Price Inflation and Wealth Transfer during the 2008 SEC Short-Sale Ban

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April 30, 2009

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Using a factor-analytic model that extracts common valuation information from the prices of stocks that were not banned, we estimate that the ban on short-selling financial stocks imposed by the SEC in September 2008 led to substantial price inflation in the banned stocks. The inflation reversed somewhat following the ban, but the data are too noisy to conclusively link the reversal to the ban. Other factors such as the pending TARP legislation may also have affected prices, though our results suggest that it was not a significant factor. If prices were inflated, buyers paid more than they otherwise would have paid for the banned stocks during the period of the ban. We provide an estimate of $4.9 billion for the resulting transfer from buyers to sellers. Such transfers should interest policymakers concerned about maintaining fair markets.

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Using a factor-analytic model that extracts common valuation information from the prices of stocks that were not banned, we estimate that the ban on short-selling financial stocks imposed by the SEC in September 2008 led to substantial price inflation in the banned stocks. The inflation reversed somewhat following the ban, but the data are too noisy to conclusively link the reversal to the ban. Other factors such as the pending TARP legislation may also have affected prices, though our results suggest that it was not a significant factor. If prices were inflated, buyers paid more than they otherwise would have paid for the banned stocks during the period of the ban. We provide an estimate of $4.9 billion for the resulting transfer from buyers to sellers. Such transfers should interest policymakers concerned about maintaining fair markets.

Beginning in the summer of 2008, the U.S. Securities and Exchange Commission (SEC) implemented a series of short-sale restrictions that had several intended and likely unintended consequences. This paper examines the effects of the absolute ban on short-selling financial sector stocks imposed by the SEC in September 2008.

The SEC was concerned that short sellers were manipulating (or could manipulate) the stock prices of financial firms which were facing strong downward price pressure due to the global financial crisis. In particular, the commissioners feared that stock price decreases might convince depositors and other creditors that the firms were in financial distress and facing significant bankruptcy risk. With such convictions, many creditors would withdraw deposits and other short-term credit facilities, which would force the firms to sell their long positions under duress. The associated liquidation costs would further lower stock prices. These liquidity death spirals could lead to bankruptcies and substantial profits for short sellers. The SEC banned short selling to mitigate concerns about sentiment driven liquidity death spirals contributing to lowering stock prices and firm financial distress.[1]

We may never know whether short sellers were indeed manipulating prices to create liquidity death spirals. When confronted, short sellers invariably defend their actions as motivated by stock valuation (selling short overvalued stocks) as opposed to market manipulation objectives. Given the extreme losses that many financial firms experienced in real estate and other securities, this argument is credible.

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[1] In SEC Release No. 34-58592, the Acting Secretary, Florence E. Harmon cites an earlier SEC release dated July 15, 2008 (related to the ban on naked short-selling) which states that:

> "*We intend these and similar actions to provide powerful disincentives to those who might otherwise engage in illegal market manipulation through the dissemination of false rumors and thereby over time to diminish the effect of these activities on our markets.*"

If financial stocks were indeed overvalued, or if they were merely properly valued before the ban, the ban on short selling had a potentially serious unintended consequence. By preventing short sellers from trading, the SEC created a bias toward higher prices. The unintended consequence of this bias is that buyers could have bought at prices above fundamental value. If so, these buyers would face significant loses when prices ultimately adjust downward to their true intrinsic values.

Anecdotal evidence suggests that this scenario may indeed have occurred. Before the September ban on short selling, Freddie Mac (FRE) and Fannie Mae (FNM) common shares were trading near 30 cents and 50 cents, respectively. During the ban, their shares rose to nearly $2.00 per share. Following the end of the ban, the shares of both firms soon dropped back to about 60 cents per share. If the ban inflated their share prices by preventing short sellers from supplying liquidity to an imbalance of buyers, the buyers traded at artificially high prices. For long sellers, the ban on short selling provided an unexpected windfall. We estimate that during the period of the ban, inflation may have transferred $597M from buyers to sellers in the shares of FRE and FNM.

This paper examines the prices of the common stocks that were subject to the SEC short sale ban to estimate the price inflation, if any, associated with the ban. Using a factor-analytic model, we provide conservative estimates of the inflation. Our estimates are based on the assumption that we can extract meaningful information about the values of the banned stocks from an analysis of the prices of the non-banned stocks.

We recognize that the banned stock values may depend on factors that we could not model so that the inflation we estimate may be due to other factors besides the SEC ban. Foremost among these other factors may have been valuation effects associated with the

Troubled Asset Repurchase Program (TARP) legislation that Congress was debating during the period of the ban.[2] If such factors did not also affect the non-banned stocks, the inflation we estimate may not have been due to the short-selling ban. We specifically address the possibility that optimism about TARP inflated the banned stock prices. Our results suggest that concerns about the TARP do not account for the results.

Our results suggest that during the 14 trading day short sale ban the stock prices of financial sector firms were inflated by approximately 10-12%, depending on the weights used to compute benchmark returns. We further find that the price inflation is lower for stocks with greater short interest before the ban. We suspect that the ban had less effect on these stocks because the market was not concerned about further short-selling of high short interest stocks. Since these highly shorted stocks would most likely have benefited from the TARP, this evidence also suggests that a TARP factor does not account for all of the inflation.

We also find some evidence that among stocks with large short positions, price inflation is strongest for those for which no listed options trade. The SEC excluded option dealers from the short sale ban. They thus were able to hedge put option exposure via short sales, which permitted their customers to form synthetic short positions. Our results suggest that options provided an effective substitute for direct short sales during the ban. Consequently, the options exchanges benefited from the ban.

We estimate that buyers transferred $4.9 billion more to sellers due to the inflation in the banned stocks during the ban period than they would have had the SEC not imposed the ban—

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[2] On October 2, 2008, the SEC announced that the ban would end three days after the TARP bill was passed. The bill was passed on October 3 and revised on October 14. The short-sale ban ended on October 8.

assuming that the inflation was not due to concerns about the pending TARP legislation. For reasons discussed below, we believe that this estimate is conservative.

Our study is related to a recent study by Boehmer, Jones, and Zhang (2008). They examine the changes in stock prices, the rate of short sales, the aggressiveness of short sellers, and various liquidity measures before, during, and after the short ban period. Focusing on a subset of the banned sample, they find that share prices for banned stocks appeared to be inflated relative to the non-banned control, and shorting activity dropped by about 85%. They also find that liquidity as measured by spreads, price impacts, and intraday volatility significantly decreased during the period of the ban.

Our study differs from Boehmer, Jones, and Zhang (2008) in two important respects. First, we provide a more sophisticated model of what prices would have been for the banned stocks had the ban not been enacted. Boehmer, et al use a sample of stocks that were not banned as a benchmark control sample. They thus implicitly assume that the banned and the non-banned stocks in aggregate shared similar characteristics other than inclusion on the ban list. In contrast, we estimate a factor-analytic model that uses stock-level loadings on risk factors common across both banned and non-banned samples to disentangle the effects of the ban from other effects that may have been due to the global financial crisis or to other valuation factors. This issue is very important because both studies are essentially one-shot event studies for which the results depend critically on the estimates of what prices would have been if the ban had not occurred. The estimation model must produce accurate estimates of these prices; otherwise the conclusions will not be credible.

Second, we provide direct estimates of the magnitude and cost of the inflation to buyers. This calculation is of obvious importance to the debate about whether the ban was sensible.

We organized the remainder of this paper as follows. Section I provides an overview of the related literature. We describe the data used in the analysis in Section II, and introduce our analytic methods in Section III. Our results about inflation appear Section IV, and our estimates about the cost of the inflation that buyers experienced appear in Section V. Finally, we conclude in Section VI.

I. Literature Review

The effect of short-sale constraints on market efficiency is well documented in the literature. Early theoretical work by Miller (1977) argued that short sale constraints exclude pessimistic investors from the market. Thus, a subset of value opinions are excluded from the cross-section of options which converge to form prices, resulting in an upward optimism bias in short sale constrained stock prices. Diamond and Verracchia (1987) extended the theoretical work of Miller, arguing in a rational framework that options introduction provide the opportunity for pessimistic investors to realize synthetic short positions, potentially mitigating short sale constraints. They argue that options thus allow the incorporation of negative information into stock prices more rapidly, moving markets closer to strong form efficiency.

In aggregate, the majority of empirical analysis finds that short sale constraints contribute to overpricing and a reduction in market quality and efficiency.[3] Our research relates most strongly to the literature focusing on aggregate market effects of short selling and short sale constraints. For example, Bris, Goetzmann, and Zhu (2007) consider whether short-sale restrictions may be helpful during severe market panics. They analyze cross-sectional and time series information from forty-six equity markets and find that short-sale restrictions do not have noticeable affects at the individual stock level. On the other hand, they find that markets with

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[3] See for example Chen et al. (2002), Lamont (2004), Nagel (2005) and Asquith et al. (2005).

active short sellers are informationally more efficient than those markets without significant short selling.

Charoenrook and Daouk (2005) examine 111 countries to determine the effect of market-wide short-sale restrictions on value-weighted market returns obtained from DataStream. They find that index returns are less volatile and markets are more liquid when short-sales are allowed. The ability to short-sale thus substantially improves market quality. They find no evidence that short-sale restrictions affect the probability of a market crash.

Looking at the relationship between short-sale constraints and options, Phillips (2008) investigates the differential effect of the 2008 short sale ban on optioned and non-optioned stocks. Phillips finds that, after controlling for financial sector exposure and a range of stock characteristics, negative information was incorporated more freely into optioned stocks during the ban. His results suggest that put options acted as an effective substitute for short sales during the ban and thus the effect of the ban, if any, was likely significantly less for optionable stocks. These results are complementary to our results.

A small literature has recently emerged which examines actions by the SEC to mitigate the effect of short sales on the market, both in general and during the 2008 short sale ban. Boulton and Braga-Alves (2008) analyze the 2008 SEC ban on naked short-sales. Although they examine the stocks of only 19 financial firms, they find that the ban had an adverse affect on liquidity and price informativeness. As mentioned previously, Boehmer, Jones, and Zhang (2008) also examine the short-sale ban of 2008 and find that the ban decreased market quality as measured by spreads, price impacts, and intraday volatility. Our study differs from theirs in that we primarily examine the price inflation and its implications whereas Boehmer, Jones, and Zhang pay more attention to other aspects of market quality.

II. Data

Our sample includes all stocks listed on the New York (NYSE), the American (AMEX) and the National Association of Securities Dealers Automated Quotations (NASDAQ) stock exchanges between September 18, 2007 and December 31, 2008. We divided the sample into three sub-periods: the *pre-ban period* (September 18, 2007 to September 18, 2008), the *ban period* (September 19 to October 8, 2008), and the *post-ban period* (October 9 to December 31, 2008). In total, the SEC placed 987 stocks the banned list, 88% of which were included on the original list released on September 19. An additional 10% were added on September 22 and 23, and the remaining 2% were added between September 24 and as late as October 7.[4]

We obtained stock price, volume, and shares outstanding data from the Center for Research in Security Prices (CRSP) database, and short interest data from the Short Squeeze database.[5] The CRSP dataset includes 7,639 stocks in our sample period. We exclude all stocks with an incomplete data record (1,731 securities), all stocks with market capitalization less than $50 million on September 18, 2008 (1,067 securities), and all stocks for which trading volume exceeded five times shares outstanding on any given day in the sample (5 securities).[6] We also exclude stocks for which inclusion on the SEC short sale ban list is ambiguous, including stocks added and subsequently deleted at the request of the firm (10 stocks), or stocks added after September 26, 2008 (10 stocks). Finally, we exclude 4 stocks for which short interest data are

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[4] On Friday, September 19, 2008 the SEC banned short sale transactions for banks, insurance companies and securities firms identified by SIC codes 6000, 3020-22, 6025, 6030, 6035-36, 6111, 6140, 6144, 6200, 6210-11, 6231, 6282, 6305, 6310-11, 6320-21, 6324, 6330-31, 6350-51, 6360-61, 6712 and 6719. The September 19, 2008 ban list included 848 firms. Many firms filed complaints asking to be included on the list. The SEC subsequently added 149 more firms to the list between September 22 and October 7, 2008. Ten firms initially included on the list requested removal. Our classification of banned stocks includes all stocks added to the ban list between September 19 and September 26, 2008. We exclude stocks added after September 26 and stocks removed from the list after initial inclusion.

[5] For robustness we replicate our analysis using stock data from the DataStream database and find the same results.

[6] Such securities were primarily ETFs for which we suspect information about shares outstanding was often inaccurate.

missing from the Short Squeeze database. The resulting sample includes 4,812 stocks, 676 of which appeared on the SEC ban list. Between October 28, 2008 and December 31, 2008, 127 of the 676 banned stocks received TARP funds. The returns analyzed in this study are dividend- and split-adjusted log price relatives.

[Insert Figure 1 approximately here]

Panel A of Figure 1 plots various cumulative returns indices over the 15 month sample period. Value-weighted indices of the non-banned and banned stocks show that these two groups lost 8% and 30% of value, respectively, during the year before the ban (the pre-ban period).[7] These average losses increased during the ban period, with non-banned and banned stocks losing an additional 18% and 14% of market value, respectively, during the 14-trading day ban. By December 31, 2008, non-banned and banned stocks had realized cumulative losses of 32% and 54%, respectively, over the previous 15 months. The losses were greater for banned stocks for which a substantial fraction of their float was sold short as of September 15, 2008. Over the entire sample period, the short interest-weighted banned index lost 67% of market value.[8]

Panel A of Figure 1 also plots a cumulative return index for banned stocks that subsequently received TARP funds in 2008. (All stocks that subsequently received TARP funds in 2008 were on the SEC banned short sale list.) We will use this TARP index in the factor analysis described below. We weighted the returns to each stock in the TARP index by the fraction of its October 28 common stock market capitalization that it received in TARP funds. This index thus reflects the returns of those stocks for which the TARP funds subsequently

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[7] We use daily market capitalization to compute the value-weighted indices.
[8] We use the percentage of float sold short on September 15, 2008 to compute the short interest-weighted indices.

proved to be largest relative to their common stock capitalization. This TARP index decreased 68% over our sample period.

Panel B of Figure 1 compares cumulative value-weighted indices for the banned subsample separately for stocks that subsequently received TARP funds in 2008 and for those that did not. Not surprisingly, the TARP stocks realized 9% greater cumulative losses than the other stocks (-61% versus -52%, respectively). The companies that received TARP funds were more financially distressed on average than those that did not.

[Insert Figure 2 approximately here]

Figure 2 reports bi-monthly mean short interest for the non-banned and banned stocks in 2008. We weighted the means by market capitalization (Panel A) and by the fraction of float sold short on September 15, 2008 (Panel B) to make the results comparable to the corresponding value and short interest-weighted index return results shown in Figure 1.

Both weighting methods produce similar results. From January through June, short interest gradually increased for both banned and non-banned stocks. Short interest then rapidly declined in the second half of the year as short sellers closed positions. Several processes explain these results. On the demand side, short sellers may have believed prices had run their course and covered their positions. Financing issues may have also caused them to reduce their leverage. On the supply side, stock lenders concerned about the integrity of their collateral funds were withdrawing shares from the lending market as were those lenders who were selling stock. The short sale ban, of course, also contributed to the decline in short interest following its imposition.

The results in Figures 1 and 2 show a period of rapid decline in security values during the global financial crisis. The banned stocks, which were primarily financial sector stocks, realized the greatest losses. Among these, those that subsequently received TARP funds lost the most on average. Short selling in stocks for which short interest was highest on September 15 had already declined substantially before the ban, suggesting short sellers of these stocks had already profited substantially earlier in the year.

Visual inspection of the cumulative index returns in Figure 1 suggests the short sale ban had a limited effect on arresting the decline in value of the banned (primarily financial sector) stocks. Stock value declines during the ban, for both non-banned and banned stocks, were more rapid than any other equivalent time span in the pre- or post-ban periods. The remainder of this paper examines prices during and around the ban period in detail.

III. The Factor-Analytic Model

We use a factor-analytic approach to estimate the market values that we would have observed for the banned stocks had the SEC not imposed the short sale ban. To do so, we use the information in the prices of the non-banned stock returns to project returns for the banned stocks. Our method is a two-stage process. In the first stage, for each stock, over the year before the short sale ban (September 18 2007 to September 18, 2008), we estimate factor loadings associated with the three Fama-French factors (Fama and French, 1993), the momentum factor (Carhart, 1997), the value-weighted banned stock index, and the TARP index using the following time-series regression:[9]

$$r_{i,t} = \alpha_i + \beta_{1,i}exMkt_t + \beta_{2,i}SMB_t + \beta_{3,i}HML_t + \beta_{4,i}MOM_t + \beta_{5,i}RetBAN + \beta_{6,i}RetTARP + \varepsilon_i \quad (1)$$

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[9] We obtained daily Fama-French and momentum factor data from Kenneth French's website.

where $r_{i,t}$ is the dividend- and split-adjusted log price relative for stock i on day t. *ExMkt, SMB, HML,* and *MOM* are the Fama-French and momentum factors on day t, *RetBAN* is the value-weighted return to the banned stocks on day t, and *RetTARP* is the TARP-weighted return to the banned stocks on day t.[10] This regression identifies factor loadings for six market-based risk factors for each stock in the sample.

Factor loadings on the variable *RetBan* will help identify the performance of the banned stocks. Those on the variable *RetTARP* will help identify the effect, if any, optimism about the passage of the TARP legislation may have had on the banned stock returns.

In the second stage, we estimate a cross-sectional return model for each day in the sample period utilizing the market-based risk factor loadings from the first stage as regressors. In addition, we also include three stock characteristics—inverse price, turnover, and volatility—to better identify how stock prices varied in the cross-section.[11] Our cross-sectional model is given by

$$
\begin{aligned}
r_{i,t} = {} & \alpha_i + \delta_{1,i}\beta_{1,i} + \delta_{2,i}\beta_{2,i} + \delta_{3,i}\beta_{3,i} + \delta_{4,i}\beta_{4,i} + \delta_{5,i}\beta_{5,i} + \delta_{6,i}\beta_{6,i} \\
& + \delta_{7,i}InvP_{i,t} + \delta_{8,i}TURN_{i,t} + \delta_{9,i}VOLAT_{i,t} + \varepsilon_i
\end{aligned}
\tag{2}
$$

where $r_{i,t}$ and β_1 through β_6 are as described above and *InvP* is the daily inverse price, *TURN* is aggregate trading volume over the previous 10 days divided by shares outstanding, and *VOLAT* is the root mean squared return over the previous ten trading days.

We estimate this factor model using only the non-banned stocks. We weight the cross-sectional model by value (market capitalization) to give greater weight to those stocks that we

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[10] We computed the TARP banned stock index by weighting each banned stock by the fraction of October 28, 2008 common stock capitalization represented by all TARP funds received between October 28, 2008 to December 31, 2008. The weights for banned stocks that did not receive TARP funds are zero.
[11] See Daniel and Titman (1997) for a similar application of this modeling methodology.

believe the market prices most accurately and which are economically most significant. The estimated coefficients are estimates of the realized factor returns associated with each of the regressors, based only on information in the returns to the non-banned stocks.

We then use these factor estimates to obtain predicted daily returns for the banned stocks based upon their cross-sectional characteristics. Finally, we aggregate the daily return estimates for each banned stock to produce a value-weighted index of the prices that we estimate would have been observed had the ban not been in place.

To identify the predictive power of the factor-analytic model, we examine the accuracy of the model's return predictions for the banned stock sub-sample in the *pre-ban period* (the year before the ban). We use three methods to measure predictive accuracy: (1) the correlation between predicted and actual mean returns, (2) paired t-tests between mean predicted and actual daily returns, and (3) the correlation between actual factor return values and those estimated with Equation 2.

We examined these measures for four different specifications of our basic model. We considered different specifications to determine to what extent our results depend on our assumptions, and to try to find a parsimonious model that we could accurately estimate. In addition to the full cross-sectional model described above, we also examined a model with only three return factors (market, banned stock and TARP) and all three stock characteristics (inverse price, turnover, and volatility), a model with the six return factors (Fama-French, momentum, banned stock and TARP) with no stock characteristics, and a model with only three return factors and no stock characteristics. For those cross-sectional models that only use three return factors, we obtained their factor loadings from time-series regressions that included only those three factors.

All four models perform well based on our three accuracy measures (Table I). During the year before the ban, the correlation between the actual and estimated daily value-weighted banned stock index return (based the factor returns implied from the non-banned stocks) is above 0.92 for the two models with three return factors and above 0.98 for the two models with six return factors. Inclusion of the three stock characteristics does not appreciably increase these correlations.

The means of the daily actual and predicted banned stock index returns in the pre-ban period are statistically indistinguishable for all four model specifications (t-statistics for the paired t-test range from 0.06 to 0.47). These results indicate that our methods are not producing significant drift in the return estimates that would bias our return inflation estimates.

The daily cross-sectional regressions estimate factor returns for the six return factors and for the three cross-sectional characteristic factors. Panel B of Table I presents correlations between the daily estimates of the six return factors and their corresponding actual factor values.[12] These correlations are all above 0.90 in the pre-ban period, with the most critical ones (market, banned stock index, and TARP) all above 0.96 for the six return factor models. The correlations are lower for the three factor models, which suggest that the additional factor structure increases the estimation accuracy. The addition of the three stock characteristic factors does appreciably affect the estimation of the return factor values, most probably because they convey orthogonal information. These correlations are all lower—though still generally quite

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[12] We cannot conduct a similar analysis for the cross-sectional characteristic factors because their actual values are unknown.

high—in the post-ban period, probably due to greater volatility and possibly to the smaller sample period.

The evidence from these analyses suggests that the six return, three stock characteristic factor model (as described in Equations 1 and 2) is the most accurate model of the four models. We use it for the remainder of the paper.[13] Visual evidence of the high correlation between the actual and estimated banned index returns appears in Figure 3, which plots cumulatives of the actual index and of the estimated index for the year before the ban.

[Insert Figure 3 approximately here]

The root mean squared difference between the actual and estimated banned stock index returns in the year before the ban is 0.20%, and the first order autocorrelation of these differences is 0.013. The low serial correlation and the essentially zero mean difference documented above indicates that the predicted variance of the cumulative differences will be approximately equal to the length of the accumulation period multiplied by the mean squared difference. We will use this result (and others) to make inferences about the significance of any inflation that we observe during and following the ban.

Before turning to our main results, note that our method almost certainly underestimates the difference between the actual prices and those that would have observed in the absence of the ban. The underestimation is due to the trading of speculators who explicitly or implicitly use factor analytic models to identify and profit from mispricing. In particular, if they (and other traders who trade on relative prices) observe that banned financial stocks are rising, they will buy

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[13] For simplicity the six factor model with stock characteristics is referred to as the factor-analytic model in the remainder of the paper.

stocks that load on factors common to the banned stocks and sell the financial stocks (if they can).

The resulting price pressures will reduce the difference that we estimate between the actual prices of the banned stocks and the prices that we would have observed without the ban. In particular, the speculators' trading will transmit some of the price inflation associated with the ban to the other stocks, which will cause us to overestimate the common factor returns. This issue will significantly affect the results if the speculators do not realize that the banned financial stocks may be rising relative to the other stocks because of the ban. Any differences that we identify in our results thus will underestimate the actual effect of the ban on market prices.

Note also that other factors that we have not included may affect the banned sample but not the not-banned sample. As noted above, one such factor would be expectations about the passage of the TARP bill that Congress was then debating. The passage of the TARP would undoubtedly affect the financial stocks more than the other types of firms in the sample. As a result, concerns about the prospects of the TARP bill would load differently on the financial stocks then they would on the rest of the sample. Although we include the TARP index in our analysis, estimates of its value from the non-banned stocks during this period may incompletely reflect the valuation effects associated with the resolution of uncertainty about the passage of the TARP bill.

IV. Price Inflation Associated with the Ban

[Insert Figure 4 approximately here]

Figure 4 presents cumulative value-weighted actual banned stock index returns and our corresponding estimate of this index obtained from factor returns implied from the non-banned

stocks. The plot covers the period from 14 trading days before the 14-day ban to 14 trading days afterwards. Panel A of Figure 4 shows that the banned stock index was relatively stable until shortly before the beginning of the ban period. The drop in the last three trading days may have triggered the SEC action. The drop did not likely anticipate the ban, which few expected. The index then rose for the first few days of the ban and then started to fall until the end of the ban. During the next two weeks, the index was relatively stable at its lower value.

Our corresponding estimate of the banned stock index follows the actual index quite closely until shortly before the ban. It then drops faster than the actual index. In the 14-day period before the ban, the difference between the actual and estimated banned stock index returns is less than approximately 1% until three days before the ban (Panel B). The difference increases substantially through the ban period. The actual cumulative banned index return over the ban period (September 19, 2008 to October 8, 2008) is 10.5% greater than our estimate of the index.

An analysis of the time series properties of the daily differences in the year before the ban indicates that the cumulative 14-day difference during the ban period is statistically different from zero based on the variance of this difference in the year before the ban: The standard deviation of the difference between 14-day actual index returns and 14-day estimated index returns, computed from overlapping returns, is 2.9% in the year before the ban. The 10.5% 14-day difference in the ban period thus corresponds to a z-statistic of 3.12. Since variances rose during the ban period, this result is overstated. A paired t-test of the difference in the 14 daily returns during the period of the ban gives a t-value of 1.47, which corresponds to a p-value of 17%. However, this result is understated because the serial correlation of daily differences during the ban period is -0.55. The negative serial correlation indicates that the difference series

has transitory volatility that is increasing the variance of the daily difference that appears in the denominator of the paired *t*-test. These results indicate that the difference is significant compared to its previous history, but perhaps not notably significant given its current volatility. If the increased volatility in the ban period were due to the ban, the former statistic would provide the appropriate measure of significance. But if the increased volatility were due to other factors, the latter statistic would be more appropriate. The truth undoubtedly lies somewhere in between these two extremes.

To summarize, these results indicate that, although financial sector stocks lost value during the short sale ban, the ban appears to have stabilized their prices, reducing average losses to financial sector stocks by 10.5% over 14 trading days. However, causality is not certain given the significant volatility in this short sample period. We intend to address this uncertainty in future drafts of this paper.

Following the ban, the inflation did not immediately revert, as we would expect if the ban did indeed cause the inflation, and this inflation was recognized by the market. During the 14-days following the ban, the cumulative difference between the actual return and our estimate of it from the non-banned stocks remained unchanged at 10.5%. By year-end, the difference decreases by about two percent, but, given the extraordinary volatility around the ban, inference over this period cannot be conclusive.

[Insert Figure 5 approximately here]

Actual and estimated short interest-weighted indices for the banned stocks appear in Figure 5. The two indices do not vary much from each other before, during, or after the ban. During the 14 trading day ban, the actual index rose 5.3% relative to estimated index (both

dropped), but the difference measure is not statistically significant. Apparently, the ban had less effect on these already heavily shorted stocks than on the other banned stocks. As we saw in Figure 1, these stocks fell the most in the year before the ban.

We obtain different results when we compute the indices separately for optionable stocks and stocks without listed options. We expect that the ban most affected stocks without listed options. During the ban, stocks with listed options could be shorted by options dealers who were hedging positions they acquired in the options market. Their customers thus could form synthetic short positions through the options market.

[Insert Figure 6 approximately here]

Figure 6 presents the difference between actual and estimated short interest-weighted banned stock index returns, separately for stocks with and without listed options. The banned stock sample of 676 stocks includes 363 optionable and 313 not optionable stocks. During the ban period, the difference between actual and estimated index returns for the optionable stocks was 1.8% (statistically insignificant), which suggests that the ban had no appreciable impact on stocks that could be synthetically shorted in the options markets. For the stocks without listed options, the actual index increased 12.8% relative to the estimated index during the ban period. The paired *t*-statistic for the test of equality of mean daily returns is 1.62.[14] These results suggest that some short selling continued in the highly shorted stocks with listed options whereas the ban had a greater effect for highly shorted stocks which could not be shorted in the options markets.

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[14] Variation in the magnitude of inflation between optionable and not optionable stocks appears only in the short interest-weighted results. For the value-weighted results, no appreciable difference in the magnitude of inflation for optionable and not optionable stocks appears (9.5% and 10.1%, respectively, relative to the aggregate sample result of 10.6%).

To help determine whether the inflation we estimate might have been due to concerns about the content and ultimate passage of the TARP bill rather than to the SEC short sale ban, we estimated the cross-sectional regression in equation (2) using all not-banned stocks plus the stocks of all companies that ultimately received TARP funds in 2008. The addition of the TARP stocks ensures that the estimated returns to the remaining banned stocks will reflect any factors related to the passage of the TARP bill that affected the TARP stocks, which we believe would have been most affected. Unfortunately, since the TARP stocks are also banned stocks, the addition of the TARP stocks also will bias the results towards identifying no short-sale induced inflation.

Our results show that during the ban period, the actual cumulative return to the value-weighted index of non-TARP banned stocks rose 5.6% relative to the index return that we estimated from the factor model estimates obtained from the not-banned stocks and the banned TARP stocks.

V. The Consequences for Buyers

To obtain an estimate of the dollar cost of the inflation to buyers during the ban period, for each banned stock on each day during the ban, we computed the product of our estimate of the percentage inflation in that stock times the dollar value of volume in that stock.[15] Summing this measure over all banned securities gives a total dollar value of inflation of $4.9 billion. As discussed above, this measure is biased downwards by the price effects of speculators who traded to speculate on differences in the valuations of the banned and not-banned stocks. This wealth transfer is of sufficient size that it should concern public policy makers at the SEC and elsewhere.

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[15] We obtained the individual stock inflation estimates from the value-weighted cross-sectional regression results.

VI. Conclusion

The analyses in this paper indicate that the short-sale ban imposed by the SEC on financial stocks in September 2008 may have inflated prices relative to where they likely would have traded without the ban. Although speculating on counterfactuals is always difficult, we believe that our factor-analytic model provides a reasonable lower bound on the degree of price inflation that occurred. Our model estimates common daily valuation factors using the sample of stocks that were not banned and uses this information to estimate returns for the banned stocks.

Our results are suggestive at best. The ability to confidently identify trading effects in a one-shot event study in the midst of so much volatility is quite challenging. We believe that we have substantially improved our inferences through the use of our factor model, but the results are not definitive. In particular, if during the ban period, factors that we did not model affected the banned stocks but not the other stocks, the inflation we identify could be due to those factors. Foremost among such factors would be concerns about the then pending TARP legislation. Our results, however, suggest that it was not a significant factor.

Assuming that the price effects that we document are indeed due to the ban, we estimate that buyers paid $4.9 billion more for the banned stocks than they otherwise would have. Such transfers should greatly concern policymakers.

The Securities and Exchange Commission is charged with maintaining fair and orderly markets.[16] As desirable as high prices may be to most people, the creation of a bias toward long sellers is inconsistent with fair markets. The results in this study suggest that an unintended

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[16] The SEC provides the following mission statement on its website (www.sec.gov):

"The mission of the U.S. Securities and Exchange Commission is to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation."

consequence of the ban on short trading may very likely have been the loss of substantial wealth by uninformed traders.

South Korea, Italy, Indonesia, and seven other countries also imposed similar short-sale bans. Although we have not analyzed their experiences, we suspect that similar results to ours would be found. Accordingly, our results should interest regulators throughout the world.

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Table I

Factor-Analytic Model Return Estimate Accuracy Measures

Table I reports three measures of the predictive accuracy of the factor-analytic model for the banned subset of stocks in the *pre-ban period*, September 18, 2007 to September 18, 2008 (one year before the short sale ban) and the post ban period, October 9, 2008 to December 31, 2008. The first measure is the correlation coefficient between actual and estimated value-weighted index returns. The estimated value-weighted returns are computed from the estimates of daily cross-sectional models that decompose the returns of the not-banned stocks into common factors. The second measure is the *t*-statistic for the paired *t*-test of the equality of the daily mean returns. The third measure is the correlation coefficient between the factor returns estimated in our cross-sectional model (Equation 2) and the actual values of those factors. Only the return factors appear in this table because only their actual values are known. Results are presented for four model specifications. The three return factor models include only the excess market (*ExMkt*), the TARP (*RetTARP*), and the banned stock (*RetBan*) index returns. *RetBAN* is the value-weighted index return to the banned stocks on day *t*. *RetTARP* is the index return to the banned stocks weighted by TARP funds received in 2008 as a fraction common stock market capitalization. The six return factor models include in addition the Fama-French size (*SMB*) and value (*HML*) factors as well as the Carhart momentum factor (*MOM*). The models with three stock characteristics also include inverse price, turnover calculated as the sum of trading volume over the last ten trading days divided by shares outstanding, and volatility calculated as the square root of mean squared returns over the last ten trading days.

Panel A

| Model	Correlation coefficient, daily actual value-weighted banned index returns with the corresponding estimated index return		Paired *t*-test *t*-statistic, for equality of means	
Period	Pre	Post	Pre	Post
3 Return Factor Model	0.9274	0.9340	0.37	0.47
3 Return Factor Model with 3 Stock Characteristic Factors	0.9306	0.9335	0.08	0.09
6 Return Factor Model	0.9824	0.9640	0.19	0.06
6 Return Factor Model with 3 Stock Characteristic Factors	0.9829	0.9606	0.37	0.32

Panel B

| Model	Correlation coefficients, actual return factors with estimated return factors					
	ExMkt	*HML*	*SMB*	*MOM*	*RetBAN*	*RetTARP*
Pre Period (N=254)						
3 Return Factor Model	0.9716				0.9255	0.9075
3 Return Factor Model with 3 Stock Characteristic Factors	0.9738				0.9247	0.9038
6 Return Factor Model	0.9789	0.9164	0.9013	0.9519	0.9773	0.9688
6 Return Factor Model with 3 Stock Characteristic Factors	0.9819	0.9171	0.8859	0.9502	0.9778	0.9664
Post Period (N=58)						
3 Return Factor Model	0.8970				0.8434	0.7542
3 Return Factor Model with 3 Stock Characteristic Factors	0.8767				0.8190	0.6948
6 Return Factor Model	0.9272	0.6314	0.8717	0.4903	0.9139	0.8522
6 Return Factor Model with 3 Stock Characteristic Factors	0.9167	0.6560	0.8571	0.4360	0.9041	0.8219

Figure 1

Cumulative Index Returns

This figure reports cumulative index returns to NYSE, AMEX and NASDAQ stocks sorted by inclusion on the SEC short sale ban list between September 19th and October 8th, 2008. Panel A plots value-weighted cumulative index returns for the banned and not-banned subsamples. This panel also plots cumulative banned stock index returns weighted by short interest on September 15th, 2008 and by TARP funds received in 2008 as a fraction of market capitalization on October 28, 2008. Panel B plots value-weighted cumulative index returns for banned stocks that received and did not receive TARP funds in 2008. We calculated all returns as dividend- and split-adjusted log price relatives. The short sale ban period is shaded.

Panel A
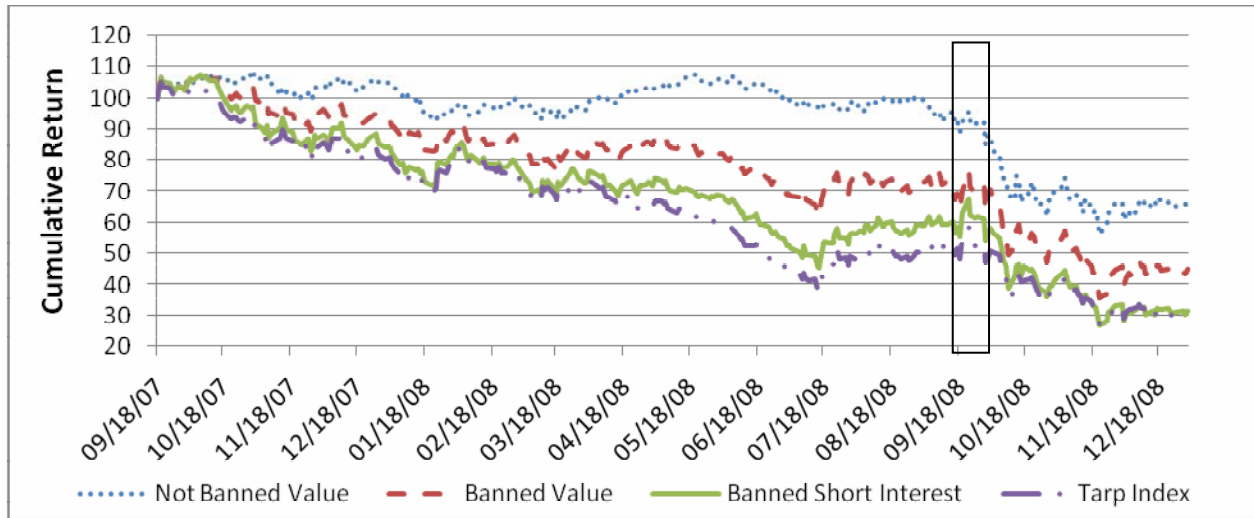
Panel B
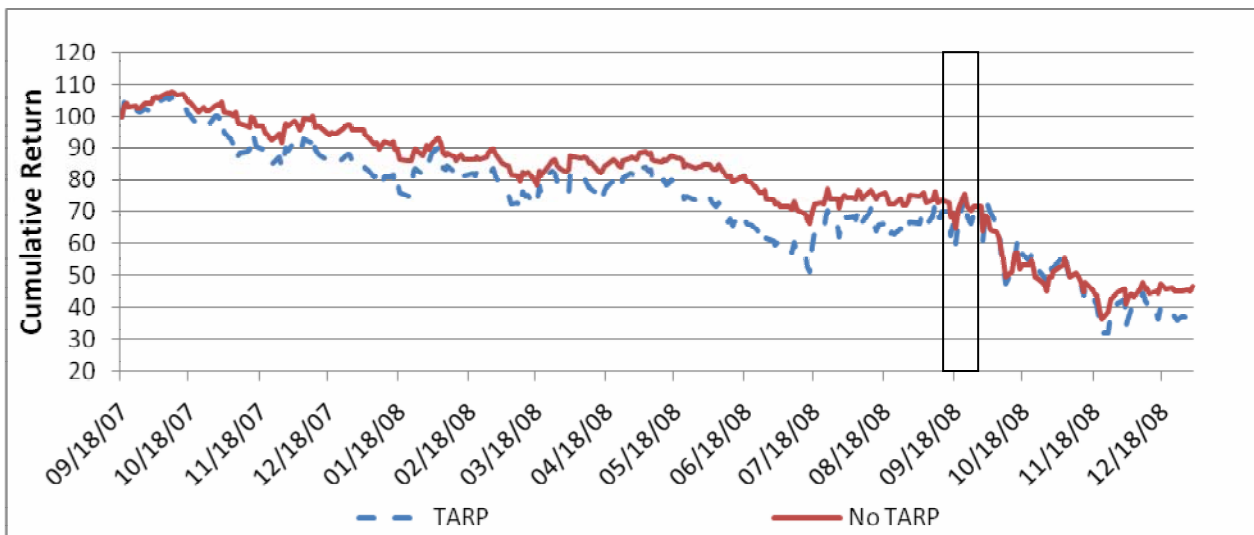
Figure 2

Mean Short Interest

This figure plots mean short interest for non-banned and banned stocks between January 15th and December 31st, 2008, where short interest is defined as the percentage of float sold short and not repurchased. Means are value weighed in Panel A and short interest weighted in Panel B, where the short interest weight is the percentage of float sold short. Stocks with missing float data in the Short Squeeze database are excluded.

Panel A: Value-weighted means
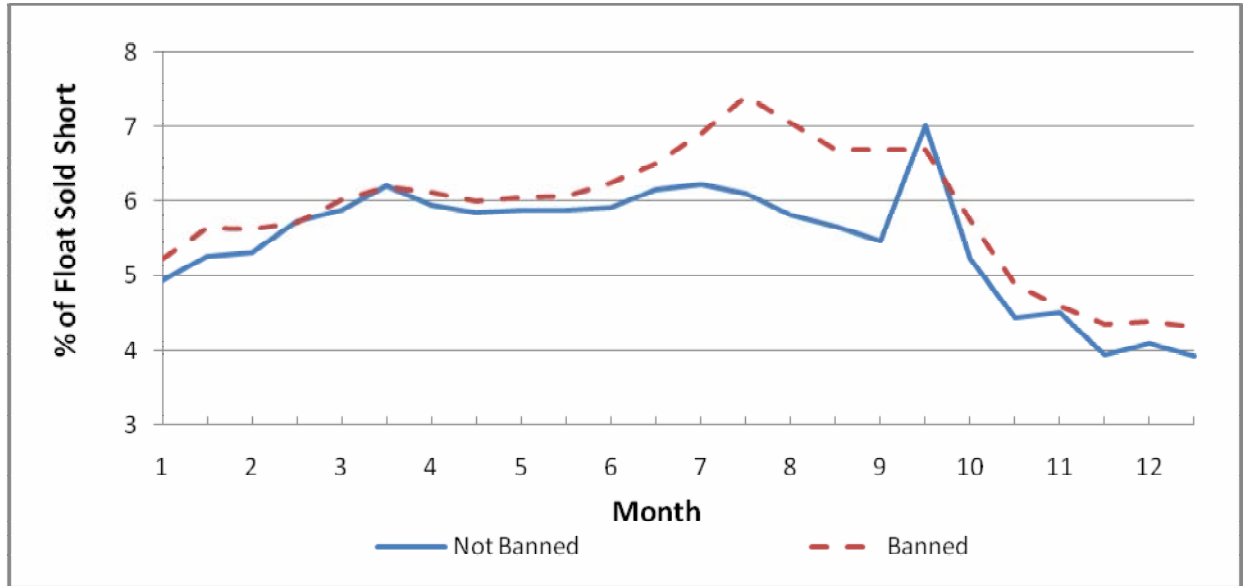
Panel B: Short-interest weighted means
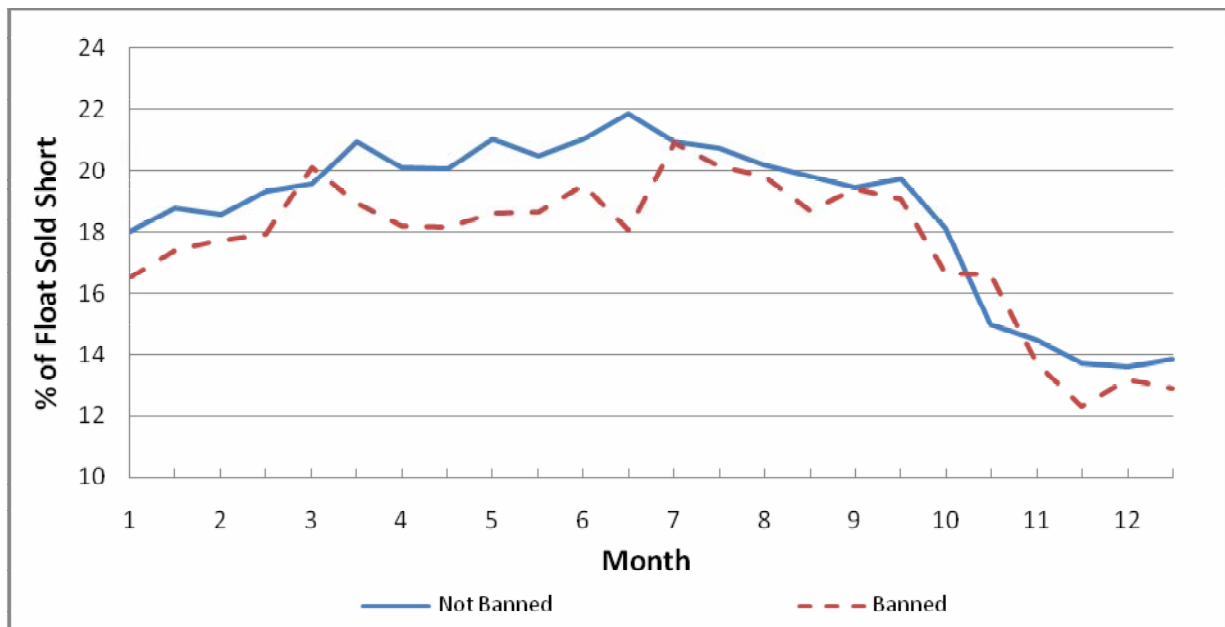
Figure 3

Actual and Estimated Cumulative Banned Index Returns in the Pre-Ban Period

This figure plots value-weighted cumulative indices of actual returns and corresponding returns estimated from the factor analytic model, in the pre-ban period, for the banned stock sub-sample. Estimated returns are computed using the six return factor model with three stock characteristic factors presented in Equation 2.
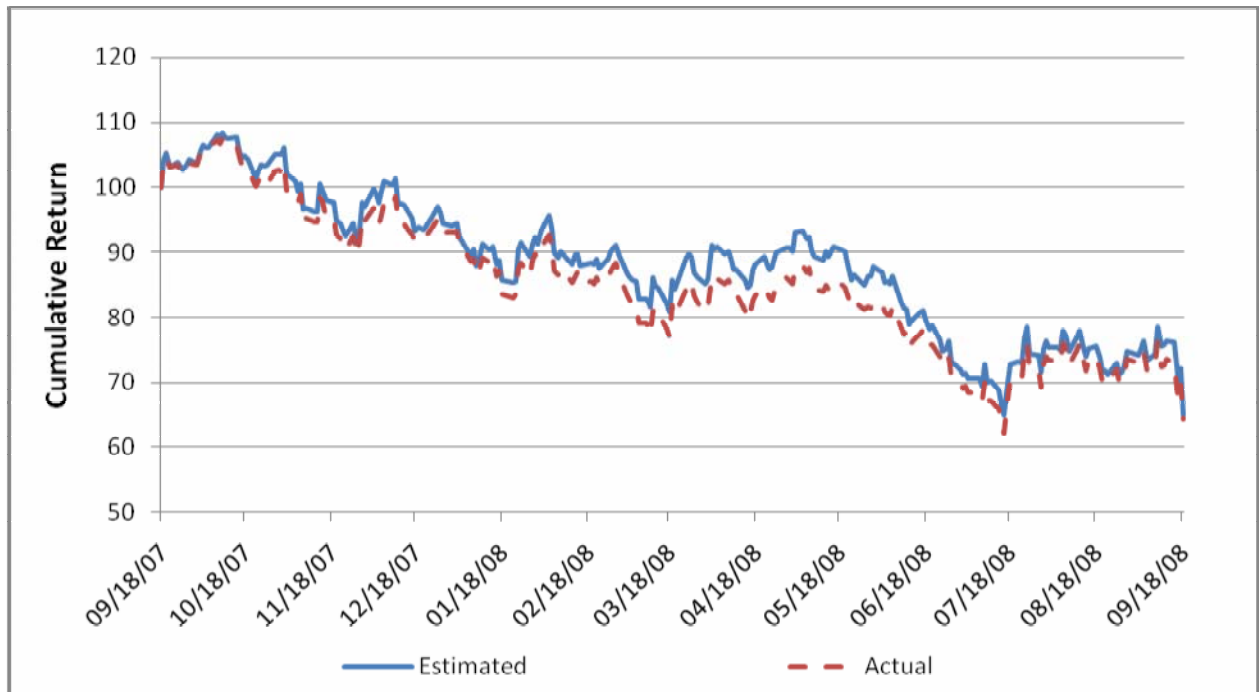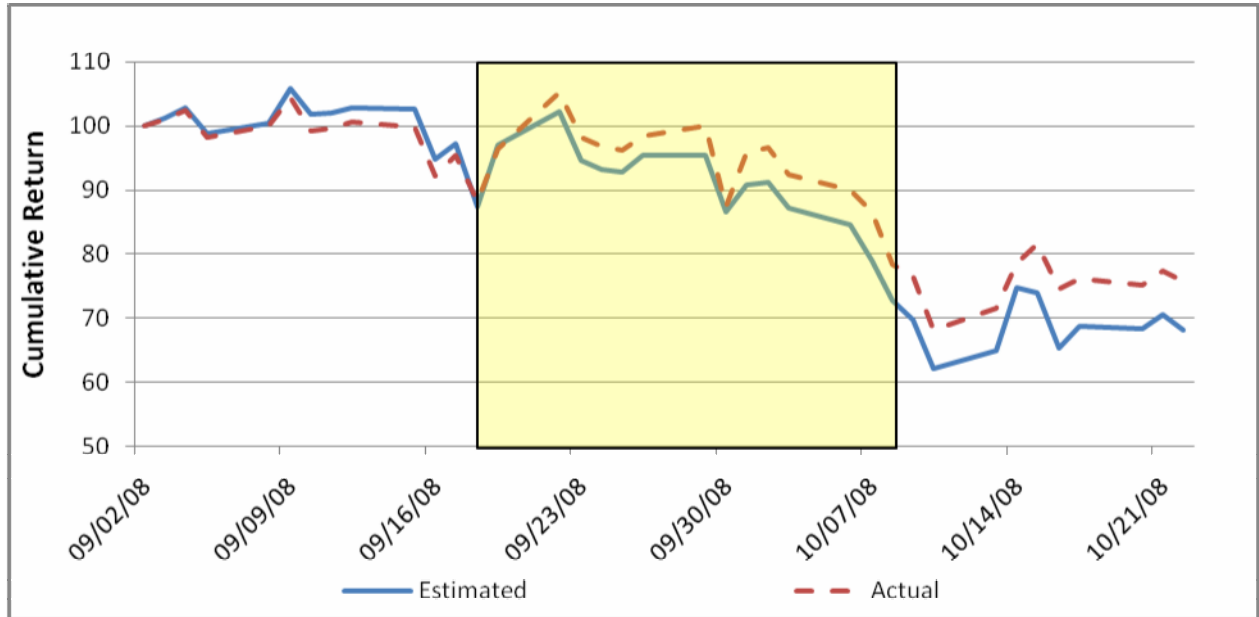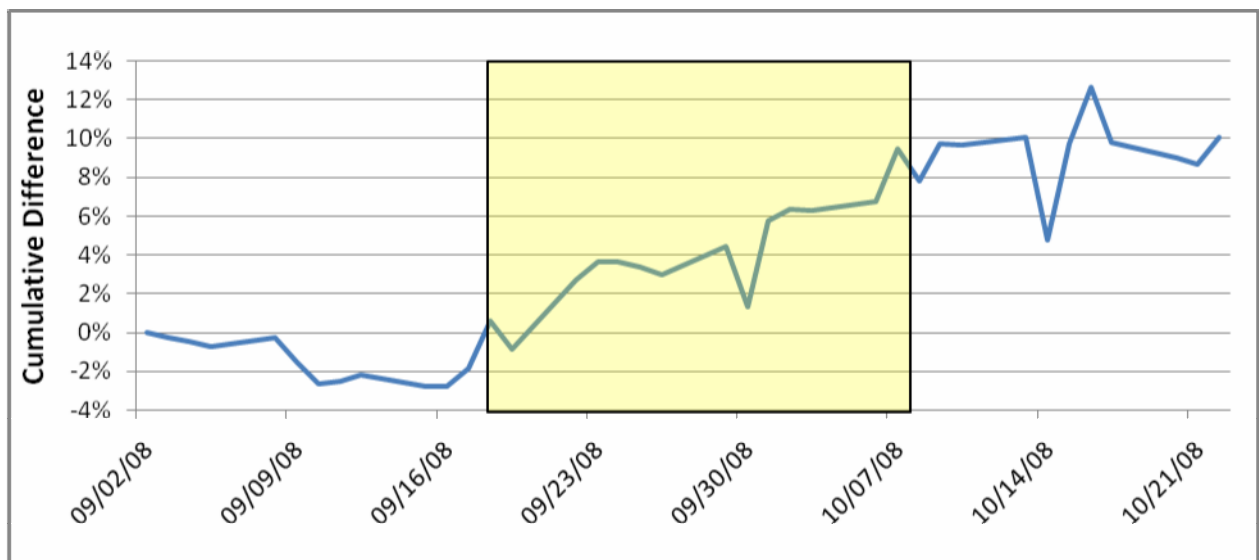
Figure 4

Value-Weighted Cumulative Returns for the Banned Sub-Sample Surrounding the Ban Period

This figure plots value-weighted cumulative indices of actual returns and corresponding returns estimated from the factor analytic model, for the banned stock sub-sample over a period starting 14 trading before the 14-day SEC short sale ban and ending 14 days after the end of the ban. The period of the ban is shaded.

Panel A

Panel B

Figure 5

Short Interest-Weighted Banned Stock Return Indices in the Ban Period

This figure plots short interest-weighted cumulative indices of actual returns and corresponding returns estimated from the factor analytic model, for the banned stock sub-sample over a period starting 14 trading before the 14-day SEC short sale ban and ending 14 days after the end of the ban. The period of the ban is shaded.

Figure 6

Difference between Actual and Estimated Short Interest-Weighted Banned Stock Return Indices, for Stocks with and without Listed Options

This figure plots the difference between short interest-weighted indices of actual returns and corresponding returns estimated from the factor analytic model, for the banned stocks, classified by whether options could be traded on the stocks, over a period starting 14 days before the 14-day SEC short sale ban and ending 14 days after the end of the ban. The period of the ban is shaded.