimally raise external funds for other reasons (such as to fund positive NPV investments), the shorting-down-value model implies that g_0 would also be negative and significant. A significantly negative g_0 would indicate that $C^*>0$ from Eq. (3.5) and that short sellers are able to expropriate at least a portion of the NPV of firms needing external capital to finance projects but not in dire need of funding to avoid bankruptcy.

Because both the ProbabilityOfCashless variable and the Altman (1968) Z values are mere proxies for financial distress, the actual independent variables are measured with error. To avoid the error-in-variables problem of biased parameter estimation, an instrumental variable estimator should be employed to obtain consistent estimates (Davidson and MacKinnon 1993). Since an expected shortage of cash represents the most extreme form of financial distress, the instrument for the ProbabilityOfCashless can be

specified to be a variable that has a value of one for firms that have a negative expected ending cash balance after one year (and therefore, without an improvement in operations, appear more likely than not to need external capital to survive) and zero otherwise.

Because the Z-score is a reduced form model that does not provide a cutoff point for group formation, the three-group method is utilized as the instrument for that variable (Kmenta 1986). The latter instrument has a value of one for the 1/3 of observations with the highest Z-scores, negative one for the 1/3 of observations with the lowest Z-scores, and zero otherwise.

To compute the proxy values, the financial statements reported from the year prior to the Lamont (2003) database event date are used. Information on unused lines of credit are collected from the companies' 10-K forms (available via EDGAR and LEXUS), and other financial statement data and stock returns are obtained from Research Insight (COMPUSTAT). Financial companies, for which Callaghan and Murphy (1998) do not calculate estimate, and companies with insufficient information available from COMPUSTAT and 10-K's are deleted from the sample. There are 166 resulting observations over the period 1987-2002.

Table 1 summarizes some financial information about the sample firms in comparison to corresponding ratios of the S&P 500. As indicated there, the sample companies appear to have healthy balance sheets with respect to the ratios of cash/assets and liability/assets, both of which are stronger than those of the index and do not appear to deteriorating up to the event date of the complaint of short selling pressure. The average operating Return on Assets (ROA), as measured by the Earnings Before Interest and Taxes (EBIT) divided by assets, is negative for the sample firms. Although the

median profitability ratio for the sample is positive, it is declining and weaker than that of the index.

As also shown in Table 1, the included firms tend to be fairly small, with a median market capitalization of \$200.43 million. While this level may be closer to the S&P SmallCap index, that index of smaller firms was not created until 1994, and so the S&P 500 was utilized as the market proxy for measuring abnormal returns in Eq. (4.5) in order to maximize the number of observations that could be included in the sample. The index is also suitable since the stocks of the S&P 500 are less likely to be convoluted by any independent shorting down of value that might contaminate a small-cap index. Additional analysis (not shown) indicated no material difference in any of the empirical results when the shorter sample was examined with the SmallCap or MidCap indexes as the market proxy.

Average and median market returns for the sample stocks are negative both before and after the event date, as indicated at the bottom of Table 1. While the average return for the sample equities two years prior to the complaint about short sales is rather large, the median return is below that of the S&P 500 over that same time interval. The correlation between the cross-section of returns in each of those three years is uncorrelated with the others (not shown), thereby providing no positive evidence that the short-selling complaints relate to stocks which had risen to prices above values and then were subsequently shorted down.

A comparison (not shown) of the abnormal returns of the purged and unpurged observations from the Lamont (2003) database provided no evidence of any sample exclusion bias. In particular, there was no significant difference ($t=0.31$) between the

abnormal annual returns on the included stocks (-27.95%) and the 103 excluded stocks (-31.66%).

A simple event study analysis of the sample equities with sufficient data is reported in Figure 1, which graphs the cumulative monthly returns on the stocks that are divided into 2 groups based on the respective companies having positive or negative values in equation (4.2). The graph indicates that downward pressure begins to occur about a month before the public complaint for both groups, and strong negative effects continue into the event month implying that the actions/complaints against the shorts are not effective in reversing the stock price decline.

After the event month, the returns on both groups are decidedly negative and far below the market index return, as implied by the shorting down effects. The negative returns on the group with an expected negative ending cash are, on average, more sizeable than those of the other group with less critical cash needs. For both groups, the cumulative returns are significantly different from (and below) zero at the .01 level ($t=-4.35$ and $t=-3.34$, respectively).

5.2 Empirical results

The results of running regression Eq. (4.4) are reported in Table 2. As shown, the parameter estimate for the probability of running out of cash is negative and significant at the .01 level. These results imply that returns are more negative for targets of short selling when the companies are more likely to run out of cash over the next year.

However, the fact that the parameter estimate is also significantly less than -1.0000 implies from Eq. (3.5) that H_T is less than V which is consistent with the hypothesis that

external providers of capital expropriate some but not all the wealth of firms in dire need of external capital as described in Section 3.¹¹

The parameter estimate for the Altman Z score is positive and statistically significant at the .10 level in the univariate regression. It is insignificant in the bivariate form of regression Eq. (4.3). These results do not support a hypothesis that firms suffer negative returns merely because of the Altman (1968) general measure of financial distress when included in the regression with the probability of running out of cash. The fact that the measure of the probability of running out of cash is significant at the .01 in the bivariate regression provides empirical support for the hypothesis that the lack of liquidity enables short sellers to exploit firms' financial distress.¹²

In order to eliminate any possible separate effect that Hillion and Vermaelen (2004) found relating to the firms with "death spiral" convertibles, further tests were conducted that eliminated from the sample the two firms that had such securities outstanding over the sample interval. As shown in Panel B of Table 2, the results are materially unaffected. The toxic effects of being short of cash are independent of the "death spiral" convertibles.

The results were also not materially changed by inclusion of the event month (13 months instead of 12) into the dependent variable abnormal return. As shown in Panel C of Table 2, the sign and significance of all the parameter estimates remain unchanged, except that the Z score becomes insignificant even in the univariate regression. In contrast, the parameter estimate for the ProbabilityOfCashless in this regression remains significant at the .01 level, with the F-statistic indicating it became even more significant. These findings are inconsistent with Lamont's (2003) overvaluation hypothesis that the

negative returns on shorted stock are caused by inhibitions on short sales created in the event month that drive the stock prices above value.¹³

Further confirmation of the model is provided by dividing the sample into two parts: those firms that have expected negative ending cash balances and those that do not. As shown in Table 3, the 30 stocks of the firms suffered market-adjusted annual returns of -60.2% over the subsequent 12 months, while the 136 the more liquid group suffered market-adjusted returns of -20.8%. The difference in the mean market-adjusted returns for the two groups was statistically significant at the .01 level, with the Satterthwaite (1946) t-statistic being 4.06. In nonparametric tests that are valid for a wide range of statistical assumptions (Hollander and Wolfe 1999), a significant difference in the two populations was also found, as exemplified by Wilcoxon and Van der Waerden statistics of 1777 and -14.74, respectively, which both correspond to z-statistics of -3.05, and which both indicate statistical significance at the .01 level.

On the other hand, the fact that the intercept in all the Table 2 regressions is significantly negative implies stock price declines even for firms with a negligible chance of running out of cash. This finding is consistent with the hypothesis that there are firms that are in need of external financing but for which the need to raise capital may not be absolutely crucial to avoid bankruptcy. Eq. (3.5) had indicated that these firms would also suffer negative returns but not as large as those in financial distress.

The Table 2 intercept estimates imply extremely large negative returns of about -20% for financing needs not related to financial distress. The boundary conditions (2.11) and (3.3) do not preclude such results if C^* is large enough, as can happen if both C and d_t are large. However, it is also possible that at least a portion of the size of the intercept

can be attributed to inaccuracies in the estimate of the probability of running out of cash.¹⁴ Given that information in the stock price was excluded from the estimate in Eq. (4.1) to avoid biasing the results (as previously mentioned), the latter possibility seems especially feasible.

5.3 Further tests with a complete-information bankruptcy risk model

To test whether a potentially more accurate measure of bankruptcy risk might change the significance of the parameter estimates, regression (4.4) using the complete-information form of the Callaghan and Murphy (1998) model that adjusts the forecasted future cash flow for the expectations that are derived from the firm's stock market price.

This adjusted model reduces the mean value for ProbabilityOfCashless from .2051 to .1675 (although the range stays the same between .0001 and .9999).

The results of the new regressions with the market adjustment to the ProbabilityOfCashless* are shown in Table 4. The intercept remained statistically significant at roughly -20%. In addition, the parameter estimate for the probability of bankruptcy stayed statistically significant from both 0 and -1, with the size of the estimate implying once again a value for H_T of about $0.5V$.

However, the g_1 estimate does not reflect the full size of losses to firms with higher bankruptcy risk. In particular, the stocks of those companies also suffer the average losses of about 20% that are picked up by the g_0 estimate for all sample companies regardless of the probability of running out of cash. Subtracting the exact intercept of $-.1885$ reported in Panel B of Table 4 from the -1.00 return that would occur if firms are shorted out of existence indicates that g_1 only needs a value of $-.8115$ for firms to suffer a complete loss in the case of certain bankruptcy. This value is statistically

insignificant at the .05 level from the Panel B g_1 estimate of $-.5060$ ($t=1.6621$). Thus, the findings reported in Table 4 are not inconsistent with the hypothesis that $H=1.0V$ and that firms can indeed be shorted into worthlessness.

While Dechow et al. (2001) and others had previously hypothesized that the large negative abnormal returns to heavily shorted stock might be due to a simple overpricing as measured by the ratio of stock market price to the equity book value, the empirical results discovered here provide strong support for the alternative theory that the abnormal returns are strictly related to internal corporate illiquidity. Further evidence on this issue is provided by the fact that the correlation between abnormal returns and market-to-book ratios (not reported) was found to be statistically insignificant ($t=0.72$) in the sample of this research.

The latter lack of significant correlation exists despite the fact that the Lamont (2003) database tended to be composed of stocks that had above-average market-to-book ratios, averaging in the top 23rd percentile of the CRSP universe on that ratio. The data, whose in-sample median and mean market/book ratios are 5.6662 and 16.15, respectively, are therefore comparable in this respect to the group of heavily shorted-down equities employed in the Dechow et al. (2001) study that were found to have higher market-to-book ratios than other stocks. If the overvaluation hypothesis were valid, a significant correlation between the returns on a sample of shorted-down stocks and price/value ratios would have been expected.

Further investigation of the market-to-book characteristics of the Lamont (2003) database provides even stronger evidence in favor of the shorting-down-value model. In particular, using once again the dummy variable with a value of 1 for companies with a

negative expected ending cash balance over the next year (and 0 otherwise) as the instrument for ProbabilityOfCashless, bivariate regressions of the stock abnormal returns on both market-to-book ratios and the probability of bankruptcy estimate computed in Eq. (4.6) were conducted. As shown in Table 5, the book-to-market ratio is statistically insignificant from zero, and this finding provides some evidence against the hypothesis presented by Dechow et al. (2001) and Christophe et al. (2004) that shorting activities are related to overvaluation. On the other hand, the parameter estimate for the probability of bankruptcy in Table 5 remains statistically significant from zero at the .01 level and is insignificantly different from $-1-g_0$ at the .10 level ($t=1.3385$). The latter finding is again consistent with the allegations that many firms are shorted to death.¹⁵

These results provide further support for the model hypothesis that it is possible to short down the value of firms needing cash. Nevertheless, empirical tests on other data with other procedures would be useful to supply additional perspective on the extent to which companies can actually be shorted out of existence. In addition, a rigorous testing of whether the book-to-market effect simply reflects the shorting down of stocks of firms with internal liquidity problems in other samples would merit a completely separate study.¹⁶

6 Conclusion

This research demonstrates both analytically and empirically that short selling the stock of firms requiring external capital can drive down both the stock price and the firm value. In some cases, a firm's stock price may approach zero, effectively eliminating the wealth of existing shareholders and maximizing profits for investors maintaining short positions

through the price decline. In less extreme cases, short sales may be responsible for company losses that are restricted, in magnitude, only by an amount equal to the value lost by the firm if it is not able to obtain the external funding.

This theory provides an alternative perspective on the need for publicly traded companies to have sufficient cash reserves or internal liquidity (such as lines of credit). Even companies that have access to sufficient cash to survive may find it useful to also have adequate liquidity to meet capital budgeting and less urgent requirements, so that the losses in intrinsic value related to short selling in cases of external capital needs can be avoided.

The shorting-down-value model is consistent with the findings of other empirical studies on short selling and financing. However, further tests would have to be conducted to determine what portion of other financial phenomena the model explains. While it should be emphasized that the findings here in no way imply that all shorting activity is motivated by attempts to drive down the intrinsic values of firms with inadequate cash resources, it would be interesting to test whether the average lower returns on stocks with lower book to market ratios (Fama and French 1995) is related to this effect.

Footnotes

1. Short sale costs include not only the holding costs of borrowing shares but also the expenses short sellers incur related to various legal actions employed by companies to stop heavy shorting of their stock.
2. It should be mentioned that much of the recent shorting in practice has been alleged to be “naked”, insofar as the stock for the short sales is not actually borrowed because the requirement to deliver shares is continuously postponed by clearing agents who effectively create the shares (Boni 2006). Such naked shorts, which are often channeled via a largely unregulated short trading environment such as in Canada (Brown 2002), may have no holding costs and have been alleged to exceed \$1 trillion in amount (Financial Wire 2004). Empirical research findings indicate that short sale constraints actually have no effect on market prices when stock can be shorted abroad (Nilsson, 2008).
3. *Assumption A5* is reasonable as attempts to manipulate prices upward are ineffective. There exists empirical evidence that public dissemination of information on increases in official short interest has a negative announcement effect (Senchak and Starks 1993) implies that the very existence of heavy short selling discourages buying pressure to manipulate price upward. Other relevant information has also been published on the long-term ineffectiveness of manipulative buyers attempting to drive up the prices of heavily shorted stocks (Zuckerman 2005).
4. The ability of the shorts to set their sales price anywhere above the bid price would lead to continuous uncertainty as to the true intrinsic value of the company

and inhibit simple trading rules to buy securities with rising spreads that might otherwise create upward pressure on prices. The increased uncertainty of intrinsic value might magnify the importance of detailed fundamental analysis, thereby possibly increasing the required return and further reducing the stock's intrinsic value (Bren et al. 1990).

5. While it is also possible that a company short of cash might be able to obtain funding via a debt issue (Ueda 2004) or preferred stock (Winton 2003), the result would be the same. In particular, an investor interested in providing the needed financing to save the firm could reasonably demand 100% participation in any earnings of the company in the form of a participating bond or stock issue (since the investor could alternatively wait until the stock price has fallen to zero before buying all the shares for nothing to achieve the same lucrative end).
6. A delay or failure to rescue viable firms in need of cash may be caused by the high costs and uncertainty associated with investigating venture capital opportunities. With most of the high returns to short sellers being concentrated in smaller companies (Asquith et al. 2005), the high costs of analyzing the long-term future potential of currently illiquid firms may simply exceed the smaller dollar gains available from smaller company investments.
7. There exists a finite capacity of the venture capital market to fund firms' cash needs and thereby reduce the value H_{T-n} expropriated from illiquid companies through competition. The fact that venture capitalists can so often force firms to issue convertibles that are recognized to result in a "death spiral" (Hillion and

- Vermaelen 2004) provides an indication of the extreme lack of bargaining power of cash-starved companies.
8. Note that if some existing shareholders in the company could be organized to act as venture capitalists and provide the needed financing, they would face the same situation as other external providers of capital. The fact that empirical stock returns have been reported to be insignificantly different from zero in the case of rights offerings (Fama and French 2005) is consistent with a hypothesis of shareholder financing stopping but not reversing the shorting down of value.
 9. The model may also apply to firms with publicly traded bonds but no public equity. In particular, a zero price for the debt would make all junior claims (like equity) worthless, thereby resulting in the same problem as for firms with publicly traded equity. Countries with a dire shortage of (and need for) foreign exchange might also be effectively bankrupted by investors shorting their currency values down toward zero, but the intrinsic value of real assets like gold cannot generally be shorted down in value because there is no urgent need to sell a commodity.
 10. Any finding of a negative relationship between returns and financial distress on heavily shorted stocks could also help explain the lower abnormal equity returns discovered by Dichev (1998) on companies with higher probabilities of bankruptcy. Note that while high probabilities of bankruptcy lead to depressed stock prices in all cases, cross-sectional average returns on stocks of companies that are already financially distressed would not subsequently be abnormally low given the possibility of offsetting large returns on the stocks of those companies that survive, unless there is indeed shorting down of intrinsic value. The empirical

findings of Boehme, Danielsen, and Sorescu (2006) indicating lower returns to stocks subject to a combination of higher short sale costs and dispersion in estimated stock values provide support for this interpretation of Dichev's (1998) findings, as the higher shorting costs may reflect larger shorting activities while the higher volatility may reflect greater probabilities of bankruptcy.

11. The parameter coefficient g_I being less than 1.0 is also consistent with a hypothesis that the short sellers drive the price down over a period in excess of 1 year. However, since the ProbabilityOfCashless variable is measured assuming a one-year horizon for running out of cash, a conclusion of $H_T < V$ can be legitimately drawn.
12. The correlation between the liquidity measure for the ProbabilityOfCashless and the Z score was statistically insignificant at the .10 level, with the low correlation coefficient of .08 providing support for the hypothesis that the two variables represent proxies for different types of financial distress and implying that multicollinearity was not a problem in the bivariate regression. Since a low correlation between proxy and instrument creates major statistical problems relating to insignificance caused large standard errors (Bound, Jaeger, and Baker (1995)), it was not feasible to use the Z score itself as the instrument for the ProbabilityOfCashless.
13. This result is also inconsistent with the Miller (1977) version of the overvaluation theory that hypothesized the market overpricing securities subject to short sale constraints to be caused by a dispersion of investor appraisal values for those stocks.

14. Ordinary Least Squares (OLS) results that do not adjust for error in variables were similar to those reported in Table 2. In further statistical analysis, White (1980) tests (not shown) indicated no evidence of significant heteroskedasticity except for the 13-month regressions, and since adjustments for heteroskedasticity for the 13-month regressions did not materially affect the results (with only the statistical significance of the parameter estimates rising slightly when the correction was made), these Generalized Least Squares (GLS) results are also not presented.
15. The sign and significance of these results were unaffected by the use of the unadjusted ProbabilityOfCashless measure in the regression. A simple OLS regression yielded similar results, although the significance level for the ProbabilityOfCashless dropped to .05 and .10 for the unadjusted and adjusted measures, respectively.
16. The Table 5 regression was also run by including the market capitalization of each firm as an additional independent variable in the Table 5 analysis (using both OLS and the instrumental variables estimator). The results (not shown) indicated that the sign of that additional variable was insignificant, and the sign and significance of the other parameters were unchanged.

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Table 1
Characteristics of Sample of 166 Firms With Public Complaints of Short Selling of their Stock^a

Variable	Sample		S&P 500	
	Mean	Median	Mean	Median
Cash/Assets (1 year prior)	28.1%	21.2%	10.5%	10.5%
Cash/Assets (at event date)	28.6%	21.6%	10.5%	10.5%
Liab./Assets (1 year prior)	45.2%	40.5%	60.3%	60.6%
Liab./Assets (at event date)	40.4%	36.8%	60.2%	60.2%
EBIT/Assets (1 year prior)	-18.7%	4.1%	10.7%	10.6%
EBIT/Assets (at event date)	-9.3%	2.7%	10.9%	10.9%
Market Capitalization ^b	\$700.7	\$200.4	\$27,4000.0	\$25,572.0
<u>1-Year Stock Return^c:</u>				
2 years before event month	66.0%	11.6%	24.5%	23.4%
Thru the event month	-16.9%	-31.3%	23.0%	22.5%
After the event month	-5.6%	-18.4%	23.8%	22.8%

^aSome of the data for this table didn't exist for periods prior to the test interval, and so the averages and medians reflect only the sample companies for which data did exist.

^bValue is listed in millions of U.S. dollars.

^cReturns are measured over the period 23 months to 12 months before the public complaint about short selling, over the 12 months up through the event month, and over the subsequent 12 months, respectively.

Table 2
Relationship Between Ex-Post Abnormal Equity Returns and Ex-Ante Financial Distress on 166 Firms With Public Complaints of Short Selling of their Stock

$$\text{Stock Return} - \text{Market Return} = g_0 + g_1 \text{ProbabilityOfCashless} + g_2 Z + \epsilon$$

g_0	(std. error)	<u>Model^a</u>	(std. error)	g_2	(std. error)	F	Months for Return Measures ^b
Panel A:							
ProbabilityOfCashless Unadjusted for Information in Stock Market Prices ^c							
Full Sample							
-1.1824***	(.0626)	-0.4734***	(.1648)			8.25***	1-12
-0.3749***	(.0776)			.0039*	(.0022)	3.19*	1-12
-0.2331***	(.0742)	-0.5259***	(.1734)	.0025	(.0019)	3.86**	1-12
Panel B:							
Elimination of Two Firms with “Death Spiral” Convertibles ^d							
-0.1763***	(.0630)	-0.4710***	(.1683)			7.83***	1-12
-0.3640***	(.0782)			.0038	(.0022)	2.95*	1-12
-0.2263***	(.0747)	-0.5267***	(.1778)	.0025	(.0020)	4.52**	1-12
Panel C:							
Full Sample Over Extended Period							
-0.2914***	(.0588)	-0.4804***	(.1548)			9.63***	0-12
-0.4496***	(.0713)			.0025	(.0020)	1.48	0-12
-0.3139***	(.0689)	-0.5036***	(.1608)	.0011	(.0018)	4.92***	0-12

***, **, * indicates significance at 1%, 5%, and 10% levels, respectively.

^aThe regression model is estimated utilizing an instrumental variables estimator, where the instrument for the Callaghan and Murphy (1998) liquidity measure of the ProbabilityOfCashless is specified to be a dummy variable with a value of 1 for companies with a negative expected ending cash balance over the next year (and 0 otherwise), and the instrument employed for the Altman (1968) Z-score is the 3-group method

^bMonths 1-12 are defined as the 12 months after the announcement of an attempt to restrict short sales. Months 0-12 include the event month. Abnormal returns are measured by subtracting the S&P 500 return from the return on each stock.

^cThe ProbabilityOfCashless is estimated using the Callaghan and Murphy (1998) model without an adjustment for the predictive information incorporated into the ratio of stock’s market price to the estimated accounting cash flow value.

^dThe 2 stocks with “death spiral” convertibles that had conversion ratios varying with stock market prices were removed from the sample.

Table 3

Tests for Differences in Ex-Post Abnormal Equity Returns Between Groups With Ex-Ante Positive and Negative Expected Ending Cash for 166 Firms With Public Complaints of Short Selling of their Stock^a

1-Year Abnormal Returns on 27 Stocks with Negative Expected Ending Cash = -60.2%
1-Year Abnormal Returns on 133 Stocks with Positive Expected Ending Cash = -20.8%

Test	Statistic	z	Significance Level for 2-Sided Test of Differences
Saatterthwaite	-4.06	-4.59	0.0001
Wilcoxon	1777.00	-3.05	0.0023
Van der Waerden	-14.74	-3.05	0.0023
Savage z	-13.29	-2.72	0.0065

^aEx-ante ending cash is estimated by applying to Eq. (4.2) the financial statements for each firm from the year prior to the public complaint about short sales. Abnormal returns are measured by subtracting the S&P 500 return from the return on each stock.

Table 4
Relationship Between Ex-Post Abnormal Equity Returns and Probability of
Bankruptcy Adjusted for Stock Market Prices on 166 Firms With Public
Complaints of Short Selling of their Stock^a

$$\text{Stock Return} - \text{Market Return} = g_0 + g_1 \text{ProbabilityOfCashless} + g_2 Z + \epsilon$$

g_0	(std. error)	<u>Model^b</u>	(std. error)	g_2	(std. error)	F	Months for Return Measures ^c
Panel A							
Full Sample							
-0.1946***	(.0613)	-0.5067***	(.1792)			7.99***	1-12
-0.2330***	(.0754)	-0.5481**	(.1833)	.0019	(.0019)	4.63**	1-12
Panel B							
Elimination of Two Firms with “Death Spiral” Convertibles ^d							
-0.1885***	(.0617)	-0.5060***	(.1838)			7.58***	1-12

***, **, * indicates significance at 1%, 5%, and 10% levels, respectively.

^aThe regression model is estimated utilizing an instrumental variables estimator, where the instrument for the Callaghan and Murphy (1998) liquidity measure of the ProbabilityOfCashless is specified to be a dummy variable with a value of 1 for companies with a negative expected ending cash balance over the next year (and 0 otherwise), and the instrument employed for the Altman (1968) Z-score is the 3-group method

^bMonths 1-12 are defined as the 12 months after the announcement of an attempt to restrict short sales. Months 0-12 include the event month. Abnormal returns are measured by subtracting the S&P 500 return from the return on each stock.

^cThe ProbabilityOfCashless is estimated using the Callaghan and Murphy (1998) model with an adjustment for the predictive information incorporated into the ratio of stock’s market price to the estimated accounting cash flow value.

^dThe 2 stocks with “death spiral” convertibles that had conversion ratios varying with stock market prices were removed from the sample.

Table 5
Relationship Between Ex-Post Abnormal Equity Returns, Book/Market Ratios, and Probability of Bankruptcy Adjusted for Stock Market Prices on 166 Firms With Public Complaints of Short Selling of their Stock^a

$$\text{Stock Return} - \text{Market Return} = g_0 + g_1 \text{ProbabilityOfCashless} + g_2 \text{Book/Market} + e$$

g_0	(std. error)	<u>Model^b</u>	g_1	(std. error)	g_2	(std. error)	F	Months for Return Measures ^c
-0.1548***	(.0784)		-0.5121***	(.1846)	.1215	(.1733)	4.01**	1-12

***, **, * indicates significance at 1%, 5%, and 10% levels, respectively.

^aThe regression model is estimated utilizing an instrumental variables estimator, where the instrument for the Callaghan and Murphy (1998) liquidity measure of the ProbabilityOfCashless is specified to be a dummy variable with a value of 1 for companies with a negative expected ending cash balance over the next year (and 0 otherwise), and the instrument employed for the Altman (1968) Z-score is the 3-group method

^bMonths 1-12 are defined as the 12 months after the announcement of an attempt to restrict short sales. Months 0-12 include the event month. Abnormal returns are measured by subtracting the S&P 500 return from the return on each stock.

^cThe ProbabilityOfCashless is estimated using the Callaghan and Murphy (1998) model with an adjustment for the predictive information incorporated into the ratio of stock's market price to the estimated accounting cash flow value.

Figure 1

Cumulative Compound Returns

