CFR-Working Paper NO. 09-09

Naked short selling: The Emperor`s New Clothes ?

V. Fotak • V. Raman • P. K. Yadav

centre for Financial Research
Look deeper

Naked Short Selling: The Emperor's New Clothes?

Veljko Fotak
Vikas Raman
Pradeep K. Yadav[1]

Abstract

Regulatory and media concern has focused heavily on the potentially manipulative distortion of market prices associated with naked short selling. However, naked shorting can also have beneficial effects for liquidity and pricing efficiency. We empirically investigate the impact of naked short-selling on market quality, and find that naked shorting leads to significant reduction in positive pricing errors, the volatility of stock price returns, bid-ask spreads, and pricing error volatility. We study naked shorting surrounding the demise of financial institutions hardest hit by the financial crisis in 2008 and find no evidence that stock price declines were caused by naked shorting. We also find that naked short-selling intensifies *after* rather than *before* credit downgrade announcements during the 2008 financial crisis. In general, we find that naked short sellers respond to public news and intensify their activity after price declines rather than triggering these price declines. We study the impact of the SEC ban on naked short selling of financial securities during July and August 2008, and find that the ban did not slow the price decline of those securities and had a negative impact on liquidity and pricing efficiency. Finally, after examining the speeds of mean reversion of pricing errors and order imbalances, we infer that Regulation SHO was successful in curbing the impact of manipulative naked short selling, and this reduction in the impact of manipulative naked shorting has continued through the 2008 financial crisis. Overall, our empirical results are in sharp contrast with the extremely negative pre-conceptions that appear to exist among media commentators and market regulators in relation to naked short-selling.

Keywords: Naked Short Selling, Short Selling, Pricing Efficiency
JEL classification: G10, G14, G18
This version: May 22, 2009

[1] Veljko Fotak, Vikas Raman and Pradeep Yadav (corresponding author) are at the *University of Oklahoma, Price College of Business*, Division of Finance, 307 W. Brooks, AH 205A, Norman, OK 73019, tel. (405)3255591. Their email addresses are, respectively: veljko@ou.edu, vikas@ou.edu and pyadav@ou.edu. Pradeep Yadav is also affiliated with the *Department of Accounting and Finance, Lancaster University* (UK), and the *Center for Financial Research at the University of Koln*, Germany. The authors thank Sumit Agarwal, Giovanni Beliossi, Amit Bubna, Tarun Chordia, Sankar De, Chitru Fernando, Robert Engle, Mudit Kapoor, Kiran Kumar, Bill Megginson, Scott Linn, Narayan Naik, Marti Subrahmanyam, Ram Thirumalai, "Vish" Viswanathan, Yesha Yadav, and other participants at the *NISM/SEBI Conference on Securities Markets*, and seminars at the *Indian School of Business* and the *University of Oklahoma*, for helpful comments and discussions. The authors gratefully acknowledge the financial support of the *Institute for Quantitative Investment Research* (INQUIRE), UK, and the *Allen-Rayonier* and *Robertson* foundations at the *University of Oklahoma*. The authors remain responsible for all errors.

Naked Short Selling: The Emperor's New Clothes?

1. Brief Background and Motivation

Short selling is the sale of a stock not owned by the seller. Generally, the stock is borrowed, or adequate borrowing arrangements are made, to ensure availability for delivery at settlement. Such short selling is "covered shorting". On the other hand, "naked short selling" or "naked shorting" is a short sale in which the seller does not arrange to borrow, or even intend to borrow the securities to deliver to the buyer within the standard three-day settlement period. As a result, the seller fails to deliver securities to the buyer when delivery is due (known as a "failure to deliver" or "FTD")[2].

Regulators have understandably sought to curb naked short selling given that regular, intentional and widespread breach of settlement-related contractual delivery obligations can potentially disrupt the smooth functioning of financial markets, even though the *Depository Trust and Clearing Corporation* (DTCC) (electronic) system of a voluntary pool of lenders mitigates such disruptions, and makes naked shorting costly[3]. The Securities and Exchange Commission (SEC), through Regulation SHO, accordingly imposed major restrictions on naked short selling (like the locate requirement) effective from January 2005. More recently, in the wake of the heavy and rapid falls in the prices of financial sector stocks during the current financial crisis, there has been considerable concern about manipulative "bear raids" by naked short-sellers, and US regulators banned naked short selling for select financial institutions between July 21st and August 12th, 2008, since "false rumors can lead to a loss of confidence [and] panic selling, which may be further exacerbated by 'naked' short selling", and as a result, "the prices of securities may artificially and unnecessarily decline well below the price level that would have resulted from the normal price discovery process"[4]. In a similar spirit, Britain's Financial Services Authority (FSA) imposed new regulations on short positions, and restrictive regulations on shorting were enacted in many other countries[5]. On the other hand, there have also been concerns about such restrictions, since short-sellers play "an important role in

[2] Our definition of "naked short sale" follows from the SEC Division of Market Regulation note "Key Points about Regulation SHO", http://www.sec.gov/spotlight/keyregshoissues.htm.
[3] Culp and Heaton (2007) provide an excellent overview of the DTCC system in this context.
[4] Security Exchange Act of 1934, Release No. 58166 / July 15, 2008.
[5] The list of countries which have recently imposed new restrictions on either short selling or naked short selling includes Spain, Portugal, France, Italy, Greece, Germany, Luxemburg, Russia, South Korea, Singapore, Hong Kong and Taiwan ("Regulating Short Selling", *Financial Times*, September 23, 2008).

exposing the poor condition of some companies" and that "neither of the regulators has produced evidence [linking naked short selling to market manipulation] so far" [6].

Contemporaneously, there has been a surge of discussion in the media about the impact of naked shorting. Over 4,600 printed articles have appeared in English-language magazines and newspapers discussing naked shorting in the past 2 years[7]. Of these, an extremely tiny minority depicts naked shorting as beneficial to market quality[8]. The vast majority focuses on the potential for stock price manipulation and on the creation of phantom shares[9]. Other evidence of the current views against naked shorting include at least three investor associations lobbying for restrictions on naked shorting[10], at least three lawsuits by investor groups alleging stock price manipulation linked to naked shorting[11] and at least twelve other lawsuits against the DTCC for allegedly facilitating naked short selling. Several senior managers of major companies targeted by naked short sellers have also been very vocal in their opposition to naked shorting, claiming that naked shorting led to their stock prices being artificially depressed[12]. The SEC has received over 5,000 complaints alleging stock price manipulation through naked short selling between January 2007 and June 2008[13].

However, it can also be forcefully argued that both covered and naked shorting should be beneficial for pricing efficiency and for liquidity. First, both covered and naked short-selling should potentially contribute to the price discovery process by enabling value-traders to more quickly and easily bring the prices of overpriced securities in line with their "true value", as argued by Miller (1977) and Diamond and Verrecchia (1987), among others. And second, financial intermediaries and other liquidity suppliers should be able to provide liquidity more

---

[6] "Naked Fear", *The Economist* (July 24, 2008).
[7] We used the *Factiva Database* to search for the term 'naked short selling', restricting our search to publications in English over the period 8/10/2006-8/10/2008.
[8] One rare example is "Don't Force the Shorts to Get Dressed", *Business Week* (Dec. 8, 2003).
[9] While the SEC and the DTCC deny the possibility of phantom shares arising from failed trades, many commentators disagree. Former SEC chairman Harvey Pitt has often made the link between FTDs and phantom shares, for example by claiming (as per Welborn, 2008) that "phantom shares created by naked shorting are analogous to counterfeit money". See also Culp and Heaton (2007) for more detailed discussion in this regard.
[10] *The Movement for Market Reform*, the *National Coalition Against Naked Short Selling* (NCANS) and the *Coalition for the Reform of Regulation SHO*.
[11] *The Biovail lawsuit* against Stephen Cohen, Gradient, and a host of others; *the Overstock lawsuit* against Rocker Partners, Gradient, and a host of others; and *The NFI lawsuit* brought by NFI shareholders against *Bank of America* (the Specialist) and the Prime Brokers.
[12] Patrick Byrne, CEO of Overstock.com, has been very vocal in this regard and has been lobbying for new regulations against naked short selling, while the corporation itself has initiated lawsuits against both naked short sellers and financial institutions accused of facilitating naked short selling (http://www.overstock.com/naked-short-selling.html). More recently, Bear Stearns CEO Alan Schwartz, Morgan Stanly CEO John Mack and Lehman Brothers CEO Richard Fuld have all blamed naked short sellers for price declines of their stock.
[13] "Naked short sales provoke complaints", *The Wall Street Journal Asia* (March 20, 2009). In this context, for example, in 2003, the SEC settled a case against parties accused of manipulating stocks through naked short selling: SEC v. *Rhino Advisors Inc.* and Thomas Badian, Feb. 26, 2003.

effectively and expeditiously in the presence of both covered and naked short-selling. While one would expect naked shorting to be at least as beneficial as covered shorting in this context, and arguably more so, the SEC has, because of the fear of *manipulative* naked shorting, *relaxed* covered-shorting restrictions but *increased* naked-shorting restrictions, through, for example, the "locate" and "close-out" requirements under Regulation SHO, removal of the uptick rule, and the temporary naked shorting "bans" during the 2008 financial crisis[14].

There is a significant body of literature focusing on the impact on market quality of short selling. This literature largely suggests and does actually find that short-selling is potentially beneficial both for pricing efficiency and liquidity[15], but also offers evidence linking short selling to price manipulation[16]. However, this literature does not distinguish between covered and naked short-selling. In particular, existing research does not provide any evidence specifically on the effect of naked shorting on liquidity, price distortions and pricing efficiency, and the extent to which the effects of naked shorting exist after controlling for covered-shorting. Our study fills this void in existing literature.

Using data on fails to deliver for the first half of 2007[17], we estimate that naked shorting has affected about 91% of NYSE securities, about 71% of NASDAQ securities and about 60% of AMEX and ARCA securities. Using a random sample of 300 NYSE securities, and a vector autoregressive model to control for causality and endogenous interrelationships between market quality metrics, we find that an increase in naked short selling leads to lower positive pricing errors, lower pricing error volatility, reduced stock price volatility and lower order imbalances. We also observe that naked short selling intensifies after positive order imbalances. These results are consistent with market makers employing naked short selling to provide liquidity when it is otherwise scarce and value arbitrageurs enhancing pricing efficiency through naked short selling. As we are more likely to find negative effects associated with naked short selling when it is most intense, we also focus on a sample of the most naked shorted securities. Even in

---

[14] The "locate" requirement obligates a broker-dealer to have, before executing a short sale order, reasonable grounds to believe that the security can be borrowed for timely delivery. The "close-out" requirement imposes additional delivery obligations on broker-dealers for "threshold" securities with a relatively high number of FTDs.

[15] Theoretical models predicting a beneficial impact of short-selling on market quality include Miller, (1977), Diamond and Verrecchia (1987), Abreu and Brunnermeier (2002, 2003) and Scheinkmann and Xiong (2003). Empirical studies supporting those theories include, among others, Harrison and Kreps (1978), Pope and Yadav (1994), Asquith and Meulbroek (1996), Aitken et al. (1998), Danielsen and Sorescu (2001), Jones and Lamont (2002), Gezy et. al. (2002), Ofek and Richardson (2003), Daouk and Charoenrook (2005), Reed (2007), Bris et. al. (2007), Boehmer et al. (2008).

[16] For example, Shkilko et al. (2008) offers evidence that short-selling is often used as a tool for price manipulation and thus destabilizes prices.

[17] Data on fails to deliver has recently been made public by the SEC under the Freedom of Information Act. Data on FTDs provided by the SEC is available at http://www.sec.gov/foia/docs/failsdata-archive.htm

this sample, we find a positive impact on market quality: a one percentage point increase in the incidence of naked short selling leads to approximately a 2.8% reduction in returns volatility, a 1% reduction in bid-ask spreads, a 4.3% decline in pricing error volatility and a 4.6 % decline in positive pricing errors.

Since naked short sellers have been widely accused in the media for having contributed to the financial crisis by precipitating *manipulative* price declines of financial firms in 2008, we analyze a few high-profile individual cases of financial firms that experienced dramatic stock price declines. In particular, we analyze naked short selling in *Bear Sterns Companies Inc.* (Bear Stearns), *Lehman Brothers Holdings Inc.* (Lehman), *Merrill Lynch & Co. Inc.* (Merrill), and *American Insurance Group* (AIG). We find that, except for one instance in June 2008 of possible stock price manipulation through naked shorting in relation to *Lehman Brothers Holdings Inc.*, most of the time, naked short selling was too low to reasonably "cause" significant stock price distortions, and when naked shorting did become abnormally heavy, it was *after* dramatic price declines, *not before*, indicating that naked short sellers were *responding to* public domain information about the firms, rather than being responsible for triggering the observed precipitous price decline. We further analyze how naked short selling changes around public news of credit rating downgrades, and again find that naked short selling increases *after* rather than before the credit downgrade announcement, again consistent with naked short sellers *responding to* public information, rather than being responsible for triggering price declines.

We also analyze the market impact of the SEC naked short selling ban for 19 financial securities between July 15 and August 12, 2008. For the period during which the ban was enacted, we find significantly higher absolute pricing errors and significantly lower trading volumes, indicating that the naked short selling ban hampered price discovery and reduced liquidity. Returns, albeit negative, were not significantly affected, indicating that the ban failed to slow the price decline of the related securities.

Finally, we examine changes in the impact of *manipulative* naked shorting, in contrast to naked shorting that improves pricing efficiency or liquidity. We find that negative pricing errors and negative order imbalances mean-revert at a significantly faster rate after Regulation SHO, indicating a lower impact of manipulative naked short selling after Regulation SHO; and importantly, this reduced impact of *manipulative* naked shorting has continued through the 2008 financial crisis.

The remainder of the paper is structured as follows. Section 2 briefly reviews extant research on naked short selling. Section 3 develops our hypotheses. Section 4 defines the measures and variables we use for naked and covered shorting, pricing efficiency, and liquidity.

Section 5 documents our empirical methods and results: provides salient descriptive statistics; investigates the impact of naked shorting on market quality; analyzes the role of naked short sellers around major economic events over the financial crisis period, e.g., the demise of Bear Stearns and Lehman Brothers, the near-demise of Merrill and AIG, and around credit rating downgrade announcements; examines the impact of the ban on naked short selling of select financial securities in July and August 2008, and analyzes changes in the impact of manipulative naked short-selling in the context of Regulation SHO and the 2008 financial crisis. Section 6 presents concluding remarks.

2. Extant Research on Naked Short-Selling

A large body of existing research examines the relation between short selling and market quality. Diamond and Verrecchia (1987) conclude, on the basis of their theoretical model, that short-selling constraints do not bias prices upwards, but reduce the speed of adjustment of prices to private information, and hence reduce pricing efficiency. Abreu and Brunnermeier (2002, 2003) and Scheinkmann and Xiong (2003) show theoretically that constraints on short selling are linked to bubbles and excess market volatility. Early studies supporting the view that short selling reduces overpricing and increases market efficiency include Miller (1977) and Harrison and Kreps (1978). Pope and Yadav (1994) find that spot-market short-selling restrictions make index futures more negatively mispriced, leading to a pricing bias. Asquith and Meulbroek (1996), Aitken et al. (1998), Danielsen and Sorescu (2001), Jones and Lamont (2002), Gezy et. al. (2002), Ofek and Richardson (2003) and Reed (2007) provide evidence that stock prices do not fully incorporate information in the presence of short sale constraints. Daouk and Charoenrook (2005) study the effects of changing restrictions on short selling in 111 countries and conclude that allowing short selling improves market quality. Bris et. al. (2007) similarly analyze equity markets around the world and find that prices incorporate negative information faster in markets where short sales are allowed. Diether et al. (2007) document that the temporary suspension of the uptick rule that restricted short-selling did not negatively affect market quality, and conclude that the suspension can be made permanent[18]. Boehmer et al. (2008) use proprietary NYSE order data to find that short sellers are, on average, better informed, and contribute to efficient pricing. Shkilko et al. (2008) focus on short selling during intraday liquidity crises and observe that short-sellers have price-destabilizing effects: they

[18] Later on the SEC did actually permanently suspend the uptick rule.

conclude that short-selling is often used as a tool for price manipulation and short selling restrictions would improve market quality.

The literature focusing specifically on naked short selling is much less developed. There are two academic "thought-pieces" without any theoretical models or empirical evidence: Christian et al. (2006) provide a descriptive review of naked shorting from a legal perspective; and, Uchimoto et. al. (2005) discuss the impact of naked short selling on ETF trading, conjecturing adverse impacts on capital formation and pricing efficiency, particularly for small and emerging companies. There are also two theoretical papers on naked shorting without any empirical evidence. Finnerty (2005) develops a theoretical model for market equilibrium in the presence of short selling, both covered and naked shorting, and concludes that naked short selling is likely to be used as an instrument for market manipulation. On the other hand, Culp and Heaton (2007) offer a theoretical model of the effects of naked shorting on markets, and, in the context of an extensive analysis of the DTCC settlement system, conclude that "naked shorting is not fundamentally different from traditional short selling and is unlikely to have detrimental effects on capital markets".

We are aware of three empirical studies specifically on naked shorting. First, Evans et al. (2008) use data from one market maker to link FTDs to hard-to-borrow situations and examine the possibility of arbitrage based on misalignments between the option and stock markets. Second, Boni (2006) analyzes delivery failures in U.S. equity markets. She finds that, prior to Regulation SHO, most U.S. equity issues, listed and unlisted, experienced at least a small percentage of failures-to-deliver each day. A substantial fraction of issues (42% of listed stocks and 47% of unlisted stocks) had persistent fails of 5 days or more. She conjectures that Regulation SHO would lead to less liquidity, increased price volatility and temporary short squeezes, but does not offer any empirical evidence on the issue[19]. And third, Edwards and Hanley (2008) examine the effect of short selling constraints and of naked short selling on the short-term performance of IPOs, and find that IPOs with greater naked shorting are more accurately priced.

However, we are not aware of *any* empirical research that investigates the link between *naked* shorting and market quality: we fill this gap in the literature with the present paper. Our aim is to empirically investigate naked shorting in the context of manipulative price distortions, pricing efficiency and liquidity; and thereby offer insights into the tradeoff market regulators

[19] Merrick, Naik and Yadav (2005) provide evidence that suggests that the "right to fail" provides an important release valve for settlement related pressures and limits the damage a potential squeezer can cause. This generates another perspective on the potential problems that can arise from restricting naked short selling.

face. Our expectation is that naked short selling potentially increases the risk of manipulative episodes, but also leads to an improvement in market quality by reducing pricing efficiency and increasing liquidity.

3. Development of Hypotheses

As highlighted in the introduction and the footnotes therein, the media and the CEOs of affected firms have vociferously and persistently accused naked short-sellers of undertaking "bear raids" and thereby causing associated stock prices to decline. Regulators have also sometimes accused naked short sellers of depressing stock prices[20]. Accordingly, our first hypothesis is the following:

H1: Naked short selling depresses stock prices.

While the large body of literature that has examined the relationship between short sales and pricing efficiency has sometimes documented contrasting results, a growing consensus is emerging that short sellers enhance price efficiency. Two recent studies are especially relevant here. First, Diether et al. (2007) use the recently available data on daily short sales to find that short sellers correct overreaction in stock prices. Second, Boehmer et al. (2008) use proprietary NYSE order data to find that short sellers, especially institutional short sellers, act as value arbitragers and correct overpriced securities to bring about permanent price effects and hence contribute to efficient pricing. While there is no empirical evidence in regard to naked short selling, Culp and Heaton (2007) argue that naked and covered short sales should have similar impacts on security markets. Similar to a covered short sale, a naked short sale (which eventually leads to a FTD) starts off with a short seller agreeing to sell a security to a buyer at the prevailing market price; but, unlike a covered short sale, the naked short seller fails to deliver the security to the buyer (on day t+3) because she has not borrowed the security from a lender[21]. Ordinarily, the DTCC system triggers immediate delivery to the buyer through borrowing from a voluntary pool of lenders, and even where the pool is empty, the buyer, by holding the selling price of the stock as collateral and also maintaining an exposure to the security, effectively becomes the lender of the security to the naked shorter. Accordingly, Culp and Heaton (2007) argue that, except for this nuance of a change in roles, covered and naked short sales are

[20] For example, Robert J. Shapiro, former undersecretary of commerce for economic affairs, claims that naked short selling costs investors $100 billion and has driven 1,000 companies into the ground ("Watch Out, They Bite!", *Time Magazine* (November 9, 2005)).

[21] Geczy, Musto and Reed (2002) note that since equity loans settle on T+0 and short sales settle on T+3, short sellers normally borrow only on T+3. Hence, at inception, a covered and a naked short sale are, usually, indistinguishable. The distinction only becomes apparent at settlement.

functionally indistinguishable. In view of this functional similarity, and the emerging consensus of an improvement in price discovery associated with short selling in general, our hypothesis is:

H2: Naked short selling reduces positive pricing errors.

Given that we know from Hasbrouck (1993) that informationally efficient markets display lower dispersion of pricing errors, our hypothesis is:

H3: Naked short selling reduces the volatility of pricing errors.

Naked short selling is often employed by market makers and other liquidity providers to quickly and efficiently fulfill orders. The SEC accordingly asserts on its website that "in certain circumstances, naked short selling contributes to market liquidity. For example, broker-dealers that make a market in a security generally stand ready to buy and sell the security on a regular and continuous basis at a publicly quoted price, even when there are no other buyers or sellers. Thus, market makers must sell a security to a buyer even when there are temporary shortages of that security available in the market. This may occur, for example, if there is a sudden surge in buying interest in that security, or if few investors are selling the security at that time. Because it may take a market maker considerable time to purchase or arrange to borrow the security, a market maker engaged in bona fide market making, particularly in a fast-moving market, may need to sell the security short without having arranged to borrow shares. This is especially true for market makers in thinly traded, illiquid stocks"[22]. In fact, naked short selling is a mechanism to improve the efficiency of security-lending markets since the option to fail becomes particularly valuable when borrowing is too expensive for covered short sellers, which is exactly when liquidity is most needed (Evans, Geczy, Musto and Reed, 2008). In this context, we expect naked short sales to increase liquidity (by decreasing bid-ask spreads) and to reduce order imbalances. This leads us to our next set of hypotheses:

H4: Naked short selling reduces bid-ask spreads.

H5: Naked short selling reduces order imbalances.

We expect that improvements in both liquidity and pricing errors should translate into more orderly and less volatile markets. Accordingly, we expect to observe lower stock price volatility in the presence of naked shorting. Hence, we hypothesize that:

H6: Naked short selling reduces stock price volatility.

Naked short-sellers are typically thought of as undertaking "bear raids" to trigger downward price spirals, and specifically with the aim of achieving credit downgrades so as to

[22] http://www.sec.gov/spotlight/keyregshoissues.htm

also profit from simultaneous positions in the CDS market. In this context, we test the following hypotheses:

H7A: Naked short-sellers triggered the price crashes associated with Bear Stearns, Lehman, AIG and Merrill.

H7B: Naked short-sellers triggered credit downgrades.

We investigate the impact of SEC restrictions on naked short selling introduced in the wake of the 2008 financial crisis. Given that we expect naked short selling to improve liquidity, reduce the volatility of pricing errors, and accelerate price declines, we expect restrictions on naked short selling to have the opposite effect. Hence, we hypothesize that:

H8A: Restrictions on naked short selling reduce trading volumes.

H8B: Restrictions on naked short selling increase bid-ask spreads.

H8C: Restrictions on naked short selling increase pricing error volatility.

H8D: Restrictions on naked short selling increase returns.

We test the effect of Regulation SHO and the 2008 financial crisis on the impact of manipulative naked short-selling. In this context, we note that naked short-sellers can have three trading motivations. They could be value arbitrageurs aiming to profit from positive pricing errors; or dealers or other traders aiming to profit from supplying liquidity (by selling when order imbalances are positive and buying when they are negative); or the manipulative traders that Regulation SHO was intended to curb and regulate. If Regulation SHO has been effective, we would expect that the impact of manipulative naked shorting would have declined after Regulation SHO, leaving only the beneficial effects on liquidity and pricing efficiency. Furthermore, we would not expect any significant differences in the wake of the 2008 financial crisis.

It is difficult to precisely define the criteria that can be used to identify and classify naked short-sellers as potentially manipulative. We define potentially manipulative naked short-sellers from the mind-set used in the financial crisis media coverage of naked short-selling, i.e., the mindset of bear-raids, based on whether naked shorting is undertaken at a time when pricing errors are positive or negative. If naked shorting is done when pricing errors are positive, it contributes positively to pricing efficiency. If it is done when pricing errors are negative, then it will arguably further amplify negative pricing errors in the next period, and thereby contribute to generating a bear-raid scenario. Hence, we would expect that the mean reversion of pricing errors, conditional on the pricing error being negative, will decrease in the presence of greater manipulative naked shorting.

We can apply similar criteria based on order imbalances. If naked shorting is done when order imbalances are positive, naked shorting will arguably have a positive liquidity-related impact. However, following the same mind-set of bear raids, naked short-selling will be potentially manipulative if it is initiated at a time when order-imbalances are negative, since it will cause them to become even more negative. Hence, once again, we would expect that the mean reversion of order-imbalances, conditional on the order-imbalance being negative, will decrease in the presence of greater manipulative naked shorting.

Accordingly we test whether:

H9A:Regulation SHO increases the rate of mean reversion of negative pricing errors.

H9B:Regulation SHO increases the rate of mean reversion of negative order imbalances.

H9C:The financial crisis does not change mean reversion of negative pricing errors.

H9D:The financial crisis does not change mean reversion of negative order imbalances.

4. Definitions of Measures and Variables

Table 1 summarizes the measures and variables we use in this paper. The measures and variables related to short-selling and pricing error are explained in greater detail in this sub-section. Liquidity measures and other variables in Table 1 are as commonly used in the literature.

4.1 Naked Short Selling

Our proxy for naked short selling is based on the outstanding number of fails to deliver (FTDs), daily data on which has been made available by the SEC under the Freedom of Information Act (FOIA) since March 22, 2004[23]. In this context, we note that, while every naked short sale does, by definition, result in an FTD, every FTD does not necessarily originate from a naked short sale. In particular, we can think of three specific factors that can make an FTD-based proxy imperfect.

First, as highlighted by the SEC, "human or mechanical errors or processing delays can result from transferring securities in physical certificate rather than book-entry form, thus causing a FTD. However, we believe such errors and delays should be random and not systematically related to any of our hypotheses and therefore may add noise but should not affect any of our conclusions. Further, former SEC commissioner Roel Campos stated in an

[23] The SEC dataset records outstanding fails to deliver only when the latter exceed 10,000 shares. We assume that, when no FTDs are reported, the number of FTDs is equal to zero. Also, in the SEC data, each share not delivered is counted twice, as the related failure to receive is recorded separately as well. Hence, to obtain a count of outstanding FTDs, our first adjustment is to divide each entry in the series by two.

interview that "The majority of these failures-to-deliver are not the result of honest mistakes or bad processing"[24].

Second, Edwards and Hanley (2008) suggest that FTDs "in price supported IPOs may arise from the mechanism of the offering process". Accordingly, to avoid the possibility of IPO-related FTDs, we exclude securities that started trading during our sample interval.

Third, it can be conjectured that a reported FTD may be caused by the trader that fails to receive (and hence not caused by naked shorting). In this context, we note that Evans et al. (2008) find that the number of FTDs is strongly related to rebate rates, indicating that FTDs originate largely from (naked) short transactions; and Boni (2006) shows that the number of FTDs is related to the number of short sales, and offers evidence that market makers 'strategically' fail to deliver when borrowing costs are high, again pointing to FTDs being governed by (naked) short selling. Still, we undertake our own empirical analysis to more formally test for this conjecture, and, consistent with extant research, do not find any support for it. Specifically, as per the regression results we report in Table 2, we find that the number of new FTDs each day is strongly and significantly related (p-value<<0.01) to the daily contemporaneous trading volume arising from short sales (that includes and should arguably be correlated with the number of naked shorts), and is *not* significantly related to the 'non-short' daily trading volume arising from regular sales (which should arguably be the source of any FTDs that are driven by failures to receive)[25].

We accordingly proxy the intensity of naked short selling by an FTD-based measure: the *Outstanding Naked Short Ratio* (*ONSR*) defined for each day *T* as the estimated cumulative naked short sales till day *T* scaled by the total number of shares outstanding (obtained from *CRSP*). To calculate the cumulative naked short sales till day *T, w*e adjust the outstanding FTDs data from SEC by adding the naked short sales that have already taken place but have not yet been observed because they will show up only after settlements are duly completed over days *T+1, T+2* and *T+3*[26]. We also compute the *New Naked Short Ratio* on day *T* as the number of

[24] "Short Sellers Squeezed All Around", *The Wall Street Journal* (April 7, 2009).

[25] We use the Regulation SHO TAQ database for the first half of 2007 to obtain the total daily number of shares traded and the total daily number of shares shorted, and thereby infer the 'non-short' daily trading volume arising from regular sales. We run security-specific regressions of new FTDs on short volume and non-short volume, and employ a Fama and MacBeth (1973) type procedure to aggregate and test for statistical significance. The results are available upon request. For the sake of brevity, they are not included in the main text.

[26] For each day *T*, the difference between cumulative FTDs on day *T* and cumulative FTDs on day *T-1* is equal to the number of new naked shorted shares minus the number of previously outstanding FTDs closed on day *T*. While we do not have data on the number of previously outstanding FTDs settled on a particular day, we approximate it on the basis of the *Office for Economic Analysis* memorandum dated August 21, 2006, "Fails to Deliver Pre- and Post-Regulation SHO" and the assumption of constant settlement rates.

new FTDs on day *T* divided by the number of shares traded on day *T*; and the *Naked to All Shorts Ratio* as the *ONSR* divided by the short interest[27].

Finally, to additionally reassure ourself that our FTD-based *ONSR* measure is a good proxy for naked shorting, we examine whether major time-series dips and surges in *ONSR* correspond to periods during which we have good economic reason to independently expect such dips and surges. Accordingly, Figure 1 presents a plot of market-wide average *ONSR* across all securities, and cumulative S&P 500 index returns for 2007 and 2008. Two features are immediately apparent. First, the low frequency crests in ONSR correspond roughly to the low frequency troughs in cumulative S&P 500 index returns, and vice-versa. Second, and more importantly, *ONSR* drops sharply in two periods where we would have independently expected it to drop, and in at least the second period, the sharp drop cannot be related to returns since the change in cumulative returns is in a direction opposite to what it is in other periods. Specifically, *ONSR* drops sharply between July 21 and August 12, 2008 when the SEC heavily increased restrictions on naked short-selling. And it drops sharply again between September 19 and October 9, 2008, when the SEC banned short sales on 799 financial stocks. Clearly, Figure 1 provides strong independent support for our FTD-based *ONSR* measure being a good proxy for naked short-selling.

4,672 NYSE, AMEX, NASDAQ or ARCA securities have at least one FTD observation exceeding 10,000 shares over our 2007 sample period, and constitute our sample of what we hereafter refer to as "securities with naked shorts". They represent about 91% of NYSE-listed securities, 61% of AMEX securities, 71% of NASDAQ securities, and 60% of ARCA securities.

In order to control for the effects of covered short selling, we also compute the *Covered Short Ratio (CSR),* the daily number of covered-shorted shares scaled by the daily trading volume in shares. Covered-shorted shares are estimated as the difference between the total number of shorted shares (obtained from the Regulation SHO data in TAQ) and the number of new FTDs on the day.

4.2 Pricing Error

In order to examine the effect of naked short selling on pricing efficiency, we construct, for each sample security, a daily estimate of information-efficient "random-walk" price in the spirit of Hasbrouck (1993), specifically using a Kalman-filter based methodology as in Dong, Kempf and Yadav (2008). The outline of the estimation model is as follows:

[27] Monthly short interest data was obtained from www.shortsqueeze.com

$$S(t) = F(t) + Y(t)$$

$$F(t) = \mu + F(t-1) + \varepsilon(t), \quad \varepsilon \sim N(0, \sigma_\varepsilon^2)$$

$$\Delta Y(t) = -\alpha Y(t-1) + \phi(t)$$

Where : $\Delta Y(t) = Y(t) - Y(t-1)$, *S(t)* is the observed log of stock price, *F(t)* is the log of information-efficient "random-walk" price, *Y(t)* is the pricing error defined as the difference between the log of the observed price and the log of this information-efficient price, and α is the rate of mean-reversion in pricing errors, i.e., the proportion of pricing error that is corrected over one time period. α is expected to range between 0 and 1, with pricing errors corrected instantaneously when α is equal to one and not corrected at all when α is equal to zero.

We accordingly calculate daily estimates of the *Pricing Error* for each day and each sample security, using daily returns data from the CRSP database. We also calculate the other pricing-error related variables from the *Pricing Error* as defined in Table 1.

5. Empirical Results

5.1 Data and Samples

Our naked shorting measures are based on SEC FOIA data as described in Section 4.1 and are available from late March 2004 to end-2008. Our market quality measures are based on NYSE TAQ data. We use TAQ short sales data released after Regulation SHO to control for covered shorting. These daily short sales data are not available after June 30, 2007, and are currently available only for securities whose primary exchange is the NYSE. Accordingly, we confine ourselves hereafter to NYSE-listed securities, and our inferences relating to the impact of naked shorting on market quality are first based on the 6-month time period January 1to June 30, 2007, where we are able to fully control for covered short sales. Since the computation of market quality measures is very resource intensive, we select a random subset of securities for in-depth analysis. We focus on common shares of US-listed securities (CRSP share codes 10 and 11) listed on the NYSE over the entire period January 1, 2007 to June 30, 2007; we rank each security by the average *ONSR* over the interval and allocate those with any FTDs to deciles 1 (lowest average *ONSR*) through 10 (highest average *ONSR*). 30 securities for which we have complete data over the entire time interval[28] are then randomly selected from each decile. Hence, our first sample covers the first half of 2007 and contains 300 securities. We call this the '2007 Overall Sample'.

[28] As previously mentioned, we focus on securities which were traded over the entire time interval to avoid the confounding effects of IPO-related FTDs.

In order to provide insight into the impact of naked shorting when such naked shorting is particularly heavy, we also focus on the subset of securities in decile 10 of the overall market. There are a total of 207 securities[29] in this decile, and we select *all* of these securities without any sampling, and they constitute our '2007 Most Naked-Shorted Sample'.

In order to investigate changes in the impact of manipulative naked short-selling, we also investigate a period before Regulation SHO and a period covering the financial crisis, albeit only for analyses that can be done without covered or total short-sales data. In this context, we analyze, first, a 'pre-SHO' '2004 Most Naked Shorted sample' based on the period April to October 2004[30], and second, a 'financial crisis' '2008 Most Naked Shorted sample' based on the period January to June 2008; both constructed in a manner analogous to our '2007 Most Naked Shorted sample'.

5.2 Preliminary Analyses

Table 3 reports descriptive statistics on the distribution of *Outstanding Naked Short Ratio* and *New Naked Short Ratio* for our main 2007 sample period, and also for the 2008 financial crisis period, for all NYSE stocks of US-incorporated firms included in the TAQ database during the respective six month periods. In addition, given regulatory and media concern about naked shorting of financial stocks in 2008, the table separately reports these descriptive statistics for the subset of financial stocks in 2008. We are also able to calculate and report the *Naked to All Shorts Outstanding Ratio* for the 2007 sample period, but we are not able to do so for 2008, since Regulation SHO data on total shorts is not available after June 30, 2007.

For our 2007 sample period, across the universe of NYSE-listed stocks, outstanding naked shorted shares are, on an average, only about 0.1% of overall shares outstanding and about 3.5% of all outstanding short positions; even the 99th percentiles of the distributions are only 1.5% and 31% respectively. New short sales account for about 1.0% of overall trading volume but are as high as 19.3% for the 99th percentile. But, surprisingly, naked short selling did not intensify during the financial crisis of 2008. Both outstanding and new naked shorts decline in the first half of 2008. They decline further in the latter half of 2008, though that is not surprising given the increased restrictions on naked shorting over that period.

Interestingly, overall averages of naked short selling measures for financial stocks, those most hit by the 2008 financial crisis, albeit slightly higher, are not very different from similar

[29] Share code 10 and 11 only, NYSE listed over the entire period.
[30] We focus on the period April to October 2004 as that is the earliest 6-months period during which data on fails to deliver is available to us.

averages for the sample of all stocks, both in 2007 and in 2008. However, the 90th and 99th percentiles approximately double in 2008 from their 2007 values, suggesting that naked short selling did increase during the financial crisis for the subset of the most naked shorted securities.

Table 3B presents descriptive statistics that shed first light on the interrelationship between naked shorting and different metrics of pricing error. Along with the 10 deciles of our '2007 Overall Sample', we include 30 securities randomly selected from the set of NYSE securities with no naked shorts in that period. This group is called Decile 0. In Table 3B, average *ONSR* increases monotonically across deciles by construction, but the increase is dramatic from 0.05% for Decile 9 to 0.49% for Decile 10. The *New Naked Short Ratio* increases in the same way. *Covered Short Ratio* also increases monotonically across *ONSR* deciles, indicating that securities with high naked shorting also have high covered shorting. Interestingly, the average pricing errors and the proportion of positive pricing errors increase across deciles, indicating positive correlation, and that naked short selling is greater for overpriced securities, and inconsistent with media suggestions that naked short-selling depresses stock prices below their fundamental value. *Spread* and *Share Turnover* are increasing across deciles and highest for the most naked shorted securities; similarly, the average *Order Imbalance* is also positive for all deciles, and the highest for deciles 9 and 10. These results indicate that naked short sellers are, in fact, net providers of liquidity, shorting shares when there is an excess demand on the long side. Larger firms have less naked shorting, though, clearly, there are also a large number of small firms in the no-naked-shorting sample. Finally, we observe that institutional ownership declines across deciles, indicating that firms with high institutional shareholding have less naked shorting. As institutional shareholding and firm size have often been used as a proxy for the ease of shorting, for example by Geczy, Musto and Reed (2002), our results appear to indicate that naked short selling increases when short selling is difficult or expensive.

For further preliminary exploration of the interrelationships that appear to exist in Table 3B, between naked short selling, covered short-selling, pricing error and order-imbalance, we focus on the '2007 Most Naked-Shorted Sample'. For each security in this sample, we identify the day on which naked short selling is at its highest and label this day as event 'day 0'. Relative to this "event date", we compute our metrics of interest for each day and for each security from day -20 to day +20, standardize each market quality metrics by security[31], and finally, average the standardized metrics across securities. Figure 2 is a plot in event time of standardized values

[31] In order to standardize variables, we compute security-specific means and standard deviations. We subtract the security-specific mean from each daily observation; and then divide the resulting number by the security-specific standard deviation.

of the *Outstanding Naked Short Ratio*, the *Covered Short Ratio*, the *Pricing Error Volatility*, *Spread*, and the *Order Imbalance*. The plots clearly show that abnormally high naked shorting follows spikes in covered short selling, and importantly, also in pricing error volatility. The latter indicates that naked short-sellers are, on average, functioning as value-arbitrageurs by reducing pricing error as a result of their actions. Order imbalances appear positive prior to the peak in naked short selling, but decline immediately afterwards, indicating that naked short-sellers are providing liquidity by shorting shares when there is an excess demand on the long side.

5.3 Naked Short-Selling and Returns

Over long horizons spanning several weeks or months, our Figure 1 indicates that higher long horizons returns are associated with relatively lower naked shorting. But, contrary to Hypotheses *H1*, and to media rhetoric and popularly held pre-conceptions, our preliminary daily-horizon analysis above does not indicate any association between naked short-selling and short-horizon (negative) returns. In fact, naked short-sellers appear to be active when securities are over-priced, and appear to be reducing these positive pricing errors towards zero rather than further amplifying already negative pricing errors.

We investigate the relationship between naked short-selling and short-horizon returns more formally in this sub-section. Given that covered shorting is correlated with naked shorting, it is necessary to add covered shorting as a control variable. We accordingly use a vector autoregressive model (hereafter VAR) to test for causality between naked short selling, covered short selling and returns over a daily horizon, while controlling for the endogenous interrelations between those variables. The variables we include are changes in *New Naked Short Ratio*, *Covered Short Ratio*, and *Return*. Accordingly, the system of three equations that we estimate is formally described in Table 4.

We estimate the VAR model in Table 4 separately for each security. All variables are standardized by subtracting the security-specific mean and dividing by the security-specific standard error, and then winsorized at three standard deviations from the mean. Using the Box-Jenkins procedure, we determine that it is most appropriate to use a VAR of order one. In order to draw inferences about true population parameters, we employ a Fama and MacBeth (1973)-type procedure: after estimating parameters by security, we compute a cross-sectional average of the parameter estimates; and significance is tested by computing the cross-sectional standard error of the parameter estimate.

Parameter estimates and tests for significance for this vector autoregressive model are presented in Table 4 Panel A and Table 4 Panel B for the '2007 Overall Sample' and the '2007 Most Naked-Shorted Sample' respectively. Our results show that, consistent with our earlier results in Table 2 and Section 4.1, there is strong and significant positive feedback between naked shorting and covered shorting. However, while changes in returns are highly negatively related to lagged covered short selling for the overall sample, we do not find any significant relationship between returns and lagged naked short selling for either of the samples. Overall, we do not find any evidence that naked short selling depresses stock prices in the short-term.

5.4 Naked Short-Selling and Market Quality

5.4.1 Main Results

Consistent with Hypotheses *H2*, *H3*, *H4*, and *H5*, our exploratory results in Section 5.2 suggest that naked short-sellers act as value arbitrageurs (naked short selling intensifies when pricing errors are positive) and as liquidity suppliers (naked short selling intensifies when order imbalances are positive). We investigate the relationship between naked short-selling and measures of market quality more formally in this sub-section. To test for causality while controlling for endogenous interrelations, we use two VAR models, with additional exogenous variable(s). The system of equations underlying each of these models is formally specified in Table 5.

In VAR Model 1, our VAR variables are changes in *Outstanding Naked Short Ratio*, *Covered Short Ratio*, *Pricing Error*, *Volatility*, *Spread* and *Order Imbalance*. In addition, we add two exogenous variables. In the pricing error equation, we add, as a predictor, an interaction between lagged changes in *Outstanding Naked Short Ratio* and a binary variable set equal to one when lagged pricing error is positive. Accordingly, we are able to separately estimate the impact of naked short selling on pricing error when the pricing error is positive in contrast to when the pricing error is negative. We add one more predictor to the equation in which the change in *Outstanding Naked Short Ratio* is the response variable: a binary variable set equal to one when order imbalance is positive and zero otherwise. This allows us to check whether positive order imbalances lead to a higher incidence of naked short selling.

In VAR Model 2, we replace *Pricing Error* by *Pricing Error Volatility*, or effectively the absolute value of the *Pricing Error*. Hence, in this Model 2, our VAR variables are changes in *Outstanding Naked Short Ratio*, *Covered Short Ratio*, *Pricing Error Volatility*, *Volatility*, *Spread* and *Order Imbalance*. In addition, we add one more predictor to the equation in which the change in *Outstanding Naked Short Ratio* is the response variable: we add a binary variable

set equal to one when order imbalance is positive and zero otherwise. This allows us to check whether positive order imbalances lead to a higher incidence of naked short selling.

We estimate VAR Model 1 and VAR Model 2 in Table 5 separately for each security. For both Model 1 and in Model 2, the results we report in Table 5 are based on standardizing all variables by subtracting the security-specific mean and dividing by the security-specific standard deviation, and then winsorizing at three standard deviations from the mean, as before. Using the Box-Jenkins procedure, we determine that, for both Model 1 and Model 2, it is most appropriate to use a VAR of order one. In both cases, in order to draw inferences about the true population parameters, we compute a weighted cross-sectional average of the parameter estimates, with weights inversely proportional to associated standard errors. Statistical significance is tested by averaging firm-specific t-statistics in the cross-section. It is assumed that the cross-sectional distribution of the t-statistics is approximately normal, and the cross-sectional standard error of the t-statistic is employed in significance testing.

We estimate VAR Model 1 and VAR Model 2 for both our '2007 Overall Sample' and our '2007 Most Naked-Shorted Sample'. We find that the sign and the significance of the various inter-relationships involved are economically reasonable for both samples. For compactness, ease of interpretation, and to preserve the focus on the specific equations of interest to us, we report in Table 5 only those relationships that are relevant to the issues addressed in the paper. In particular, first, we report, for both models and for both samples, the determinants of naked short-selling, i.e. how each of our explanatory variables impact on naked short-selling after controlling for endogenous interactions. And second, we report, for both models and for both samples, the effects of naked short-selling, i.e. how naked short-selling impacts on each of our explanatory variables after controlling for endogenous interactions. We document several results of considerable economic significance.

Across both Panel A and Panel B: consistent with our earlier results, there is strong and significant positive feedback between covered shorting and naked shorting. Lagged changes in the *Covered Short Ratio* are positively related to changes in the *Outstanding Naked Short Ratio*, and vice-versa; i.e., an increase in covered shorting is likely to lead to an increase in naked shorting, and vice-versa. This suggests that the two trading techniques are complementary rather than substitutes.

From Panel A alone: first, when order-imbalance is positive, i.e., when there are more buyers relative to sellers, an increase in order imbalances leads to a significant increase in naked short selling, which is consistent with naked short sellers providing liquidity, when such liquidity-supply is needed. Second, when order-imbalance is negative, i.e., when there are more

sellers relative to buyers, an increase in order imbalances leads to a decrease in naked short selling, albeit at marginal levels of significance for the overall sample. This is definitely *not* consistent with naked short-sellers manipulatively reinforcing selling pressure (with the aim of driving down prices), and is again consistent with a liquidity-related perspective in trading decisions – where the naked short-seller reduces costs by entering the market when liquidity-related conditions are favorable, selling more when there is relatively greater buying pressure, and selling less when there is relatively greater selling pressure. Third, that the naked short-seller's decision is driven largely by a liquidity-related perspective is again shown by the finding that, for the most naked-shorted sample, irrespective of specification, naked short-selling is significantly lower when spreads are relatively higher; and by the fact that neither pricing error nor volatility drive naked shorting in any specification.

From Panel B alone: first, when pricing error is positive, naked short-selling significantly reduces pricing error in both samples, consistent with an increase in pricing efficiency and with naked short-sellers functioning as value arbitrageurs. Second, when pricing errors are negative, naked short selling increases pricing errors significantly in the overall sample, i.e. drives them towards zero, and hence reduces the magnitude of the pricing error: again the implication is that naked short selling, on average, improves pricing efficiency. Third, though the second effect (corresponding to negative pricing errors) is weaker for the most naked-shorted sample, naked short-selling significantly reduces the volatility of pricing errors in this most naked-shorted sample again consistent with an increase in pricing efficiency. Fourth, again consistent with improved pricing efficiency, an increase in naked shorting reduces stock return volatility in the most naked shorted sample in both estimation modeling frameworks. Finally, an increase in naked shorting reduces bid-ask spreads, thereby improving liquidity, and consistent with the scenario emerging from Panel A above, that of naked-short-sellers functioning effectively as liquidity suppliers.

5.4.2 Economic Significance

Since the vector autoregressive models we employ are based on standardized variables, it is often difficult to interpret the economic significance of our results. Accordingly, we translate the coefficients of interest in Table 5 into impact assessments based on percentage points, by multiplying each parameter estimate by the standard error of the dependent variable. To further highlight the impact of those changes, we also divide the parameter estimate by the mean value of the related variable.

Based on the '2007 Overall Sample', we find that a one percentage point increase in the *Outstanding Naked Short Ratio* leads, approximately, to a 3% to 4% reduction (depending on model) in the volatility of 5-minute returns, a 1% reduction in bid-ask spreads, a 50% decline in order imbalances and a 3.5% decline in pricing error volatility. The impact on pricing error points to a 30% decrease in the magnitude of negative pricing errors and a 7% decrease when pricing error is positive.

An analysis of economic significance of parameter estimates based on the '2007 Most Naked Shorted Sample' leads to similar results. The estimated reduction in volatility is of a similar magnitude, ranging from 2.8% to 3.8%. The reduction in bid-ask spreads is also of a similar magnitude (around 1%). The reduction in order imbalances is more modest: a one percentage point increase in *ONSR* is associated with a reduction in order imbalance of about 10%. The reduction of pricing error volatility is about 4%. The impact on pricing error is also more modest: we estimate a decline in pricing error of about 4.5% when pricing error is positive and an increase in pricing error of about 9% when pricing error is negative.

5.4.3 Robustness

As discussed above, we estimate the vector autoregressive models by security. In order to draw population-wide inferences, we use a Fama and MacBeth (1973)-type of cross-sectional aggregation. In unreported results, we also perform a nonparametric analysis of our parameter estimates. In particular, we check whether the proportion of positive (negative) parameter estimates is consistent with the results of our Fama and Macbeth-style aggregation. We find that results of this nonparametric analysis are totally consistent with the results reported above.

We also repeat our analysis without standardizing and winsorizing our data. When attempting to then estimate the vector autoregressive models, we are unable to converge to a solution for almost half of our sample, primarily because of large disparities in the magnitude of the elements of the associated error variance-covariance matrix induced by the presence of outliers. However, for those cases for which we are able to estimate the vector autoregressive models, our results are completely consistent with the analysis conducted with standardized and winsorized data.

Finally, we also estimate the vector autoregressive models by including only the ten securities with the highest average *Outstanding Naked Short Ratio* in our sample. The results obtained are qualitatively similar to those for the '2007 Most Naked-Shorted Sample'.

5.4.3 Bottom-Line

In conclusion, our results in this sub-section considerably reinforce our preliminary results, and do so much more unequivocally, and provide strong support to Hypotheses *H2*, *H3*, *H4*, *H5* and *H6*. Naked short-sellers appear to have a considerably positive effect on market quality, first by enhancing pricing efficiency through correction of security overvaluation and reduction of volatility, and second by providing and improving liquidity through reduction of order-imbalances and bid-ask spreads[32].

5.5 Naked Short Selling and the 2008 Financial Crisis

In the wake of the financial crisis of 2008, the media has consistently pointed an accusing finger at naked short-sellers, blaming them for having caused, or at least accelerated, sharp declines in stock prices, particularly of financial firms. Naked short-sellers have typically been thought of villains who have deliberately undertaken "bear raids" to drive the price down, create conditions that trigger credit downgrades, and profit from the downward price spiral and the eventual collapse of the financial institutions involved. In this context, in this sub-section, we examine two questions. First, is there any naked-shorting linked evidence of manipulative "bear-raid" type activity prior to the price crashes associated with four important casualties of the 2008 financial crisis – Bear Stearns, Lehman, AIG and Merrill, or were the naked short-sellers just following rational value-based strategies *in response to* public information? Second, is there any evidence of naked short-selling having triggered credit downgrades, or did significant naked short selling take place in response to a credit downgrade?

5.5.1. Bear Stearns

The first large financial casualty of the 2008 financial crisis was Bear Stearns, the fifth largest investment banking firm in the nation at the time of its demise. We analyze naked short selling on the days preceding and immediately following the dramatic loss of market value that led to the demise of the firm. We compute *Outstanding Naked Short Ratio* for Bear Stearns on each trading day from January 1 to March 28, 2008. We also compute for the same period, as a control variable, an equal weighted average *Outstanding Naked Short Ratio* for four other financial institutions with the same primary SIC code as Bear Stearns, and with the closest

[32] We do not make comparative inferences between covered versus naked short selling because our research design is based only on naked-shorting deciles (and not on covered shorting deciles), and the role of the covered shorting variable is only that of a control variable.

market value as of the end of the fiscal year 2007[33]. We calculate the difference test for its statistical significance each day[34]. Our results are presented in Table 6A.

Figure 3 provides a time-line about the crisis. Outstanding suspicions about liquidity problems at Bear Stearns started being reported in the media from March 10 onwards, and also reports that the company's management was repeatedly denying rumors about problems. The first major price-crash took place on Friday March 14, when the price per share dropped from $57 to $30 after a 9 a.m. announcement that Bear would receive an unprecedented loan from the Federal Reserve System[35]. Two days later, on Sunday March 16, JP Morgan proposed buying Bear Stearns for $2 per share[36]. When markets opened on March 17, a second major price crash materialized, and the price dropped to a close of $4.81.

Table 6A and Figure 3 show that, up to March 11, abnormal naked short selling (i.e. our difference metric above) was statistically insignificant or significantly less than "normal". While naked short selling did increase significantly on March 12 and 13, the increase was tiny relative to what took place on or after March 14, and also tiny from an economic perspective, with outstanding naked shorted shares less than 0.5% of shares outstanding until market close on March 13. Naked shorting increased massively and rapidly only on March 14 and on March 17, reaching 1.12% (t-stat. 20.7) and 6.9% (t-stat. 137.3) respectively, but even at this level the number of outstanding naked short shares was not high enough to cause an economically significant distortion in the supply of shares. More importantly, given that the Fed announcement was at the start of trading, this increase in naked shorting was subsequent to the announcement and the consequent precipitous price-drop. Meanwhile, the company's management appeared to happily reinforce rumors that the price collapse happened because of naked-shorting[37]. Yet, the abnormal incidence of naked short selling did not precede the price decline; rather, the decline in stock price was triggered by well-identified events. By the time naked short selling spiked on March 17, the company was already negotiating a distress sale.

Even in this extreme scenario, often cited as a glaring example of the negative role of naked short sellers in financial markets, we fail to find any evidence of naked short sellers engaging in manipulative "bear-raid" type activity. Rather, they appeared to be following

[33] The four control stocks are: Raymond James Financial Corporation, Ameritrade Holdings Corporation, Ameriprise Financial Inc. and Charles Schwab Corporation.
[34] We construct a t-statistic for the difference in means as follows: we compute the mean and standard error of this difference over the time interval January 1st to February 15th, 2008; we subtract this historic mean from the daily difference and then divide the resulting number by the historic estimate of the standard deviation of the difference.
[35] "Fed Races to Rescue Bear Stearns in Bid to Steady Financial System Storied Firm", *The Wall Street Journal* (March 15, 2008).
[36] "JP Morgan Chase to Acquire Bear Stearns", *J.P. Morgan News Release* (March 16,2008).
[37] "Short Sellers Aren't Jackals, They're Bears, Fleckenstein Says", Bloomberg.com (October 29, 2008).

rational value-based strategies *in response to* public information The decline in stock price appears motivated by unrelated and clearly identifiable factors; and consistent with our previous results, naked short sellers are facilitating price discovery, rather than increasing pricing errors.

5.5.2 Lehman.

The second notable casualty of the financial crisis of 2008 was Lehman. To investigate the link between naked short selling and the stock price crash, we employ the same method we used for Bear Stearns. We analyze naked short selling on the days surrounding the dramatic loss of market value of the firm on September 9, 2008. We identify four other financial institutions (having the same primary SIC code as Lehman) with the closest market value as of the end of the fiscal year 2007. We then compute daily an equal weighted average *Outstanding Naked Short Ratio* for those benchmark institutions and subtract it from the *Outstanding Naked Short Ratio* of Lehman, and test for the statistical significance of the difference[38]. Our results are presented in Table 6B. In Figure 4A we present a graphical summary of the relationship between *Outstanding Naked Short Ratio* and stock price for the period spanning January 2008 to Lehman's bankruptcy on September 15, 2008. We offer a closer look at the period surrounding Lehman's bankruptcy in Figure 4B.

Aside from a spike in naked short selling on August 25, our results indicate abnormally low naked short selling in the days leading to September 9, with abnormal *Outstanding Naked Short Ratio* at around 0.01%. While the intensity of naked short selling increases on September 9, abnormal *Outstanding Naked Short Ratio* is still less than 0.1%. It is only after September 10 that abnormal *Outstanding Naked Short Ratio* increases dramatically, breaching 2% on September 11 and 4% on September 17th.

Our *Outstanding Naked Short Ratio* plots reveal that naked short selling of Lehman's stock intensified after September 9, 2008, just prior to the firm's bankruptcy. But we should note that, by September 9, the firm's stock price had already lost approximately 87% of its value as of the beginning of the year. The biggest single-day price drop, about 45%, occurred on September 9, following news that talks with the Korea Development Bank, previously rumored to be considering a 25% stake in Lehman, had failed. While *Outstanding Naked Short Ratio* increases on that day, outstanding naked short shares still represent less than 0.08% of shares

[38] We construct a t-statistic for difference in means as follows: we compute the mean and standard error of this difference over a period starting on January 1st, 2008 and ending 20 trading days prior to September 9th, 2008; we subtract this historic mean from the daily difference and then divide the resulting number by the historic estimate of the standard deviation of the difference.

outstanding. On September 11, as shareholders rejected a rescue plan by management, the stock price fell by an additional 42% and *Outstanding Naked Short Ratio* further increased to 1.6%. Over the following days, talks of a possible acquisition by Bank of America and Barclays failed, triggering further declines in stock price and an increase in *Outstanding Naked Short Ratio* to 2.4%; and on September 15th, Lehman announced its bankruptcy.

A recent article in Bloomberg[39] notes that a rumor about Barclays Plc buying Lehman for a 25% discount to market value was responsible for a 11% fall in Lehman's stock price on June 30th. We find that *Outstanding Naked Short Ratio* spikes to 6 bps (from 0.06 bps) on June 27th. The irregular spike in *Outstanding Naked Short Ratio* on the day preceding the rumor is suspicious, and does hint towards a manipulative trading strategy, but is still miniscule, and certainly not enough to bring down Lehman.

In sum, our analysis shows that, first of all, the incidence of naked short selling, even at its peak, was too low to justify the decline in price that took place. Second, our analysis indicates that naked short selling intensified after the stock had lost most of its value and in reaction to negative news about the company, which is inconsistent with stock price manipulation.

5.5.3 Merrill

We analyze the relationship between *Outstanding Naked Short Ratio* and the stock price for Merrill in Figure 5. We note that the stock price decline of Merrill Lynch is fairly gradual through the year and is not accompanied by any significant increase in the intensity of naked short selling. The *Outstanding Naked Short Ratio* reaches its highest value on October 14th, 2008, at 0.092%, and that is economically minuscule. Given that naked shorting remains so small all through the period, we do not engage in any formal statistical testing. There is clearly no evidence of naked-shorting linked manipulation.

5.5.4 AIG

We analyze the relationship between *Outstanding Naked Short Ratio* and the stock price for AIG in Figure 6. The company lost about 40% of its market value by the end of August 2008, amid piling losses on its CDS portfolios. The largest single-day price drop is observed on September 15, 2008. On that day, Standard & Poor's cut AIG's credit rating due to "the combination of reduced flexibility in meeting additional collateral needs and concerns over

[39] "Naked Short Sales Hint Fraud in Bringing Down Lehman", *Bloomberg* (March 19, 2009).

increasing residential mortgage-related losses". Following the announcement, the company's stock price dropped by about 60%. Yet, the intensity of naked short selling remained low, with *Outstanding Naked Short Ratio* reaching its year high at 0.16% on September 29, 2008. Once again, given that naked shorting remains so small all through the period, we do not engage in any formal statistical testing. There is clearly no evidence of naked-shorting linked manipulation.

5.5.5. Naked Short Selling and Credit Rating Downgrades

Naked short-sellers have been alleged to engage in (manipulative) naked short selling by creating conditions that trigger credit downgrades specifically to profit not just from the downward price spiral but also from linked credit default swap positions on the associated stock. In this context, we examine naked short selling around credit rating downgrades for a sample of the most affected financial securities. As our sample of financial firms, we use the 17 securities (as in section 5.5.6 later) for which the SEC had issued an emergency order temporarily banning naked short selling in mid-2008[40]. To that list, we add Bear Stearns that had not been included in the SEC emergency order temporarily banning naked short selling, but was clearly affected by the crisis. Also, we exclude Lehman, as its credit rating downgrade was soon followed by a bankruptcy. For this sample of companies, we identify 21 long term issuer downgrades by S&P over the year 2008.

For each downgrade, we compute *Outstanding Naked Short Ratio* for the security of interest for 40 trading days preceding and following the announcement. We then compute average *Outstanding Naked Short Ratio* for each day in the event day calendar, where day 0 is the day of the downgrade. We compute abnormal daily *Outstanding Naked Short Ratio* by subtracting the average *Outstanding Naked Short Ratio* computed over 100 trading days ending 20 days prior to the credit rating downgrade. We report results for various event windows. We compute *Cumulative Abnormal Outstanding Naked Short Ratio* as the sum of daily *Outstanding Naked Short Ratio* for all days in the event window. The *Mean Cumulative Abnormal Outstanding Naked Short Ratio* is the cross-sectional average of the security-specific *Cumulative Abnormal Outstanding Naked Short Ratio*. The *t*-statistic for significance of the mean is computed making use of the historic estimate of the standard error adjusted for date clustering (and computed over the estimation period of 100 trading days ending 20 days prior to the credit rating downgrade). The results are reported in Table 7.

[40] See Security and Exchange Commission Release No. 58166, July 15th, 2008. The emergency order was initially set to expire on July 29th, 2008, but was later on extended.

We find that naked short selling is abnormally low in the days preceding the credit rating downgrade, and not abnormally high as would be expected on the basis of manipulative naked shorting creating conditions that trigger the downgrade. Consistent with a rational value-maximizing position, naked short selling is abnormally high in the days following the downgrade. This abnormal naked shorting is sustained for approximately one month following the rating downgrade. This evidence is consistent with naked short sellers reacting to negative news regarding the company, rather than with a manipulative intent, as per our hypothesis *H7B.*

5.6. The Impact of Restrictions on Naked Short Selling

On July 15, 2008, the SEC issued an emergency order banning naked short sales of the stocks of 19 publicly traded financial institutions[41]. The emergency order took effect on July 21, 2008 and expired on August 12th, 2008. We examine the impact of those restrictions on stock price returns and on various market quality metrics. Given our previous results indicating that naked short selling appears to have positive effects on market quality, we expect deterioration of the latter in the presence of a ban on naked short selling.

We obtain data from CRSP for 17 of the 19 affected securities[42]. We find a matched sample as follows: we start from the universe of firms listed on CRSP as of January 1, 2008; for each one of our target securities, we identify common equity of the firm sharing the same SIC code with the closest market capitalization to that of our targets (as of January 1, 2008). Then, for each of the 34 securities (the 17 affected securities and the 17 unique matches) and for each day in the interval January 1, 2008 to September 9, 2008, we compute the *Outstanding Naked Short Ratio*, *Pricing Error Volatility*, *Spread* and *Volume*, as defined in Table 1. We also compute daily *Close-to-Close Returns.* We average each of these 5 variables to obtain a daily mean for the affected sample (as the average of the daily metrics for the 17 affected securities) and a daily mean for the control sample. We then run 5 separate OLS regressions; in each regression, the response variable is the affected sample mean of either *Outstanding Naked Short Ratio*, *Pricing Error Volatility*, *Volume*, *Spread* or *Close-to-Close Return*, while the explanatory variables include an intercept, the control sample mean of the variable of interest and a binary variable, *Event*, set equal to 1 on all days during which restrictions were in place and equal to 0 on all other days. Our results, presented in Table 8, indicate that the number of naked short

[41] BNP Paribas Securities Corp., Bank of America Corporation, Barclays, Citigroup Inc., Credit Suisse Group, Daiwa Securities Group Inc., Deutsche Bank Group AG, Allianz SE, Goldman, Sachs Group Inc, Royal Bank ADS, HSBC Holdings PLC ADS, J. P. Morgan Chase & Co., Lehman Brothers Holdings Inc., Merrill Lynch & Co., Inc., Mizuho Financial Group, Inc., Morgan Stanley, UBS AG, Freddie Mac, Fannie Mae.

[42] The common equity of both BNP Paribas Securities Corp. and Daiwa Securities Group Inc. trades over the counter; the CRSP database does not include over the counter securities.

shares outstanding declines during the ban, as expected. Yet, we observe lower trading volumes and higher spreads (both significant at the 1% level); both results are in line with our expectations (respectively, hypotheses *H8A* and *H8B*), indicating that a ban on naked short selling impacts the stock's liquidity. We also document higher pricing error volatility, indicating that restrictions on naked short selling hamper the price discovery process (hypothesis *H8C*). Our results include a negative, but not statistically significant, coefficient on the *Event* binary variable in the *Close-to-Close Return* regression, indicating that the ban on naked short selling failed to slow the price decline of the affected securities, contrary to our hypothesis *H8D*.

5.7 Manipulative Naked Short Selling

Naked short-sellers can be value arbitrageurs aiming to profit from positive pricing errors; or liquidity suppliers trading to use lower spreads or higher order imbalances to reduce their trading costs, or the manipulative traders that Regulation SHO was intended to curb and regulate. This sub-section focuses on manipulative naked short-selling. The potential benefits of naked shorting for liquidity suppliers was duly acknowledged by the SEC in their policy statement prefacing Regulation SHO, and hence, broker-dealers engaged in bona-fide market-making were exempted from the "locate" requirement. Any naked short-selling should arguably reduce positive pricing errors anyway, and our findings reflect that expectation. If the "locate" and "close-out" requirements introduced by Regulation SHO have been effective in curbing manipulative naked shorting, we would expect that the impact of manipulative naked shorting would have declined after Regulation SHO, leaving only any beneficial effects on liquidity and pricing efficiency, and that may potentially be the reason why we find only significantly positive effects of naked shorting.

It is difficult to include all aspects of "manipulation" in an analysis of "manipulative" naked shorting; and given the lack of data on daily total short sales prior to January 2005 and after June 2007, we are unable to compute the *Covered Short Ratio* and to re-estimate our vector autoregressive models for any period of time preceding Regulation SHO or during the 2008 financial crisis. Accordingly, we define potentially manipulative naked short-selling from the mindset of bear-raids, based on whether naked shorting is undertaken at a time when pricing errors and order imbalances are positive or negative. If naked shorting is undertaken when pricing errors and order imbalances are positive, then naked short-selling is "healthy" since it will increase pricing efficiency and provide liquidity respectively. However, in the presence of greater *manipulative* naked shorting, we would expect that the mean reversion of pricing errors, conditional on the pricing error being negative, and the mean reversion of order-imbalances,

conditional on the order-imbalance being negative, will both decrease. Hence, we base our inferences on "manipulative" naked shorting on the mean reversion of pricing errors and the mean reversion of order imbalances, before and after Regulation SHO, and during the 2008 financial crisis.

In order to test how the rate of adjustment of pricing error is affected, we compute the coefficients of mean reversion for the securities in our '2007 Most Naked Shorted sample', our 'pre-SHO' '2004 Most Naked Shorted sample', and our 'financial crisis' '2008 Most Naked Shorted sample', all based on the model for *Pricing Error* described in Table 9.

To test whether the 2004 and 2008 coefficients of mean reversion, conditional on the sign of pricing error, are different from the baseline 2007 coefficients, we employ two-sample t-tests. Our results for the variables of interest are in Table 9. The coefficient for negative pricing error increases with the introduction of Regulation SHO in January 2005, indicating that prices revert at a faster rate, in line with our hypothesis *H9A*, and showing that the impact of manipulative naked shorting has declined after Regulation SHO; but, consistent with hypothesis *H9C,* no significant difference is observed in the coefficient of mean reversion for positive pricing errors, indicating that the activities of value arbitrageurs are happily unaffected by the regulation. On the other hand, there is no significant difference in mean reversion, neither for positive pricing errors nor for negative pricing errors, between 2007 and 2008, indicating that the financial crisis period did not see an increase in the impact of manipulative naked shorting or a decrease in the beneficial effects of naked shorting relative to 2007, but did see a significant decrease in the impact of manipulative naked shorting relative to the period prior to Regulation SHO[43].

Similarly, we calculate mean reversions for order imbalances for the 2004, 2007 and 2008 most naked-shorted samples based on the *OIB* equation in Table 9. Our results, also reported in Table 9, indicate, as expected (Hypothesis *H9B*), faster mean reversion in order imbalances after the introduction of Regulation SHO, and significantly more so when order imbalances are positive. On the other hand, consistent with hypothesis *H9D,* there are no significant differences in mean reversion between 2007 and 2008. These findings indicate that not only has the impact of manipulative naked short-selling declined after Regulation SHO, naked short-sellers are also making a greater liquidity-related contribution after Regulation SHO; and furthermore, that the financial crisis period did not see an increase in the impact of manipulative naked shorting or a decrease in the beneficial effect of naked shorting relative to

[43] We do not report a formal test of the difference between 2004 and 2008 for sake of compactness, but the statistical significance of this difference is very similar to that between 2004 and 2007.

2007, but did see a significant decrease in the impact of manipulative naked shorting relative to the period prior to Regulation SHO[44].

6. Conclusions

We document that naked short selling affects a large number of securities. We analyze the impact of naked short selling on market quality and find that this impact is very positive overall. On average, naked short sellers function effectively as liquidity providers who reduce order imbalances, and as value arbitrageurs who stabilize markets and reduce the mispricing of overvalued securities.

We analyze naked shorting in several financial firms most affected by the financial crisis of 2008 around the days surrounding their sharpest declines in market value, and find no significant evidence indicating that the stock price decline was triggered by naked short sellers. Similarly, by analyzing naked short selling around credit rating downgrades, we find that naked short sellers react to downgrade announcements rather than trigger them.

We also investigate the market impact of the SEC ban on naked short selling affecting 19 financial securities between July 15th and August 12th, 2008. We find higher absolute pricing errors and lower trading volumes, indicating that a ban on naked short selling hampers the price discovery process and negatively impacts liquidity. Returns do not appear to be affected, indicating that the ban on naked short selling failed to slow the price decline of the related securities.

Finally, we analyze changes in the impact of manipulative naked shorting pre-and-post Regulation SHO, and during the 2008 financial crisis, and we find that proxies for the impact of manipulative naked shorting have declined significantly after the introduction of Regulation SHO, and *not* changed significantly over the 2008 financial crisis.

Our results are in sharp contrast with the extremely negative pre-conceptions that appear to exist among media commentators and market regulators in relation to naked short-selling. While unregulated naked short-selling could be potentially manipulative, and the associated settlement failures could be somewhat disruptive to the smooth functioning of financial markets, the duly regulated naked short-selling that has existed after Regulation SHO appears to have been net beneficial for pricing efficiency and market liquidity, and Regulation SHO also appears to have successfully curbed the impact of manipulative naked shorting, and this reduction in the impact of manipulative naked shorting has continued through the 2008 financial crisis.

[44] Once again, we do not report a formal test of the difference between 2004 and 2008 for sake of compactness, but the statistical significance of this difference is very similar to that between 2004 and 2007.

References

Abreu, D. and M.K. Brunnermeier (2002), "Synchronization Risk and Delayed Arbitrage", *Journal of Financial Economics* 66, 341-360.

Abreu, D. and M.K. Brunnermeier (2003), "Bubbles and Crashes", *Econometrica* 71, 173-204.

Aitken, M., A. Frino, M.S. McCorry and P.L. Swan (1998), "Short Sales are Almost Instantaneous Bad News: Evidence from the Australian Stock Exchange", *Journal of Finance* 53, 2205-2223.

Asquith, P. and L. Meulbroek (1996), "An Empirical Investigation of Short Interest", *Working Paper*.

Boehmer, E., C.H. Junes and X. Zhang (2008), "Which Shorts are Informed?", *Journal of Finance* 63 (2), 491-526.

Boni, L. (2006), "Strategic delivery failures in U.S. equity markets", *Journal of Financial Markets* 9 (1), 1-26.

Bris, A., W.N. Goetzmann and N. Zhu (2007), "Efficiency and the Bear: Short Sales and Markets Around the World", *Journal of Finance* 62 (3), 1029-1079.

Christian, J.W., R. Shapiro and J.P. Whalen (2006), "Naked short selling: how exposed are investors?", *Houston Law Review* 43, 1033-1090.

Culp, C.L. and J.B. Heaton (2007), "Naked Shorting", *Working Paper*.

Danielsen, B. and S. Sorescu (2001), "Why do Option Introductions Depress Stock Prices? A Study of Diminishing Short Sales Constraints", *Journal of Financial and Quantitative Analysis* 36, 451-484.

Daouk, H. and A. Charoenrook (2005), "A Study of Market-Wide Short-Selling Restrictions", *Working Paper*.

Diether, K.B., K.H. Lee and I.M. Werner (2007), "It's SHO Time! Short-Sale Price-Tests and Market Quality", *Working Paper*.

Diamond, D.W. and R.E. Verrecchia (1987), "Constrains on Short-Selling and Asset Price Adjustment to Private Information", *Journal of Financial Economics* 18 (2), 277-311.

Dong, J., A. Kempf and P. Yadav (2008), "Resiliency, the Neglected Dimension of Market Liquidity: Empirical Evidence from the New York Stock Exchange", *Working Paper*.

Edwards, A. K. and K. Weiss Hanley (2008) "Short Selling in Initial Public Offerings", *Working Paper*.

Evans, R.B., C.C. Geczy, D.K. Musto, and A.V. Reed (2008), "Failure is an Option: Impediments to Short Selling and Options Prices", *Review of Financial Studies*, forthcoming.

Fama, E.F. and J.D. MacBeth (1973), "Risk, return, and equilibrium: Empirical tests", *Journal of Political Economy* 81, 607-633.

Finnerty, J.D. (2005), "Short Selling, Death Spiral Convertibles, and the Profitability of Stock Manipulation", *Working Paper*.

Gezy, C.C., D.K. Musto and A.V. Reed (2002), "Stocks are Special too: an Analysis of the Equity Lending Market", *Journal of Financial Economics* 66, 241-269.

Harrison J. and D. Kreps (1978), “Speculative Investor Behavior in a Stock Market with Heterogeneous Expectations”, *Quarterly Journal of Economics* 92, 323-336.

Jones, C. and O. Lamont (2002), “Short Sales Constraints and Stock Returns”, *Journal of Financial Economics* 66, 207-239.

Lee, C. and M. Ready (1991), “Inferring Trading Direction from Intraday Data”, *Journal of Finance* 46, 733-746.

Lo, A.W. and J. Wang (2000), "Trading Volume: Definitions, Data Analysis, and Implications of Portfolio Theory", *The Review of Financial Studies* 13 (2), 257-300.

Miller, E. (1977), “Risk, Uncertainly, and Divergence of Opinion”, *Journal of Finance* 32, 1151-1168.

Ofek, E. and M. Richardson (2003), “DotCom Mania: the Rise and Fall of Internet Stock Prices”, *Journal of Finance* 74, 305-342.

Pope, P. F., and P.K. Yadav (1994), “The Impact of Short Sales Constraints on Stock Index Futures Prices: Evidence from FT-SE 100 Futures”, *The Journal of Derivatives* 1, 15–26.

Reed, A. (2007), “Costly Short-Selling and Stock Price Adjustment to Earnings Announcements”, *Working Paper*.

Richardson, G., S.E. Sefcik and R. Thompson (1986), “A Test of Dividend Irrelevance Using Volume Reactions to a Change in Dividend Policy”, *Journal of Financial Economics* 17 (2), 313-333.

Scheinkman, J. and W. Xiong (2003), “Overconfidence and Speculative Bubbles”, *Journal of Political Economy* 111, 1183-1219.

Shkilko, A., B.F. Van Ness, and R.A. Van Ness (2007), “Price-Destabilizing Short Selling”, *Working Paper*.

Stickel, S.E., R. Verrecchia (1994), “Evidence that Trading Volume Sustains Stock Price Changes”, *Financial Analysts Journal* 50 (6), 57-67.

Uchimoto, W., M. Traynor, J. Connolly and J.S. Rizzello (2005), “Coming Up Short on Share Lending. A Look at Regulation SHO and is Effects on Share Lending”, *Journal of Indexes* November/December 2005, 32-36.

Table 1 - Variable Definitions

Table 1 defines the variables used in our analysis. All variables are daily, unless otherwise specified.

Short Selling	
Outstanding Naked Short Ratio (ONSR)	Ratio of estimated outstanding fails to deliver over total shares outstanding.
New Naked Short Ratio (NNSR)	Ratio of estimated number of shares that failed to deliver over trading volume, in shares.
Naked to All Shorts Ratio	Ratio of *ONSR* over the total number of outstanding shorted shares.
New FTD	Estimated number of shares that fail to deliver on a particular day.
Short Ratio	Ratio of the total number of shorted shares (both covered and naked) over shares outstanding.
Covered Short Ratio (CSR)	Ratio of estimated covered-shorted shares over trading volume in shares. Covered-shorted shares are estimated as the difference between the total number of shorted shares and the estimated number of new FTDs.
Short Volume	Number of shares sold short.
Non-Short Volume	Number of traded shares minus number of shares sold short.
Pricing Error	
Pricing Error (PE)	The non-random walk component of a daily return series estimated using a Kalman filter methodology.
Negative Pricing Error (Negative PE)	A binary variable set equal to 1 if *PE* is negative and to zero otherwise
Positive Pricing Error (Positive PE)	A binary variable set equal to 1 if *PE* is positive and to zero otherwise.
Pricing Error Volatility (PE Volatility)	The absolute value of the pricing error.
Proportion Positive Pricing Error	The proportion of days over the sample period during which the pricing error is positive.
Liquidity Related Metrics	
Order Imbalance (OIB)	The difference between the market value of shares traded in buyer initiated trades and the market value of shares traded in seller initiated trades, divided by total daily dollar trading volume.
Positive OIB	A binary variable set equal to 1 if *OIB* is positive and to zero otherwise
Spread	The difference between the last bid and the last ask of the day, divided by the average of the last bid and last ask of the day
Volume	Daily number of shares traded.
Other	
Return	The daily average of the 5-minute stock price return.
Volatility	The standard error of the 5-minute stock price return.
Share Turnover	Daily trading volume, in number of shares, divided by total shares outstanding.
Institutional Ownership	The ratio of shares held by institutional investors over total shares outstanding.
Market Value	The number of shares outstanding multiplies by the closing price for the day.

Table 2 - New Fails to Deliver and Short Trading Volume.

This table presents results of a regression of *New FTD* on *Short Volume* and *Non-Short Volume*, using a sample of 292 NYSE securities between January and June 2007. We construct the sample as follows: *ONSR* is computed for all NYSE common stock of US-based firms (CRSP share codes 10 and 11) included in the CRSP database over the entire interval January 1st, 2007 to June 30th 2007; daily *ONSR* is averaged by security; securities with average *ONSR* greater than 0 (zero) are ranked by average *ONSR* and then allocated to deciles 1-10; 30 securities are randomly selected from each decile for a total sample of 300 securities ('2007 Overall Sample'). The model is estimated by security; reported results are for 292 securities, as data for 8 securities is incomplete. The reported results are average parameter estimates. Significance is tested employing the Fama and MacBeth (1973) procedure. Significance is denoted as follows: "*" indicates significance at the .1 level "**" indicates significance at the .05 level; "***" indicates significance at the .01 level. All variables are defined as in Table 1. We use OLS regression to estimate the following equation, with the subscript *i* being security specific:

$$New\ FTD_{i,t} = \alpha_i + \beta_{1,i} Short\ Volume_{i,t} + \beta_{2,i} Non\ Short\ Volume_{i,t} + \varepsilon_{i,t}$$

	Parameter Estimate	***t*-value**	
Intercept	-155.95	-0.20	
Short Volume	0.05	4.71	***
Non-Short Volume	<0.01	1.17	
R-squared	14.40%		

Table 3A - Summary Statistics of the Incidence of Naked Shorting.

This table presents the mean, median, 90th percentile (*P90*) and 99th percentile (*P99*) of the distribution of various metrics of the intensity of naked shorting; all metrics are computed daily for all NYSE common stock of US-based firms (CRSP share codes 10 and 11) included in the CRSP and TAQ databases over the entire interval January 1st, 2007 to June 30th 2007. All variables are defined as in Table 1.

Panel A: January 2007 to June 2007

	Mean	Median	P90	P99
Outstanding Naked Short Ratio	0.09%	0.00%	0.08%	1.45%
New Naked Short Ratio	0.98%	0.00%	0.67%	19.34%
Naked to All Shorts Ratio	3.47%	0.25%	6.09%	31.03%

Panel B: January 2008 to June 2008

	Mean	Median	P90	P99
Outstanding Naked Short Ratio	0.07%	0.00%	0.14%	1.05%
New Naked Short Ratio	0.87%	0.00%	1.50%	15.17%

Panel C: July 2008 to December 2008

	Mean	Median	P90	P99
Outstanding Naked Short Ratio	0.06%	0.00%	0.09%	0.81%
New Naked Short Ratio	0.73%	0.00%	0.48%	11.24%

Panel D: Financial Companies (SIC: 60 and 61), January 2007 to June 2007

	Mean	Median	P90	P99
Outstanding Naked Short Ratio	0.11%	0.00%	0.10%	1.23%
New Naked Short Ratio	1.18%	0.00%	1.05%	14.08%

Panel E: Financial Companies (SIC: 60 and 61), January 2008 to June 2008

	Mean	Median	P90	P99
Outstanding Naked Short Ratio	0.12%	0.00%	0.26%	2.14%
New Naked Short Ratio	0.95%	0.00%	2.10%	13.49%

Table 3B - Mean Values by Outstanding Naked Short Ratio Decile.

The sample is built as follows: *Outstanding Naked Short Ratio* (*ONSR*) is computed daily over the period January 1st, 2007 to June 30th 2007 for all NYSE common stock; daily *ONSR* is averaged by security; securities with average *ONSR* greater than 0 (zero) are ranked by average *ONSR* and then allocated to deciles 1-10. 30 securities are randomly selected from each decile ('2007 Overall Sample'). An additional 30 securities are selected from the list of NYSE-listed securities included in CRSP with no naked shorts over the above interval; those securities are allocated to decile 0. Daily statistics are computed, then average statistics are tabulated by security; security averages are then averaged over deciles; decile averages are reported. All variables are defined as in Table 1.

Decile	*ONSR*	*New Naked Short Ratio*	*Covered Short Ratio*	*Pricing Error*	*Proportion Positive Pricing Error*	*Order Imbalance*	*Share Turnover*	*Spread*	*Return* (basis points)	*Volatility*	*Institutional Ownership*	*Market Value* (US$ M)
Never Naked Shorted (0)	0.000%	0.00%	1.43%	0.12%	49.81%	0.01%	0.40%	0.40%	0.03	0.12%	33.91%	$568
1	0.001%	0.01%	1.20%	-0.07%	48.72%	3.97%	0.32%	0.10%	0.00	0.13%	69.05%	$16,639
2	0.003%	0.03%	1.34%	0.08%	50.73%	6.68%	0.44%	0.12%	-0.01	0.13%	70.49%	$12,287
3	0.004%	0.05%	1.19%	0.06%	50.31%	6.79%	0.33%	0.14%	0.05	0.12%	65.58%	$14,844
4	0.005%	0.04%	1.56%	-0.05%	49.94%	6.53%	0.43%	0.13%	0.02	0.14%	64.20%	$5,794
5	0.008%	0.07%	1.46%	-0.13%	47.21%	9.15%	0.44%	0.19%	-0.03	0.14%	61.91%	$4,841
6	0.011%	0.08%	1.59%	-0.24%	50.67%	6.20%	0.42%	0.13%	0.00	0.12%	53.12%	$6,630
7	0.016%	0.10%	1.19%	-0.01%	50.96%	6.23%	0.65%	0.13%	0.03	0.12%	58.68%	$3,053
8	0.026%	0.14%	1.63%	0.11%	51.47%	9.74%	0.58%	0.17%	0.06	0.14%	49.58%	$2,781
9	0.051%	0.17%	1.56%	0.17%	51.86%	11.48%	0.53%	0.19%	0.04	0.13%	31.26%	$1,286
10	0.490%	1.25%	2.47%	0.24%	52.32%	10.64%	0.75%	0.29%	-0.05	0.16%	39.35%	$1,292

Table 4 - Naked Short Selling, Covered Short Selling and Returns

This table presents results from the estimation of vector autoregressive models of order one. *ONSR* is computed for all NYSE common stock of US-based firms (CRSP share codes 10 and 11) included in the CRSP database over the entire interval January 1st, 2007 to June 30th 2007. Daily *ONSR* is averaged by security to obtain *Mean ONSR*. Securities with a *Mean ONSR* greater than 0 (zero) are ranked by *Mean ONSR* and then allocated to deciles 1-10; for Panel A, 30 securities are selected from each decile; hence our sample contains 300 securities ('2007 Overall Sample'); reported results are for 292 securities, as for 8 securities we did not have sufficient data to estimate the model. For panel B, we report results for securities in the 10th decile (intense naked shorting); the 10th decile contains 207 securities ('2007 Most Naked Shorted Sample'); reported results are for 202 securities, as for 5 securities we did not have sufficient data to estimate the model. All variables are standardized and winsorized; hence parameters estimates are in units of standard deviations of response variables. VARs are estimated by security. Reported parameter estimates are averages of parameter estimates, by security. Significance is tested employing the Fama and MacBeth (1973) procedure; t-statistic is reported in italics, below the parameter estimate. Significance is denoted as follows: "*" indicates significance at the .1 level "**" indicates significance at the .05 level; "***" indicates significance at the .01 level. All variables are defined as in Table 1. The VAR equation is as follows:

$$\Delta \mathbf{Y}_{i,\mathbf{t}} = \mathbf{c}_i + \boldsymbol{\varphi}_i \Delta \mathbf{Y}_{i,\mathbf{t-1}} + \boldsymbol{\psi}_i \mathbf{X}_{i,\mathbf{t}} + \boldsymbol{\varepsilon}_{i,\mathbf{t}} \qquad \Delta \mathbf{Y}_{i,\mathbf{t}} = \mathbf{Y}_{i,\mathbf{t}} - \mathbf{Y}_{i,\mathbf{t-1}} \qquad \boldsymbol{\varepsilon}_{i,t} \sim \text{i.i.d.} N(\mathbf{0}, \boldsymbol{\Omega})$$

$$\mathbf{Y}_{i,\mathbf{t}} = \begin{bmatrix} New\ Naked\ Short\ Ratio_{i,t} \\ Covered\ Short\ Ratio_{i,t} \\ Return_{i,t} \end{bmatrix}$$

Panel A – 2007 Overall Sample, 292 Securities

Response - Change	Predictor - Lagged Change			Constant
	NNSR	*CSR*	*Return*	
NNSR	0.04	0.01	<0.01	0.00
	*6.30****	*3.00****	*1.17*	*-2.34***
CSR	0.07	-0.36	<0.01	-0.01
	*6.08****	*-52.49****	*0.64*	*-23.09****
Return	-0.02	-0.02	-0.49	0.00
	-1.40	*-2.41***	*-83.79****	*0.26*

Panel B – 2007 Most Naked-Shorted Sample, 202 Securities

Response - Change	Predictor - Lagged Change			Constant
	NNSR	*CSR*	*Return*	
NNSR	0.06	0.02	<0.01	0.00
	*6.10****	*5.49****	*-1.28*	*0.45*
CSR	0.11	-0.37	<0.01	-0.01
	*6.30****	*-44.86****	*-0.94*	*-18.81****
Return	-0.01	-0.01	-0.50	0.00
	-0.59	*-0.73*	*-63.34****	*4.54****

Table 5 - Summary Results, Determinants and Impact of Naked Short Selling

This table provides results from the estimation of two vector autoregressive models of order one: VAR with *Pricing Error* (Model 1) and VAR with *Pricing Error Volatility* (Model 2). *ONSR* is computed for all NYSE common stock of US-based firms (CRSP share codes 10 and 11) included in the CRSP database over the entire interval January 1st, 2007 to June 30th 2007. Securities with a *Mean ONSR* greater than 0 (zero) are ranked by *Mean ONSR* and then allocated to deciles 1-10; for the '2007 Overall Sample', 30 securities are selected from each decile; hence our sample contains 300 securities; reported results are for 292 securities, as for 8 securities we did not have sufficient data to estimate the model. For the '2007 Most Naked-Shorted Sample', we report results for securities in the 10th decile (intense naked shorting); the 10th decile contains 207 securities; reported results are for 202 securities, as for 5 securities we did not have sufficient data to estimate the model. All variables are standardized and winsorized; hence parameters estimates are in units of standard deviations of response variables. The panels are extracts of results obtained from Model 1 and Model 2; Panel 1 reports results pertaining to the determinants of *ONSR* and Panel 2 reports results pertaining to the impact of *ONSR*. Reported parameter estimates are weighted averages of parameter estimates, by security; the weights are inversely proportional to the standard error of the parameter estimate and they are scaled so that they add to 1. Significance is tested employing a modified Fama and MacBeth (1973) procedure; t-statistics are reported in italics, below the parameter estimate. Significance is denoted as follows: "*" indicates significance at the .1 level "**" indicates significance at the .05 level; "***" indicates significance at the .01 level. All variables are defined as in Table 1. The VAR equations are as follows:

Model 1 (with Pricing Error)

$$\Delta \mathbf{Y}_{i,\mathbf{t}} = \mathbf{c}_i + \boldsymbol{\varphi}_i \Delta \mathbf{Y}_{i,\mathbf{t-1}} + \boldsymbol{\psi}_i \mathbf{X}_{i,\mathbf{t}} + \boldsymbol{\varepsilon}_{i,\mathbf{t}} \qquad \Delta \mathbf{Y}_{i,\mathbf{t}} = \mathbf{Y}_{i,\mathbf{t}} - \mathbf{Y}_{i,\mathbf{t-1}} \qquad \boldsymbol{\varepsilon}_{i,t} \sim \text{i.i.d.} N(\mathbf{0}, \boldsymbol{\Omega}_1)$$

$$\mathbf{Y_{i,t}} = \begin{pmatrix} ONSR_{i,t} \\ CSR_{i,t} \\ PE_{i,t} \\ Volatility_{i,t} \\ Spread_{i,t} \\ OIB_{i,t} \end{pmatrix} \qquad \boldsymbol{\psi}_i \mathbf{X_{i,t}} = \begin{pmatrix} \psi_{i,1,1} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \psi_{i,3,3} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} Positive\ OIB_{i,.t-1} \\ 0 \\ Positive\ PE_{i,t-1} * \Delta ONSR_{i,t-1} \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

Model 2 (with Pricing Error Volatility)

$$\Delta \mathbf{M}_{i,\mathbf{t}} = \mathbf{c}_i + \boldsymbol{\theta}_i \Delta \mathbf{M}_{i,\mathbf{t-1}} + \boldsymbol{\eta}_i \mathbf{N}_{i,\mathbf{t}} + \boldsymbol{\xi}_{i,\mathbf{t}} \qquad \boldsymbol{\xi}_{i,t} \sim \text{i.i.d.} N(\mathbf{0}, \boldsymbol{\Omega}_2) \qquad \Delta \mathbf{M}_{i,\mathbf{t}} = \mathbf{M}_{i,\mathbf{t}} - \mathbf{M}_{i,\mathbf{t-1}}$$

$$\mathbf{M_{i,t}} = \begin{pmatrix} ONSR_{i,t} \\ CSR_{i,t} \\ PE\ \ Volatility_{i,t} \\ Volatility_{i,t} \\ Spread_{i,t} \\ OIB_{i,t} \end{pmatrix} \qquad \boldsymbol{\eta}_i \mathbf{N_{i,t}} = \begin{pmatrix} \eta_{i,1,1} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} Positive\ OIB_{i.t-1} \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

Panel A - Determinants of Naked Short Selling

Sample	Predictors - Lagged Changes							Other Predictors	
	ONSR	*CSR*	*PE*	*PE Volatility*	*Volatility*	*Spread*	*OIB*	*Positive Lag OIB*	*Constant*
2007 Overall 292 securities	0.050	0.011	0.004		0.001	-0.003	-0.003	0.027	-0.018
	*6.74****	*2.98****	*1.11*		*0.40*	*-1.18*	*-0.99*	*3.29****	*-3.46****
2007 Most Naked Shorted 202 securities	0.062	0.018	-0.001		-0.002	-0.006	-0.004	0.033	-0.020
	*6.76****	*4.89****	*-0.22*		*-0.51*	*-2.02***	*-1.40*	*3.88****	*-3.72****
2007 Overall 292 securities	0.0487	0.0096		-0.0017	0.0013	-0.0024	-0.0031	0.0256	-0.0164
	*6.79****	*2.75****		*-0.56*	*0.43*	*-0.9*	*-1.23*	*3.25****	*-3.36****
2007 Most Naked Shorted 202 securities	0.062	0.017		0.001	-0.002	-0.006	-0.004	0.032	-0.020
	*6.85****	*4.65****		*0.37*	*-0.72*	*-1.75**	*-1.68**	*3.97****	*-3.84****

Panel B - Impact of Naked Short Selling

Sample	Response - Change							
	ONSR	*CSR*	*PE*	*PE* (incremental effect when lag PE > 0)	*PE Volatility*	*Volatility*	*Spread*	*OIB*
2007 Overall 292 securities	0.050	0.068	0.023	-0.052		-0.014	-0.006	-0.035
	*6.74****	*5.92****	*1.80**	*-2.84****		*-1.38*	*-0.63*	*-2.81****
2007 Most Naked Shorted 202 securities	0.062	0.108	0.015	-0.053		-0.029	-0.033	-0.020
	*6.76****	*6.05****	*0.84*	*-2.06***		*-2.01***	*-2.57***	*-1.20*
2007 Overall 292 securities	0.049	0.069			-0.010	-0.020	-0.007	-0.034
	*6.79****	*6.06****			*-1.04*	*-1.97***	*-0.80*	*-2.73****
2007 Most Naked Shorted 202 securities	0.062	0.102			-0.030	-0.039	-0.032	-0.018
	*6.85****	*5.68****			*-2.26***	*-2.73****	*-2.59****	*-1.06*

Table 6A – Behavior of Bear Stern Companies' (Ticker: BSC) Outstanding Naked Short Ratio (ONSR) during March, 2008.

ONSR is computed as the ratio between our estimate of outstanding fails to deliver and shares outstanding. *Index ONSR* is calculated as the equal weighted average of *ONSR* of common stock of 4 firms with the same primary SIC code as Bear Stearns Companies (Bear Stearns) and with the market capitalization closest to Bear Stearns as of the end of the fiscal year 2007. We construct a t-statistic using the mean and standard error of the *ONSR* difference over the time interval January 1st, 2008 to February 15th, 2008. Significance is denoted as follows: "*" indicates significance at the .1 level "**" indicates significance at the .05 level; "***" indicates significance at the .01 level.

ate	BSC Stock Price	BSC ONSR	Index ONSR	Difference in ONSR	T-Value	
3/3/2008	77.32	0.15%	0.00%	0.14%	-1.24	
3/4/2008	77.17	0.07%	0.00%	0.06%	-3.16	***
3/5/2008	75.78	0.07%	0.01%	0.06%	-3.20	***
3/6/2008	69.9	0.12%	0.01%	0.11%	-2.11	***
3/7/2008	70.08	0.06%	0.01%	0.06%	-3.32	***
3/10/2008	62.3	0.06%	0.01%	0.06%	-3.32	***
3/11/2008	62.97	0.14%	0.00%	0.14%	-1.39	
3/12/2008	61.58	0.58%	0.03%	0.55%	8.36	***
3/13/2008	57	0.53%	0.03%	0.50%	7.18	***
3/14/2008	30	1.12%	0.04%	1.08%	20.71	***
3/17/2008	4.81	6.09%	0.04%	6.04%	137.34	***
3/18/2008	5.91	5.87%	0.02%	5.85%	132.93	***
3/19/2008	5.33	5.87%	0.02%	5.84%	132.70	***
3/20/2008	5.96	5.84%	0.04%	5.80%	131.66	***
3/24/2008	11.25	6.13%	0.02%	6.11%	139.00	***
3/25/2008	10.94	7.19%	0.04%	7.14%	163.23	***
3/26/2008	11.21	5.46%	0.04%	5.42%	122.81	***
3/27/2008	11.23	5.84%	0.03%	5.81%	131.82	***
3/28/2008	10.78	6.18%	0.03%	6.14%	139.76	***
3/29/2008	10.49	6.18%	0.03%	6.14%	139.76	***

Table 6B – Behavior of Lehman Brothers Holdings Inc.'s (Ticker: LEH) Outstanding Naked Short Ratio (ONSR) in August and September 2008.

ONSR is computed as the ratio between our estimate of outstanding fails to deliver and shares outstanding. *Index ONSR* is calculated as the equal weighted average of *ONSR* of common stock of 4 firms with the same primary SIC code as Lehman Brothers Holdings Inc (Lehman) and with the market capitalization closest to Lehman as of the end of the fiscal year 2007. We construct a t-statistic as using the mean and standard error of the *ONSR* difference over the time interval starting January 1st, 2008 and ending 20 trading days prior to September 9th, 2008. Significance is denoted as follows: "*" indicates significance at the .1 level "**" indicates significance at the .05 level; "***" indicates significance at the .01 level.

Date	LEH Stock Price	LEH ONSR	Index ONSR	Difference in ONSR	T-Values	
8/25/2008	13.45	0.16%	0.00%	0.15%	13.98	***
8/26/2008	14.03	0.08%	0.00%	0.08%	5.30	***
8/27/2008	14.78	0.08%	0.00%	0.08%	5.08	***
8/28/2008	15.87	0.01%	0.00%	0.00%	-3.49	***
8/29/2008	16.09	0.01%	0.01%	0.00%	-3.66	***
9/2/2008	16.13	0.01%	0.01%	0.00%	-3.43	***
9/3/2008	16.94	0.01%	0.00%	0.01%	-3.24	***
9/4/2008	15.17	0.00%	0.01%	0.00%	-4.08	***
9/5/2008	16.20	0.00%	0.01%	-0.01%	-4.75	***
9/8/2008	14.15	0.01%	0.01%	0.00%	-4.46	***
9/9/2008	7.79	0.08%	0.02%	0.06%	3.47	***
9/10/2008	7.25	0.43%	0.02%	0.41%	43.46	***
9/11/2008	4.22	1.64%	0.02%	1.63%	185.67	***
9/12/2008	3.65	2.43%	0.02%	2.41%	277.32	***
9/15/2008	0.21	2.43%	0.02%	2.41%	276.59	***
9/16/2008	0.30	2.61%	0.08%	2.53%	290.37	***
9/17/2008	0.13	4.08%	0.09%	3.99%	461.09	***
9/18/2008						
9/19/2008			DELISTED			
9/22/2008						
9/23/2008						

Table 7 – Naked Short Selling around Credit Rating Downgrades

We analyze long-term issuer credit rating downgrades by S&P for 17 financial firms: Bank of America Corporation, Barclays, Bear Stearns Companies Inc., Citigroup Inc., Credit Suisse Group, Deutsche Bank Group AG, Allianz SE, Goldman, Sachs Group Inc, Royal Bank ADS, HSBC Holdings PLC ADS, J. P. Morgan Chase & Co., Merrill Lynch & Co., Inc., Mizuho Financial Group, Inc., Morgan Stanley, UBS AG, Freddie Mac, Fannie Mae, over the year 2008. We compute *ONSR* for each firm's common stock (when the primary exchange is not in the US, we use the corresponding ADR). In all, we identify 21 downgrades; day 0 is the day of the downgrade. We compute abnormal daily *ONSR* by subtracting the *Mean ONSR* from daily *ONSR*. *Mean ONSR* is computed over 100 trading days ending 20 days prior to the credit rating downgrade. We report results for various event windows. *Cumulative Abnormal ONSR* is the sum of daily *ONSR* for all days in the event window. The *t*-statistic for significance of the mean is computed making use of the historic estimate of the standard error (computed over the estimation period of 100 trading days ending 20 days prior to the credit rating downgrade), adjusted for date clustering. Significance is denoted as follows: "*" indicates significance at the .1 level "**" indicates significance at the .05 level; "***" indicates significance at the .01 level.

Event Window	N	Mean Cumulative Abnormal ONSR	t-stat	
(-20,-1)	21	-0.36%	-1.93	*
(-10,-1)	21	-0.27%	-2.03	**
(-5,-1)	21	-0.15%	-1.64	
(0,0)	21	-0.02%	-0.57	
(+1,+5)	21	0.32%	3.44	***
(+1,+10)	21	0.57%	4.25	***
(+1,+20)	21	0.67%	3.56	***

Table 8 –The Impact of Restrictions on Naked Short Selling imposed by the SEC between July 21st, 2008 and August 12th, 2008.

The following table presents parameter estimates and related t-statistics (in italics, grey font) from 5 OLS regressions, one for each variable of interest: *ONSR*, *PE Volatility*, *Volume*, *Spread* and *Close-to-Close Return*. All variables are computed daily over the interval January 1st, 2008 to September 9th 2008. In each k^{th} ($1 <= k <= 5$) regression, the response variable is the mean value of the k^{th} variable of interest for the sample of the 17 stocks that were subject to restrictions on naked short selling. Explanatory variables include, in each regression, an intercept, the mean value of the k^{th} variable of interest for the control sample, *Control*, and a binary variable, *Event*, equal to 1 between July 21st, 2008 and August 12th, 2008. All variables are defined as in Table 1, with the exception of *Close-to-Close Return*; *Close-to-Close Return* is computed as the difference between the day's adjusted close price (as reported by CRSP) and the previous day's adjusted close price, divided by the previous day's adjusted close price. Significance is denoted as follows: "*" indicates significance at the .1 level "**" indicates significance at the .05 level; "***" indicates significance at the .01 level. The OLS regression equation is as follows:

$$Response\,Variable_{k,t} = \alpha_k + \beta_{1,k} Event + \beta_{2,k} Control\,Variable_{k,t} + \varepsilon_{k,t}$$

	Predictor						
Response	*Event*	*Intercept*	*Control - ONSR*	*Control - PE Volatility*	*Control - Volume*	*Control - Spread*	*Control – Close-to-Close Return*
ONSR	-0.001 *-4.83****	0.0007 *7.30****	2.0136 *4.07****				
PE Volatility	0.0743 *4.99****	0.1972 *20.02****		0.6247 *0.98*			
Volume	-0.0078 *-2.76****	-0.008 *-3.00****			2.885 *12.86****		
Spread	0.0001 *0.5*	0.0009 *5.62****				0.2779 *0.0051*	
Close-to-Close Return	-0.0063 *-1.59*	-0.0018 *-1.42*					1.1786 *25.37****

Table 9 –Pricing error and OIB reversals

This table presents results of regressions used to test the difference between the rates of mean reversion of *Pricing Error* and *Order Imbalance* between 2004 and 2007, and 2007 and 2008. For 2007, we use our '2007 Most Naked-Shorted Sample', constructed as in Table 5. We repeat the same procedure for all NYSE common stocks of US-based firms included in the CRSP database between April 1st, 2004 and October 1st 2004 to obtain our '2004 Most Naked-Shorted Sample' which contains 193 securities; and we obtain results for 188 securities. We repeat the same procedure for all NYSE common stock of US-based firms included in the CRSP database between January 1st, 2008 and June 30th 2008, obtaining our '2008 Most Naked-Shorted Sample', which contains 231 securities; and we obtain results for 193 securities. The following two OLS regressions are conducted for all three samples.

$$\Delta Pricing\ \ Error_{i,t} = \gamma_i + \alpha_{NEG,i} Pricing\ \ Error_{i,t-1} + \alpha_{INC\_POS,i} Pricing\ \ Error_{i,t-1} * Positive\ \ PE_{i,t-1} + \phi_{1,i}\Delta Spread_{i,t} + \phi_{2,i}\Delta Volatility_{i,t} + \varepsilon_{i,t}$$

$$\Delta OIB_{i,t} = \gamma_i + \beta_{NEG,i} OIB_{i,t-1} + \beta_{INC\_POS,i} OIB_{i,t-1} * Positive\ \ OIB_{i,t-1} + \phi_{1,i}\Delta Spread_{i,t} + \phi_{2,i}\Delta Volatility_{i,t} + \varepsilon_{i,t}$$

The regressions are estimated by security (i). The reported results are average parameter estimates (standard errors are reported below, in italics). The difference in parameter estimates of interest are reported in the table and tested by using a two-sample t-test. Significance is denoted as follows: "*" indicates significance at the .1 level "**" indicates significance at the .05 level; "***" indicates significance at the .01 level. All variables are defined as in Table 1

Parameter		2004	2007	2008	Difference (2007-2004)		Difference (2007-2008)	
					Estimate	T-Value	Estimate	T-Value
Coefficient of Mean Reversion for Negative PE	α_{NEG}	0.58 *0.02*	0.64 *0.02*	0.64 *0.03*	0.06	1.76*	0.00	0.03
Coefficient of Mean Reversion for Positve PE	$\alpha_{NEG} + \alpha_{INC\_POS}$	0.62 *0.02*	0.65 *0.02*	0.62 *0.03*	0.03	0.64	-0.03	-0.70
Coefficient of Mean Reversion for Negative OIB	β_{NEG}	0.68 *0.06*	0.89 *0.06*	0.81 *0.02*	0.22	2.63***	-0.08	-1.25
Coefficient of Mean Reversion for Positve OIB	$\beta_{NEG} + \beta_{INC\_POS}$	0.71 *0.01*	0.81 *0.01*	0.83 *0.01*	0.09	5.04***	0.03	1.36

Figure 1

Plot of Outstanding Naked Short Ratio (ONSR) and Cumulative S&P 500 Returns, January 1st 2007 to December 31st, 2008.

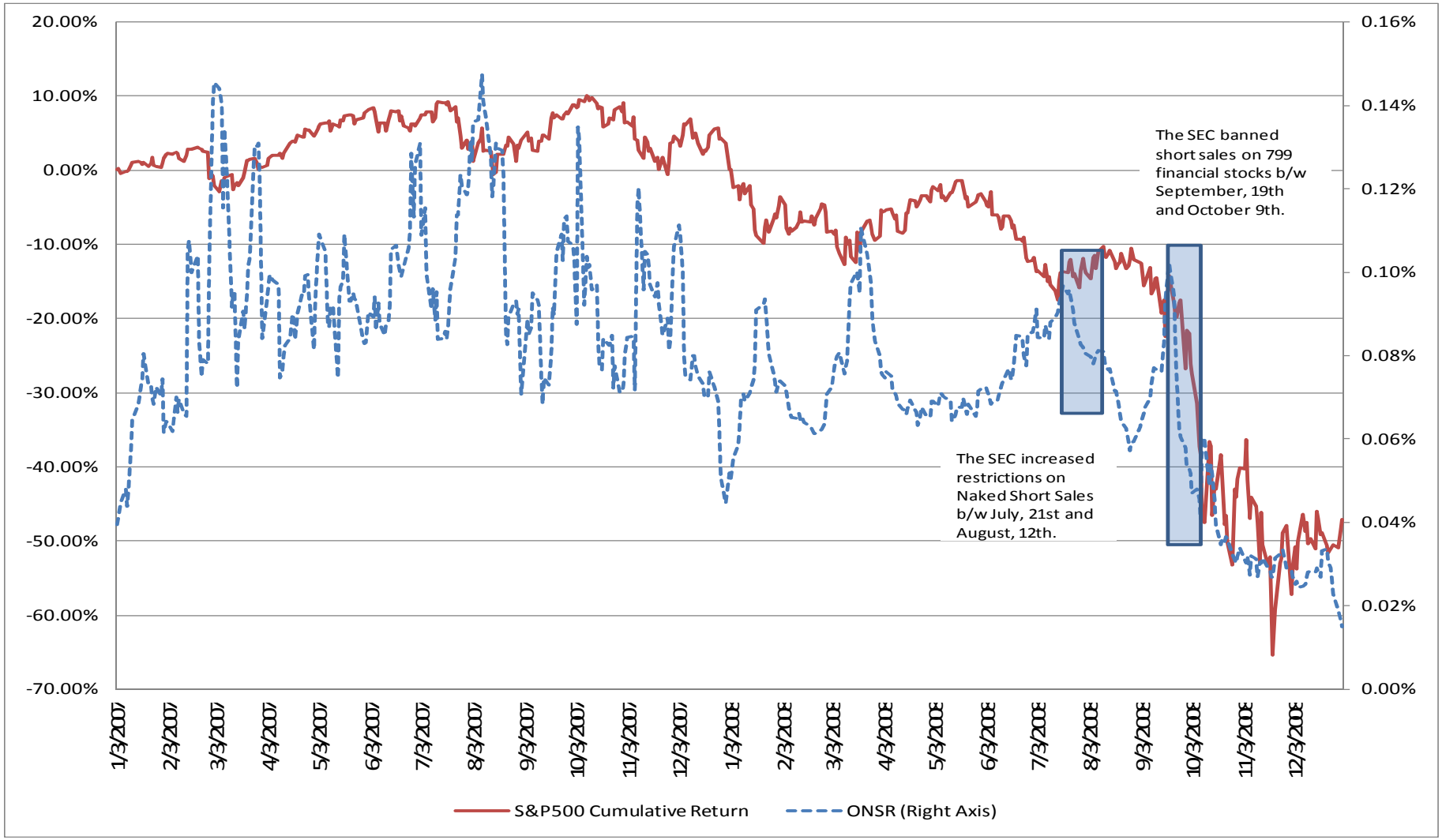


Figure 2 – Naked Shorting, Covered Shorting, Pricing Error and Liquidity around Naked Shorting Peaks.
Plot of averages of *Outstanding Naked Short Ratio*, *Covered Short Ratio*, *PE Volatility*, *Order Imbalance* and *Spread* against a relative date; all series are computed daily by security, for all securities in the '2007 Most Naked-Shorted Sample'. All the variables have been standardized prior to being averaged; average values are plotted. For each security, the relative calendar is centered on the day (day 0) on which the *Outstanding Naked Short Ratio* reaches its maximum value within the interval January 1st to June 30th, 2007.

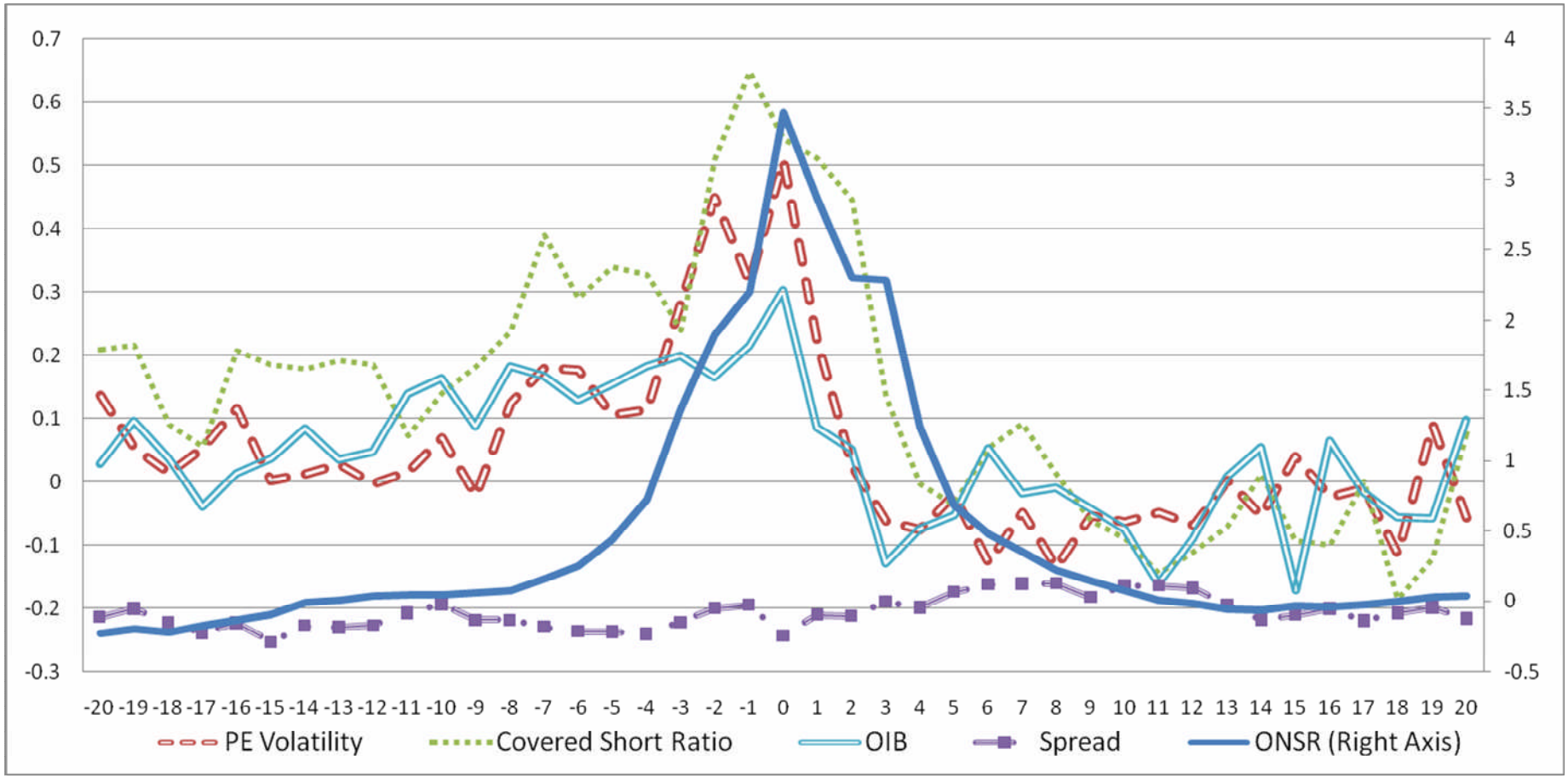


Figure 3

Plot of *Outstanding Naked Short Ratio* and *Return Index* related to Bear Sterns Companies Inc. common stock (ticker: BSC) against calendar date. The *Return Index* is set to 1 on the 1st of January, 2008; $Return\ Index_i = \sum_{j=1}^{i}(1 + R_{BSC,j})$. $R_{BSC,j}$ is the observed total return for BSC on day *j*, from the CRSP database.

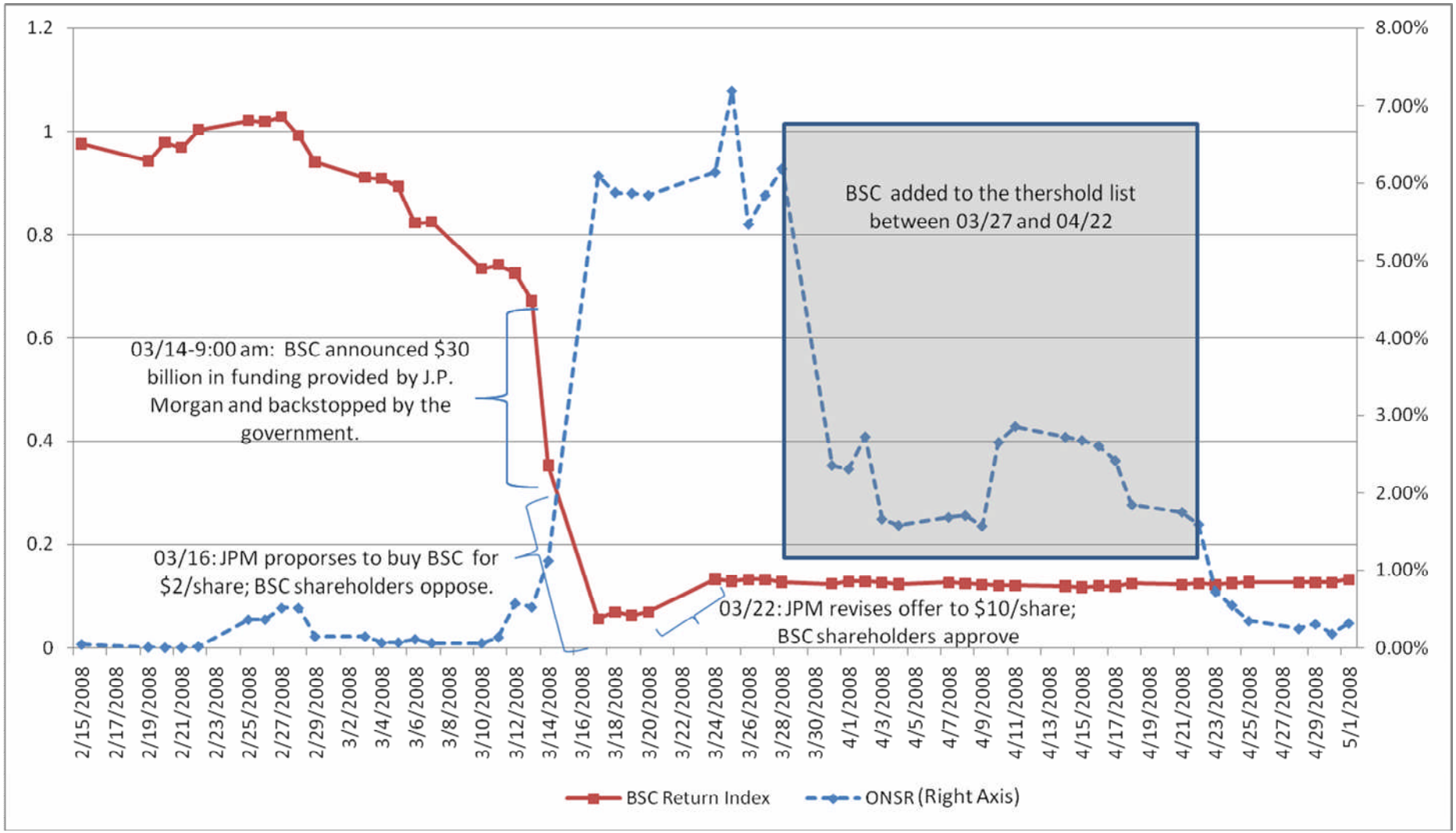


Figure 4A

Plot of *Outstanding Naked Short Ratio* and *Return Index* related to Lehman Brothers Holdings Inc. common stock (ticker: LEH) against calendar date. The *Return Index* is set to 1 on the 1st of January, 2008; $Return\ Index_i = \sum_{j=1}^{i}(1 + R_{LEH,j})$. $R_{LEH,j}$ is the observed total return for LEH on day *j*, from the CRSP database.

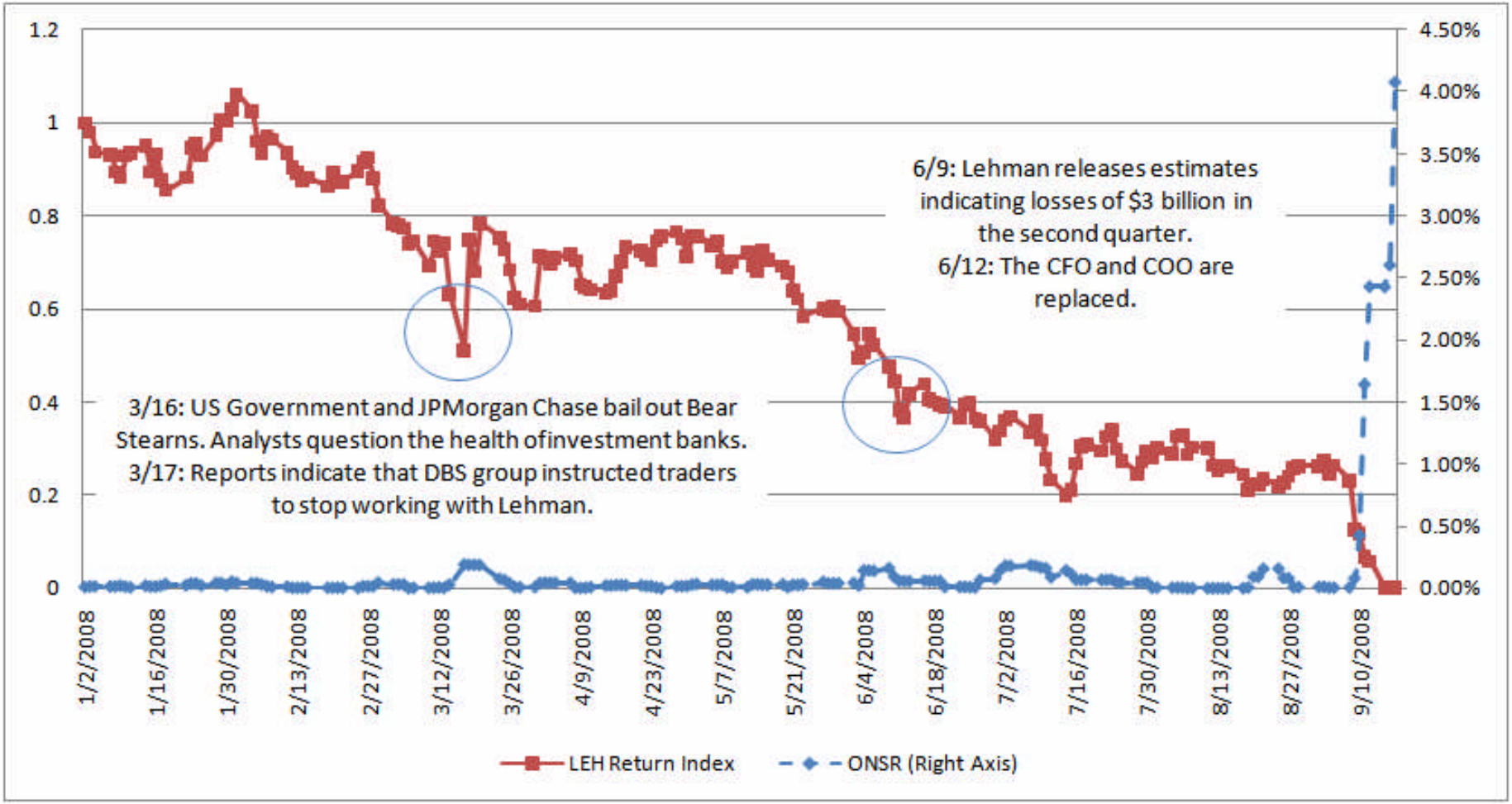


Figure 4B

Plot of *Outstanding Naked Short Ratio* and *Return Index* related to Lehman Brothers Holdings Inc. common stock (ticker: LEH) against calendar date. The *Return Index* is set to 1 on the 1st of January, 2008; $Return\ Index_i = \sum_{j=1}^{i}(1 + R_{LEH,j})$. $R_{LEH,j}$ is the observed total return for LEH on day *j*, from the CRSP database.

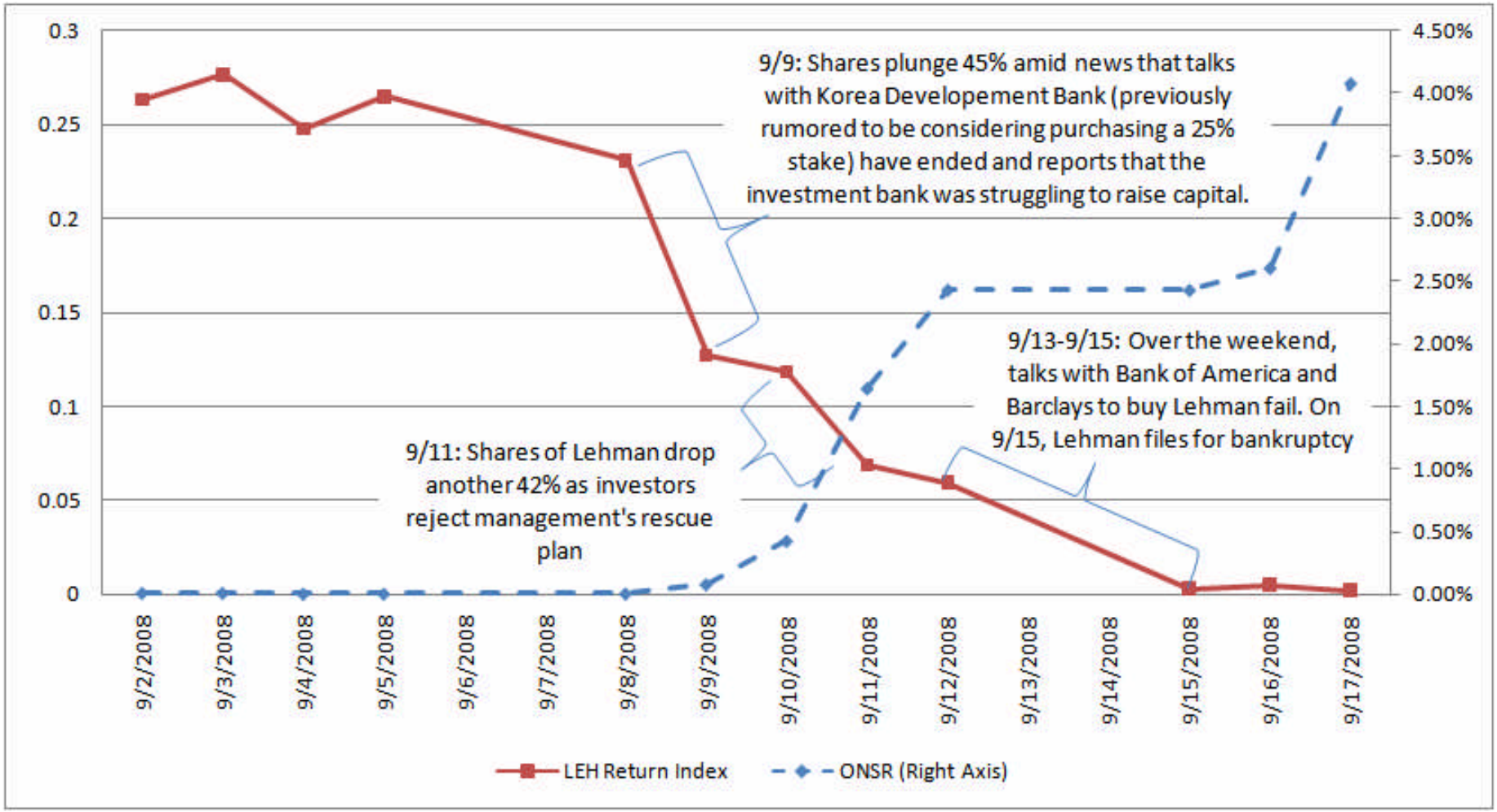


Figure 5

Plot of *Outstanding Naked Short Ratio* and *Return Index* related to Merrill Lynch & Co., Inc. common stock (ticker: MER) against calendar date. The *Return Index* is set to 1 on the 1st of January, 2008; $Return\ Index_i = \sum_{j=1}^{i}(1+R_{MER,j})$. $R_{MER,j}$ is the observed total return for MER on day *j*, from the CRSP database.

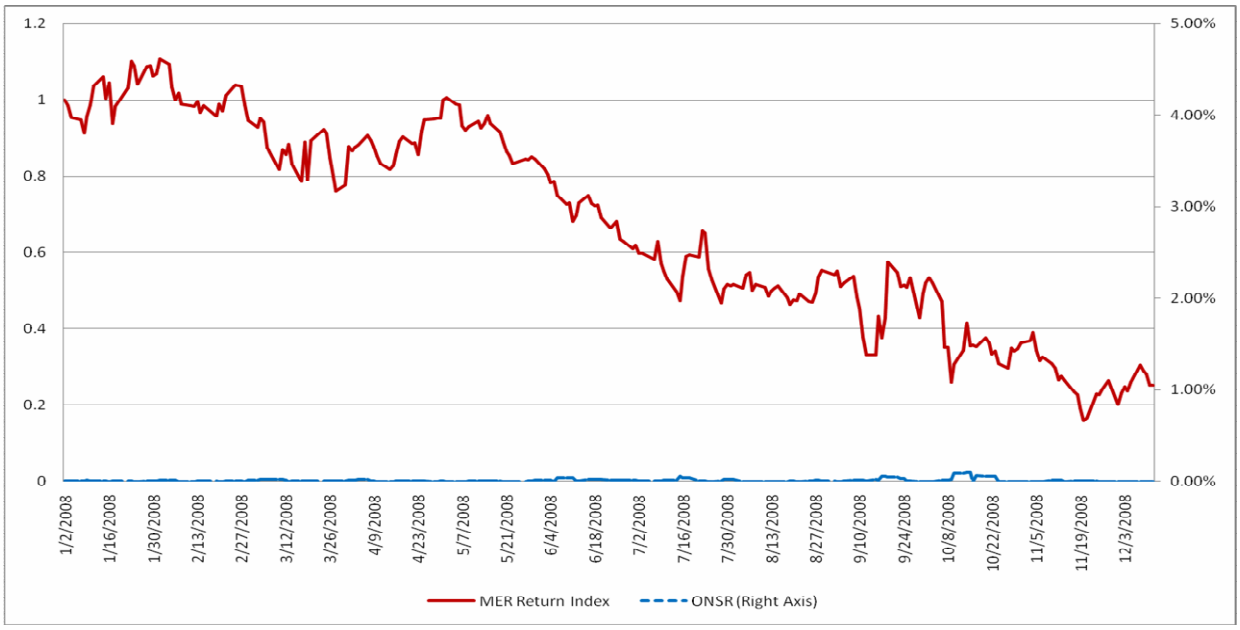
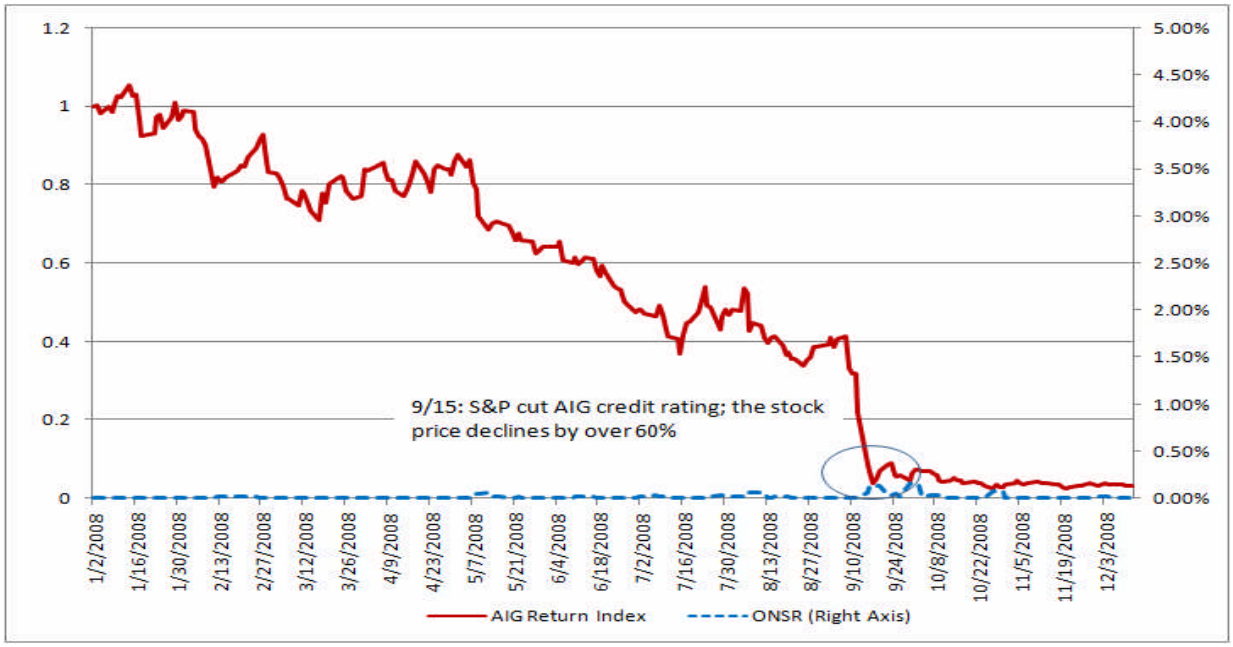


Figure 6

Plot of averages of *Outstanding Naked Short Ratio* and *Return Index* related to American International Group common stock (ticker: AIG) against calendar date. The *Return Index* is set to 1 on the 1st of January, 2008; $Return\ Index_i = \sum_{j=1}^{i}(1+R_{AIG,j})$. $R_{AIG,j}$ is the observed total return for AIG on day *j*, from the CRSP database.



CFR Working Paper Series

centre for financial research cologne

CFR working papers are available for download from **www.cfr-cologne.de**.

Hardcopies can be ordered from: centre for financial research (CFR), Albertus Magnus Platz, 50923 Koeln, Germany.

2012

No.	Author(s)	Title
12-06	A. Kempf, A. Pütz, F. Sonnenburg	Fund Manager Duality: Impact on Performance and Investment Behavior
12-05	R. Wermers	Runs on Money Market Mutual Funds
12-04	R. Wermers	A matter of style: The causes and consequences of style drift in institutional portfolios
12-03	C. Andres, A. Betzer, I. van den Bongard, C. Haesner, E. Theissen	Dividend Announcements Reconsidered: Dividend Changes versus Dividend Surprises
12-02	C. Andres, E. Fernau, E. Theissen	Is It Better To Say Goodbye? When Former Executives Set Executive Pay
12-01	L. Andreu, A. Pütz	Are Two Business Degrees Better Than One? Evidence from Mutual Fund Managers' Education

2011

No.	Author(s)	Title
11-16	V. Agarwal, J.-P. Gómez, R. Priestley	Management Compensation and Market Timing under Portfolio Constraints
11-15	T. Dimpfl, S. Jank	Can Internet Search Queries Help to Predict Stock Market Volatility?
11-14	P. Gomber, U. Schweickert, E. Theissen	Liquidity Dynamics in an Electronic Open Limit Order Book: An Event Study Approach
11-13	D. Hess, S. Orbe	Irrationality or Efficiency of Macroeconomic Survey Forecasts? Implications from the Anchoring Bias Test
11-12	D. Hess, P. Immenkötter	Optimal Leverage, its Benefits, and the Business Cycle
11-11	N. Heinrichs, D. Hess, C. Homburg, M. Lorenz, S. Sievers	Extended Dividend, Cash Flow and Residual Income Valuation Models – Accounting for Deviations from Ideal Conditions
11-10	A. Kempf, O. Korn, S. Saßning	Portfolio Optimization using Forward - Looking Information

11-09	V. Agarwal, S. Ray	Determinants and Implications of Fee Changes in the Hedge Fund Industry
11-08	G. Cici, L.-F. Palacios	On the Use of Options by Mutual Funds: Do They Know What They Are Doing?
11-07	V. Agarwal, G. D. Gay, L. Ling	Performance inconsistency in mutual funds: An investigation of window-dressing behavior
11-06	N. Hautsch, D. Hess, D. Veredas	The Impact of Macroeconomic News on Quote Adjustments, Noise, and Informational Volatility
11-05	G. Cici	The Prevalence of the Disposition Effect in Mutual Funds' Trades
11-04	S. Jank	Mutual Fund Flows, Expected Returns and the Real Economy
11-03	G.Fellner, E.Theissen	Short Sale Constraints, Divergence of Opinion and Asset Value: Evidence from the Laboratory
11-02	S.Jank	Are There Disadvantaged Clienteles in Mutual Funds?
11-01	V. Agarwal, C. Meneghetti	The Role of Hedge Funds as Primary Lenders

2010

No.	Author(s)	Title
10-20	G. Cici, S. Gibson, J.J. Merrick Jr.	Missing the Marks? Dispersion in Corporate Bond Valuations Across Mutual Funds
10-19	J. Hengelbrock, E. Theissen, C. Westheide	Market Response to Investor Sentiment
10-18	G. Cici, S. Gibson	The Performance of Corporate-Bond Mutual Funds: Evidence Based on Security-Level Holdings
10-17	D. Hess, D. Kreutzmann, O. Pucker	Projected Earnings Accuracy and the Profitability of Stock Recommendations
10-16	S. Jank, M. Wedow	Sturm und Drang in Money Market Funds: When Money Market Funds Cease to Be Narrow
10-15	G. Cici, A. Kempf, A. Puetz	The Valuation of Hedge Funds' Equity Positions
10-14	J. Grammig, S. Jank	Creative Destruction and Asset Prices
10-13	S. Jank, M. Wedow	Purchase and Redemption Decisions of Mutual Fund Investors and the Role of Fund Families
10-12	S. Artmann, P. Finter, A. Kempf, S. Koch, E. Theissen	The Cross-Section of German Stock Returns: New Data and New Evidence
10-11	M. Chesney, A. Kempf	The Value of Tradeability
10-10	S. Frey, P. Herbst	The Influence of Buy-side Analysts on Mutual Fund Trading
10-09	V. Agarwal, W. Jiang, Y. Tang, B. Yang	Uncovering Hedge Fund Skill from the Portfolio Holdings They Hide
10-08	V. Agarwal, V. Fos, W. Jiang	Inferring Reporting Biases in Hedge Fund Databases from Hedge Fund Equity Holdings
10-07	V. Agarwal, G. Bakshi,	Do Higher-Moment Equity Risks Explain Hedge Fund

	J. Huij	Returns?
10-06	J. Grammig, F. J. Peter	Tell-Tale Tails
10-05	K. Drachter, A. Kempf	Höhe, Struktur und Determinanten der Managervergütung-Eine Analyse der Fondsbranche in Deutschland
10-04	J. Fang, A. Kempf, M. Trapp	Fund Manager Allocation
10-03	P. Finter, A. Niessen-Ruenzi, S. Ruenzi	The Impact of Investor Sentiment on the German Stock Market
10-02	D. Hunter, E. Kandel, S. Kandel, R. Wermers	Endogenous Benchmarks
10-01	S. Artmann, P. Finter, A. Kempf	Determinants of Expected Stock Returns: Large Sample Evidence from the German Market

2009

No.	Author(s)	Title
09-17	E. Theissen	Price Discovery in Spot and Futures Markets: A Reconsideration
09-16	M. Trapp	Trading the Bond-CDS Basis – The Role of Credit Risk and Liquidity
09-15	A. Betzer, J. Gider, D.Metzger, E. Theissen	Strategic Trading and Trade Reporting by Corporate Insiders
09-14	A. Kempf, O. Korn, M. Uhrig-Homburg	The Term Structure of Illiquidity Premia
09-13	W. Bühler, M. Trapp	Time-Varying Credit Risk and Liquidity Premia in Bond and CDS Markets
09-12	W. Bühler, M. Trapp	Explaining the Bond-CDS Basis – The Role of Credit Risk and Liquidity
09-11	S. J. Taylor, P. K. Yadav, Y. Zhang	Cross-sectional analysis of risk-neutral skewness
09-10	A. Kempf, C. Merkle, A. Niessen-Ruenzi	Low Risk and High Return – Affective Attitudes and Stock Market Expectations
09-09	V. Fotak, V. Raman, P. K. Yadav	Naked Short Selling: The Emperor`s New Clothes?
09-08	F. Bardong, S.M. Bartram, P.K. Yadav	Informed Trading, Information Asymmetry and Pricing of Information Risk: Empirical Evidence from the NYSE
09-07	S. J. Taylor , P. K. Yadav, Y. Zhang	The information content of implied volatilities and model-free volatility expectations: Evidence from options written on individual stocks
09-06	S. Frey, P. Sandas	The Impact of Iceberg Orders in Limit Order Books
09-05	H. Beltran-Lopez, P. Giot, J. Grammig	Commonalities in the Order Book
09-04	J. Fang, S. Ruenzi	Rapid Trading bei deutschen Aktienfonds: Evidenz aus einer großen deutschen Fondsgesellschaft
09-03	A. Banegas, B. Gillen, A. Timmermann, R. Wermers	The Performance of European Equity Mutual Funds

09-02	J. Grammig, A. Schrimpf, M. Schuppli	Long-Horizon Consumption Risk and the Cross-Section of Returns: New Tests and International Evidence
09-01	O. Korn, P. Koziol	The Term Structure of Currency Hedge Ratios

2008

No.	Author(s)	Title
08-12	U. Bonenkamp, C. Homburg, A. Kempf	Fundamental Information in Technical Trading Strategies
08-11	O. Korn	Risk Management with Default-risky Forwards
08-10	J. Grammig, F.J. Peter	International Price Discovery in the Presence of Market Microstructure Effects
08-09	C. M. Kuhnen, A. Niessen	Public Opinion and Executive Compensation
08-08	A. Pütz, S. Ruenzi	Overconfidence among Professional Investors: Evidence from Mutual Fund Managers
08-07	P. Osthoff	What matters to SRI investors?
08-06	A. Betzer, E. Theissen	Sooner Or Later: Delays in Trade Reporting by Corporate Insiders
08-05	P. Linge, E. Theissen	Determinanten der Aktionärspräsenz auf Hauptversammlungen deutscher Aktiengesellschaften
08-04	N. Hautsch, D. Hess, C. Müller	Price Adjustment to News with Uncertain Precision
08-03	D. Hess, H. Huang, A. Niessen	How Do Commodity Futures Respond to Macroeconomic News?
08-02	R. Chakrabarti, W. Megginson, P. Yadav	Corporate Governance in India
08-01	C. Andres, E. Theissen	Setting a Fox to Keep the Geese - Does the Comply-or-Explain Principle Work?

2007

No.	Author(s)	Title
07-16	M. Bär, A. Niessen, S. Ruenzi	The Impact of Work Group Diversity on Performance: Large Sample Evidence from the Mutual Fund Industry
07-15	A. Niessen, S. Ruenzi	Political Connectedness and Firm Performance: Evidence From Germany
07-14	O. Korn	Hedging Price Risk when Payment Dates are Uncertain
07-13	A. Kempf, P. Osthoff	SRI Funds: Nomen est Omen
07-12	J. Grammig, E. Theissen, O. Wuensche	Time and Price Impact of a Trade: A Structural Approach
07-11	V. Agarwal, J. R. Kale	On the Relative Performance of Multi-Strategy and Funds of Hedge Funds
07-10	M. Kasch-Haroutounian, E. Theissen	Competition Between Exchanges: Euronext versus Xetra
07-09	V. Agarwal, N. D. Daniel, N. Y. Naik	Do hedge funds manage their reported returns?

07-08	N. C. Brown, K. D. Wei, R. Wermers	Analyst Recommendations, Mutual Fund Herding, and Overreaction in Stock Prices
07-07	A. Betzer, E. Theissen	Insider Trading and Corporate Governance: The Case of Germany
07-06	V. Agarwal, L. Wang	Transaction Costs and Value Premium
07-05	J. Grammig, A. Schrimpf	Asset Pricing with a Reference Level of Consumption: New Evidence from the Cross-Section of Stock Returns
07-04	V. Agarwal, N.M. Boyson, N.Y. Naik	Hedge Funds for retail investors? An examination of hedged mutual funds
07-03	D. Hess, A. Niessen	The Early News Catches the Attention: On the Relative Price Impact of Similar Economic Indicators
07-02	A. Kempf, S. Ruenzi, T. Thiele	Employment Risk, Compensation Incentives and Managerial Risk Taking - Evidence from the Mutual Fund Industry -
07-01	M. Hagemeister, A. Kempf	CAPM und erwartete Renditen: Eine Untersuchung auf Basis der Erwartung von Marktteilnehmern

2006

No.	Author(s)	Title
06-13	S. Čeljo-Hörhager, A. Niessen	How do Self-fulfilling Prophecies affect Financial Ratings? - An experimental study
06-12	R. Wermers, Y. Wu, J. Zechner	Portfolio Performance, Discount Dynamics, and the Turnover of Closed-End Fund Managers
06-11	U. v. Lilienfeld-Toal, S. Ruenzi	Why Managers Hold Shares of Their Firm: An Empirical Analysis
06-10	A. Kempf, P. Osthoff	The Effect of Socially Responsible Investing on Portfolio Performance
06-09	R. Wermers, T. Yao, J. Zhao	Extracting Stock Selection Information from Mutual Fund holdings: An Efficient Aggregation Approach
06-08	M. Hoffmann, B. Kempa	The Poole Analysis in the New Open Economy Macroeconomic Framework
06-07	K. Drachter, A. Kempf, M. Wagner	Decision Processes in German Mutual Fund Companies: Evidence from a Telephone Survey
06-06	J.P. Krahnen, F.A. Schmid, E. Theissen	Investment Performance and Market Share: A Study of the German Mutual Fund Industry
06-05	S. Ber, S. Ruenzi	On the Usability of Synthetic Measures of Mutual Fund Net-Flows
06-04	A. Kempf, D. Mayston	Liquidity Commonality Beyond Best Prices
06-03	O. Korn, C. Koziol	Bond Portfolio Optimization: A Risk-Return Approach
06-02	O. Scaillet, L. Barras, R. Wermers	False Discoveries in Mutual Fund Performance: Measuring Luck in Estimated Alphas
06-01	A. Niessen, S. Ruenzi	Sex Matters: Gender Differences in a Professional Setting

2005

No.	Author(s)	Title
05-16	E. Theissen	An Analysis of Private Investors´ Stock Market Return Forecasts

05-15	T. Foucault, S. Moinas, E. Theissen	Does Anonymity Matter in Electronic Limit Order Markets
05-14	R. Kosowski, A. Timmermann, R. Wermers, H. White	Can Mutual Fund „Stars“ Really Pick Stocks? New Evidence from a Bootstrap Analysis
05-13	D. Avramov, R. Wermers	Investing in Mutual Funds when Returns are Predictable
05-12	K. Griese, A. Kempf	Liquiditätsdynamik am deutschen Aktienmarkt
05-11	S. Ber, A. Kempf, S. Ruenzi	Determinanten der Mittelzuflüsse bei deutschen Aktienfonds
05-10	M. Bär, A. Kempf, S. Ruenzi	Is a Team Different From the Sum of Its Parts? Evidence from Mutual Fund Managers
05-09	M. Hoffmann	Saving, Investment and the Net Foreign Asset Position
05-08	S. Ruenzi	Mutual Fund Growth in Standard and Specialist Market Segments
05-07	A. Kempf, S. Ruenzi	Status Quo Bias and the Number of Alternatives - An Empirical Illustration from the Mutual Fund Industry
05-06	J. Grammig, E. Theissen	Is Best Really Better? Internalization of Orders in an Open Limit Order Book
05-05	H. Beltran-Lopez, J. Grammig, A.J. Menkveld	Limit order books and trade informativeness
05-04	M. Hoffmann	Compensating Wages under different Exchange rate Regimes
05-03	M. Hoffmann	Fixed versus Flexible Exchange Rates: Evidence from Developing Countries
05-02	A. Kempf, C. Memmel	Estimating the Global Minimum Variance Portfolio
05-01	S. Frey, J. Grammig	Liquidity supply and adverse selection in a pure limit order book market

2004

No.	Author(s)	Title
04-10	N. Hautsch, D. Hess	Bayesian Learning in Financial Markets – Testing for the Relevance of Information Precision in Price Discovery
04-09	A. Kempf, K. Kreuzberg	Portfolio Disclosure, Portfolio Selection and Mutual Fund Performance Evaluation
04-08	N.F. Carline, S.C. Linn, P.K. Yadav	Operating performance changes associated with corporate mergers and the role of corporate governance
04-07	J.J. Merrick, Jr., N.Y. Naik, P.K. Yadav	Strategic Trading Behaviour and Price Distortion in a Manipulated Market: Anatomy of a Squeeze
04-06	N.Y. Naik, P.K. Yadav	Trading Costs of Public Investors with Obligatory and Voluntary Market-Making: Evidence from Market Reforms
04-05	A. Kempf, S. Ruenzi	Family Matters: Rankings Within Fund Families and Fund Inflows
04-04	V. Agarwal, N.D. Daniel, N.Y. Naik	Role of Managerial Incentives and Discretion in Hedge Fund Performance
04-03	V. Agarwal, W.H. Fung, J.C. Loon, N.Y. Naik	Risk and Return in Convertible Arbitrage: Evidence from the Convertible Bond Market
04-02	A. Kempf, S. Ruenzi	Tournaments in Mutual Fund Families

04-01	I. Chowdhury, M. Hoffmann, A. Schabert	Inflation Dynamics and the Cost Channel of Monetary Transmission

centre for financial research
cfr/university of cologne
Albertus-Magnus-Platz
D-50923 cologne
Fon +49(0)221-470-6995
Fax +49(0)221-470-3992
kempf@cfr-cologne.de
www.cfr-cologne.de