OFFICE OF ECONOMIC ANALYSIS
MEMORANDUM

To: Chairman Christopher Cox

Through: James Overdahl

From: Daniel Aromi and Cecilia Caglio

Date: December 16, 2008

Re: Analysis of Short Selling Activity during the First Weeks of September 2008

This memo is written in response to questions posed by you and the other commissioners concerning the nature of short selling in the volatile period in early September 2008 that prompted the Commission to approve several emergency orders, many of which were aimed at curbing the potential for short selling to drive prices down. The main objective is to examine the extent to which short selling appeared to drive prices downward during this period.[1] To this end, this memo seeks to establish if, at an intraday level, there exists an association between measures of short selling activity and stock returns. In particular, we would like to document whether periods of negative returns are associated with unusually high short selling activity.

There are different reasons why investors and intermediaries short sell stocks. These include liquidity provision and speculative trading. Further, as is the case with other buys and sells, short-selling can also be used to "front run" other investors or manipulate prices. Depending on their motives, some short sellers might be contrarian traders, short-selling during periods of positive returns, while others might be momentum traders. In addition they might differ in terms of the price aggressiveness of the orders submitted with its resulting price pressure. The impact of measures that restrict short sales depends on how different short sellers are affected by the restrictions. For example, restricting short sales that provide liquidity or react to price overreaction might result in higher transaction costs and higher volatility.

Our results are inconsistent with the notion that, on a regular basis, episodes of extreme negative returns are the result of short selling activity. On average, short sale volume as a fraction of total volume is higher for periods of positive returns than for periods of negative returns. In addition, the average price aggressiveness of sellers who own the stock is higher than what is observed for short sellers. Our analysis is based on average behavior, we can not rule out the possibility that there might exist some instances in which short selling activity peaked during a period of extreme negative returns.

Short sale volume as a fraction of total volume is higher for periods of positive returns than for periods of negative returns. We find the same results when we compare extremely low and extremely high return periods. In addition, the average volume of short sales is generally not significantly higher for periods of negative returns when compared to periods of positive returns.

[1] Note that this analysis does not test for a causal relationship between short selling and stock prices or returns, but it can provide statistics that are consistent or inconsistent with such a causal relationship.

The analysis of the price pressure emphasizes the role of short sellers during extreme market movements. In general, during periods of extreme negative returns, the sell pressure is more intense for long trades indicating that short sales put less pressure on prices than other sales during periods of extreme negative returns. During periods of extreme positive returns, we observe buy pressure, both for trades involving short sales and long trades. However, the selling pressure for other sales is higher than short selling pressure.

Data Selection and Methodology

Our study covers the 13-day period preceding the short selling ban imposed on September 19th 2008 because this is a period during which many observers were concerned that short sellers were driving prices down.

Even though our analysis period does not extend to the period when the short selling ban applied, we study both stocks that were ultimately subject to the short selling ban and stocks that were never subject to the ban. Presumably, the stocks subject to the ban were the ones that were more likely to be targeted by short sellers. Therefore, comparing these stocks to a set of other stocks allows for an analysis of whether short sellers did indeed behave differently in these stocks.

To more efficiently handle the computing demands of this analysis, we selected a subsample of stocks subject to the ban ("banned stocks") and a comparable subsample of stocks that were not subject to the ban ("control stocks"). We selected the firms from the original group of banned stocks based on the following selection criteria. We separate the 799 ban stocks into four groups by size[2]: top 50, and divide the remaining into thirds. We select randomly firms from each of the bottom three groups, and select all from the top group, to get a total of 196 firms.

Using the same size cutoffs that were used to select the banned stocks group, we randomly select the control sample from the entire population of stocks that were not subject to the ban. The final sample includes 394 firms, 196 in the banned sample and 198 in the control sample. We retain the information on the size groupings so that we can divide our two samples into subsamples by size.

We used intraday quote and trade data from TAQ to estimate stock volume, and intraday returns, data from the Center for Research in Securities Prices (CRSP) to estimate market capitalization, and SRO data to estimate short selling levels.

Description of short selling activity and return levels

The first part of our analysis examines the relation between short selling and returns. To capture short term price movements, we focus on five minute intervals. For each stock included in out

[2] We use the market capitalization as of December 2007 to create size groups; out of 799 only 781 firms had available data.

analysis, we compute the return, short selling volume, and total volume over each five minute interval during regular trading hours. We then estimate a short sale ratio for this interval, which is the ratio between short sale volume and total volume. Because every trade has a sell side, this ratio can be used to compare the prevalence of short sales relative to other sales.

The figure 1 shows the average short sale ratio for different five-minute return levels. Results are presented for the ban/control samples and four different levels of market capitalization.

The results show that, for high market capitalization and low market capitalization stocks, the short sale ratio is lower during periods with negative returns. In other words, there is less price reaction when a sale is a short sale instead of a long sale. Holding the absolute level of returns constant, the short sale ratio is lower for periods with negative returns. This is particularly noticeable for periods in which returns are extremely low or high. For example, Figure 1 shows that for large market capitalization ban stocks the average short sale ratio for five-minute returns lower than -225 basis points is approximately 0.28. This is approximately 17% (0.05) below the short sale ratio for the periods in which the return was above 225 basis points. Out of the eight groups of stocks, the group of banned low market capitalization stocks is the only one in which average short sale ratios are higher for negative return periods.

In addition to the high/low return level comparison, we observe that there is non monotonic relationship between volatility and the short sale ratio. Periods of low volatility, with return levels between -25 and 25 basis points, are characterized by low short sale ratios. For high and medium market capitalization stocks, short sale ratios increase from low volatility periods to intermediate volatility levels, that is, periods of moderately positive or negative return. Then, as we move from intermediate to extreme return levels, short sale ratios decrease.

To find out whether a similar pattern holds for lower frequencies, we also computed returns and average short sale ratios for 30 minute periods. The computed statistics are shown on figure 2. Our previous conclusions are strengthened by the 30 minute statistics. For every subgroup of stocks we find that the short sale ratio is, on average, lower for negative return periods.

This is an analysis of average levels of short selling activity. It shows that intraday short-selling activity is not consistent with the idea that, on average, extreme negative returns are the result of short-selling activity. We do not rule out the possibility that there might be some instances in which short-selling activity did increase during a period of extreme negative returns. But it is clear that a substantial fraction of short sale volume is not associated with negative returns; and this suggests that short selling is not merely a tool for driving prices down.

Analysis of short selling activity during extreme return periods

A. Short-selling volume

In this section we compare measures of short-selling activity for periods of extremely low and extremely high returns. The focus on extreme return periods is justified since the concern about short sales is centered on volatility. For each stock we calculate the standard deviation of five minute returns for the analysis period. A five minute period is classified as a period of extreme negative returns if the return for that period is lower than -2 times the standard deviation

calculated for that stock. A five minute period is classified as a period of extreme positive returns if the return for that period is higher than 2 times the standard deviation calculated for that stock.

For this analysis, we focus only on the periods of extreme returns and estimate the average short sale ratio, short sale volume and total volume across extreme positive return periods and extreme negative return periods for each size group in our sample. The number of periods with extremely high and extremely low returns is similar and accounts for approximately 1% to 2.5% of the total number of periods.

The statistics are shown in Table 1. We find that the short sale ratio is mostly higher during periods of positive returns than during periods of negative returns. In other words, higher intensity of short selling is associated with higher returns. For "control" stocks, the average short sale ratio is significantly higher in extremely positive return periods than in extremely negative return periods for all size groups. For stocks in the ban the average short sale ratio in positive return periods is higher than in negative return periods for the top three size groups. But it is significantly higher only for the group with the largest market capitalization.

These tests confirm our previous observation that short-selling activity is higher in periods with positive returns, but these results focus specifically on extreme returns. We find that for all but one subgroup, short selling is higher during periods of extremely positive returns than in periods of extreme negative returns. In addition, the difference is significant for many of the size groups, especially for control stocks.

These findings indicate that, on average, short seller's intraday activity is contrarian. On average, short sales seem to decrease intraday volatility by selling relatively more during periods of positive returns.

The difference between the stocks subject to the ban and control stocks is noteworthy, especially as we consider smaller stocks. In particular, the association between relatively higher short selling ratios for positive return periods versus negative return periods is weaker for stocks in the ban than for control stocks. This difference deserves further investigation. For example, this might be an indication of a different mix of short sale motives for the two groups of stocks. A partition of short sale activity by motive is beyond the scope of this memo and might be unattainable without information on investor level holdings information.

Additionally, we checked the robustness of our results by running the tests in various ways, but none of these changes affect the results. These preliminary analyses are not reported on the table. For example, we considered different criteria for classifying extreme return. Instead of using a threshold of 2 times the standard deviation we also considered 1 time the standard deviation and 3 times the standard deviation. In addition, we studied short-selling activity and returns for 30 minute periods instead of 5 minute periods.

We also studied short-selling activity before and after periods of extreme returns. We found that short-selling activity is significantly higher after extremely positive returns than after extremely negative returns. This is consistent with the idea that an important fraction of short sellers are contrarian traders and benefit from short term price overreaction. We do not find any significant differences in short-selling ratios for periods that precede extremely negative and extremely

positive returns. This is not consistent with the idea that short sales cause extreme negative returns.

B. Price Pressure

In this section, we compare the price aggressiveness of trades involving short sales to trades that do not involve short sales, dividing the stocks into four groups by size, extreme return, and inclusion in the short selling ban.

In order to identify and separate long trades from short sales trades, we merge the short-selling transaction data with the dataset of all transactions and then assign the prevailing BBO to each trade.[3]

To measure the degree that short sales put pressure on prices, we compute a measure of price pressure, or price aggressiveness, for each five-minute period. We define this measure for short sales as the difference between short sale volume executed above the quote mid-point and short sale volume executed below the quote mid-point divided by total short sale volume. A number below zero would indicate that short sellers tend to demand liquidity while a number above zero would indicate that short sellers tend to supply liquidity. The lower the measure of price aggressiveness, the more the traders tend to be liquidity demanders, who can apply more price pressure than liquidity suppliers. We estimate a similar measure for trade volume that does not involve a short sale. We report these measures in Table 2.

We observe that during intervals of extreme negative returns, the price pressure is negative indicating that executed sell orders in general demand liquidity during periods of extreme negative returns. Interestingly, the measure of price pressure is less negative for short sales than for other sales, suggesting that short sales put less pressure on prices than other sales during periods of extreme negative returns. The results are statistically significant for large and mid capitalization stocks. We observe buy pressure, both for short sales and other sales, during periods of extreme positive returns. For large stocks, the buy pressure is statistically higher for short sales than for other sales (0.23 versus 0.08 and 0.21 versus 0.10 for banned and control stocks, respectively). This result indicates that all sellers are liquidity suppliers during periods of increasing prices and that short sellers are more likely to be supplying liquidity than long sellers.

When we compare the price pressure for banned and control stocks, short sales are more likely to be liquidity suppliers in banned stocks than in control stocks. This is particularly true in the case of negative market movements: short sale price pressure is negative, but is less negative for banned stocks compared to control stocks (for brevity, the statistical significance tests are not reported on the table). This evidence is not consistent with stories that short sellers exerted more price pressure in financial stocks than in other stocks during this time period.

[3] We match TAQ trade data with the short sale dataset provided by the market centers by four conditions: same symbol; same market center; same trading price; same timestamp. We exclude trades and quotes that have a code indicating an error or a correction, or a nonstandard settlement. We were able to match about 92% of the short selling trades.

We also analyzed short-selling price pressure after periods of extreme returns. These analyses are reported on Table 3. We found that after extreme negative return intervals, the short sale price pressure is positive and statistically different from the price pressure for other sales. This result supports the idea that short sellers are not demanding liquidity after prices decline. We also notice that the short-selling price pressure is positive after periods of extreme positive returns, while for other sales the negative price pressure indicates a sell pressure. The results support the intuition from the previous section that, in aggregate, short sellers act as contrarians.

Figure 1:
Short selling ratio and return levels – Five minute periods
The figures correspond to a sample of "ban" and "control" stocks as determined by the September 18 emergency order. The data corresponds to the first 13 trading days of September (09/02/2008-09/18/2008).
Short selling ratio for each five minute period is calculated by dividing the short sale volume by total volume for each stock. A stock is classified as large cap if the market capitalization on December 31 2007 is above $12.4 billions. Mid cap stocks are those with market capitalization between $12.4 billions and $440millions. Stocks are classified as small cap if the market capitalization on December 31 2007 is below $440 millions.

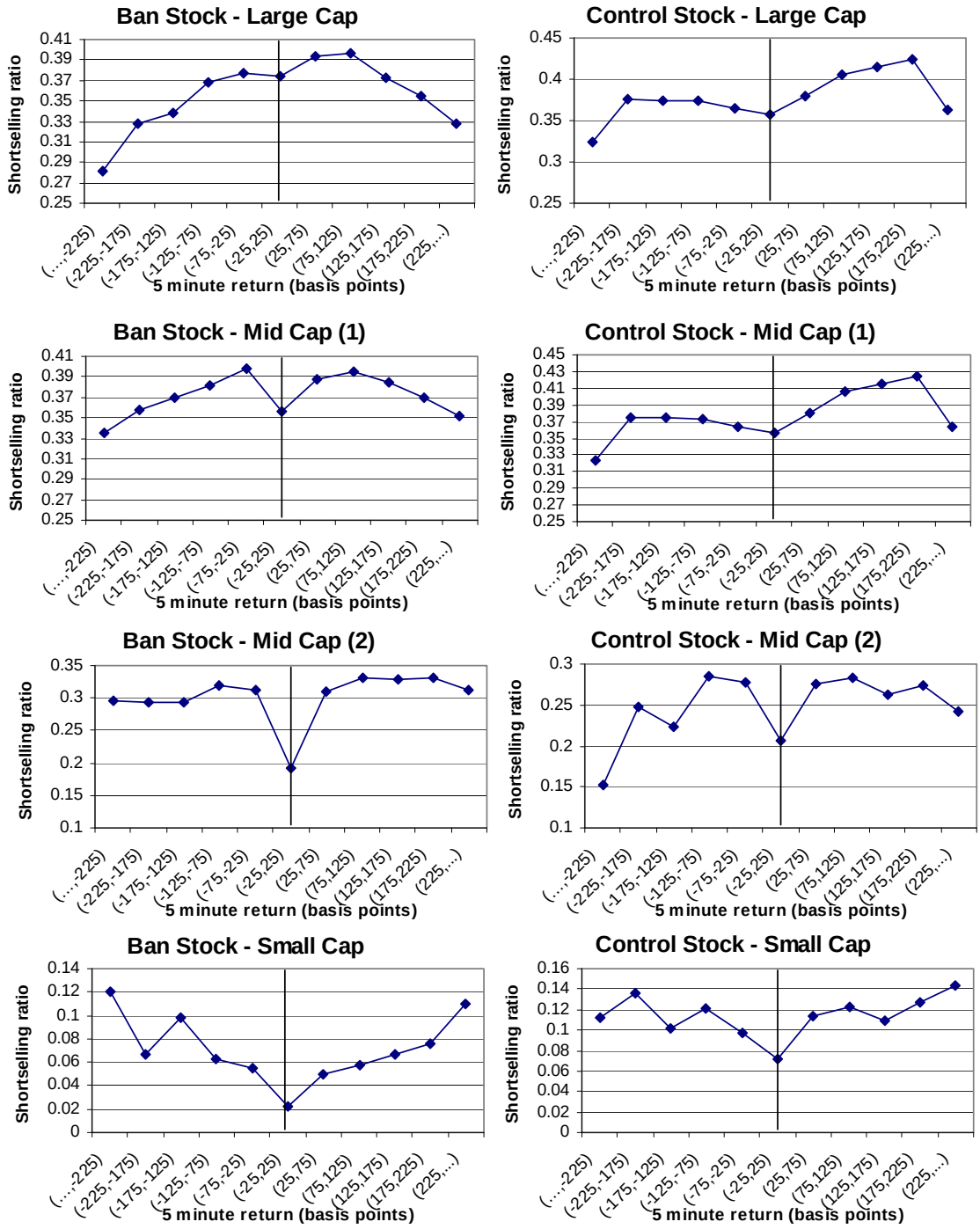

Figure 2:

Short selling ratio and return levels – 30 minute periods

The figures correspond to a sample of "ban" and "control" stocks as determined by the September 18 emergency order. The data corresponds to the first 13 trading days of September (09/02/2008-09/18/2008).
Short selling ratio for each 30 minute period is calculated by dividing the short sale volume by total volume for each stock. A stock is classified as large cap if the market capitalization on December 31 2007 is above $12.4 billions. Mid cap stocks are those with market capitalization between $12.4 billions and $440millions. Stocks are classified as small cap if the market capitalization on December 31 2007 is below $440 millions. Statistical significance of the differences are indicated by * for significance at the 10% level, ** for significance at the 5% level and *** for significance at the 1% level.

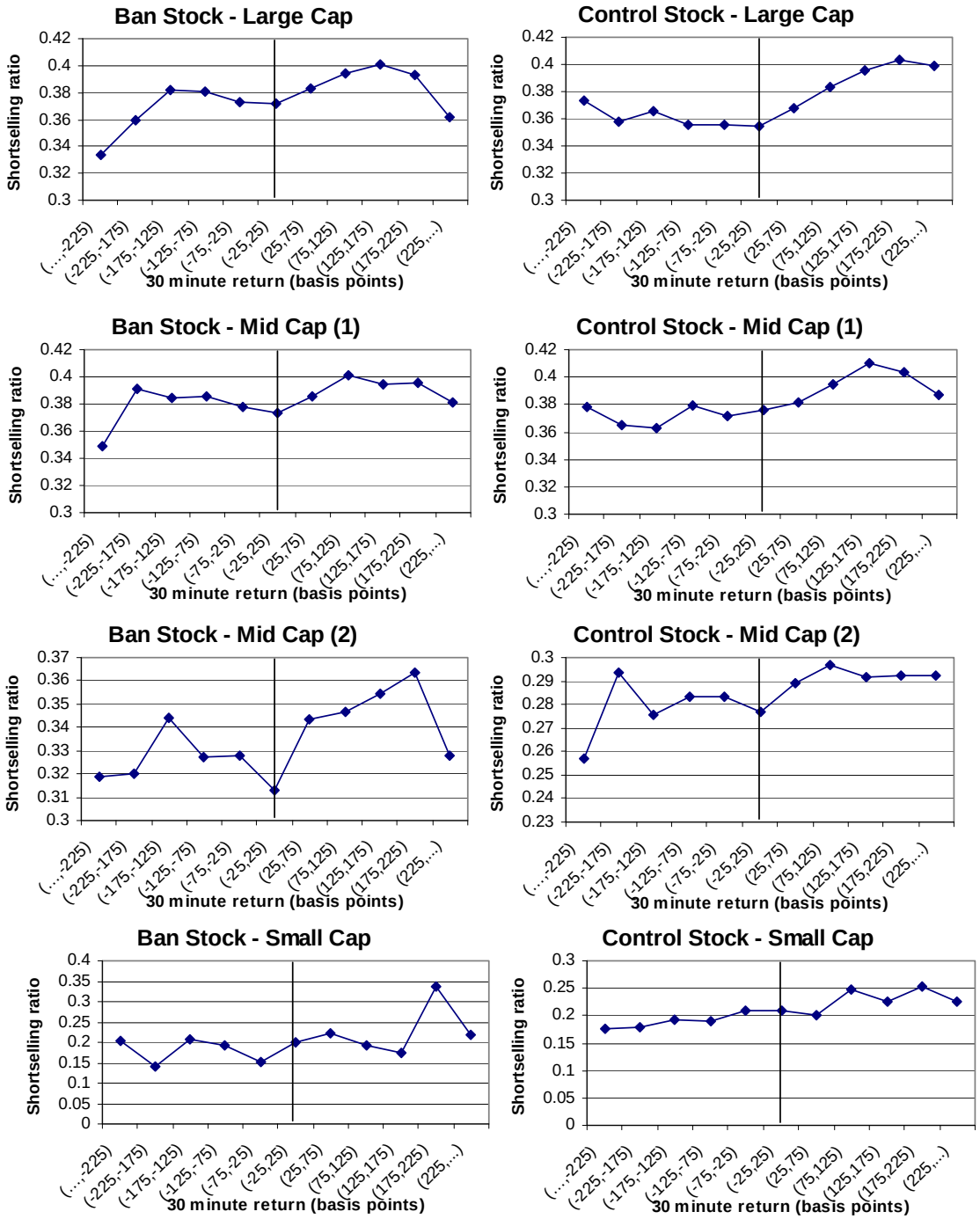

Table 1
Returns, volume and short sales

A five minute period is classified as a low return period of the corresponding return is below -2 times the standard deviation of the five minute return for that stock for the sample trading days. A five minute period is classified as a high return period of the corresponding return is above 2 times the standard deviation of the five minute return for that stock for the sample trading days. The data corresponds to a sample of "ban" and "control" stocks as determined by the September 18 emergency order. It covers the first 13 trading days of September (09/02/2008-09/18/2008). Short sale ratio for each 5 minute period is calculated by dividing the short sale volume by total volume for each stock. A stock is classified as large cap if the market capitalization on December 31 2007 is above $12.4 billions. Mid cap (1) stocks are those with market capitalization between $12.4 billions and $440millions. Mid cap (2) stocks are those with market capitalization between $440 millions and $102millions. Stocks are classified as small cap if the market capitalization on December 31 2007 is below $102 millions. Statistical significance of the differences are indicated by * for significance at the 10% level, ** for significance at the 5% level and *** for significance at the 1% level.

Short sale ratio

Stock group	Return level		Difference
	low	High	
Ban			
Large Cap	0.35	0.39	-0.04***
Mid Cap (1)	0.37	0.38	-0.01
Mid Cap (2)	0.30	0.31	-0.01
Small Cap	0.12	0.09	0.03*
No Ban			
Large Cap	0.36	0.40	-0.04***
Mid Cap (1)	0.38	0.40	-0.02**
Mid Cap (2)	0.26	0.29	-0.03***
Small Cap	0.13	0.16	-0.03**

Short sale volume

Stock group	Return level		Difference
	low	High	
Ban			
Large Cap	384662	399552	-14890
Mid Cap (1)	27734	29398	-1664
Mid Cap (2)	2149	2536	-386
Small Cap	164	103	61
No Ban			
Large Cap	99092	110495	-11403*
Mid Cap (1)	15810	19953	-4143***
Mid Cap (2)	1966	2036	-70
Small Cap	526	527	-2

Table 2
Returns and price pressure

This table shows the results for contemporaneous price pressure order imbalance in the five minute interval after an extreme positive/negative return interval. A five minute period is classified as a low return period of the corresponding return is below -2 times the standard deviation of the five minute return for that stock for the sample trading days. A five minute period is classified as a high return period of the corresponding return is above 2 times the standard deviation of the five minute return for that stock for the sample trading days. The data corresponds to a sample of "ban" and "control" stocks as determined by the September 18 emergency order. It covers the first 13 trading days of September (09/02/2008-09/18/2008). The price pressure order imbalance for each five minute interval is calculated by dividing the difference between the buyer- and seller- initiated trade volume by total trading volume within each five minute interval. A higher or less negative number suggests less price pressure. A stock is classified as large cap if the market capitalization on December 31 2007 is above $12.4 billion. Mid cap (1) stocks are those with market capitalization between $12.4 billion and $440million. Mid cap (2) stocks are those with market capitalization between $440 million and $102million. Stocks are classified as small cap if the market capitalization on December 31 2007 is below $102 million. Statistical significance of the differences are indicated by * for significance at the 10% level, ** for significance at the 5% level and *** for significance at the 1% level.

	Return level: High			Return level: Low		
	Price Pressure Short Sales (1)	Price Pressure Other Trades (2)	Diff (1)-(2)	Price Pressure Short Sales (1)	Price Pressure Other Trades (2)	Diff (1)-(2)
Ban Stocks						
Large Cap	0.23	0.08	0.15***	-0.12	-0.18	0.06***
Mid Cap (1)	0.23	0.20	0.03*	-0.18	-0.20	0.02
Mid Cap (2)	0.27	0.27	-0.01	-0.20	-0.28	0.08**
Small Cap	-0.03	0.15	-0.19	-0.10	-0.10	0.01
Control Stocks						
Large Cap	0.21	0.10	0.11***	-0.16	-0.19	0.03***
Mid Cap (1)	0.27	0.19	0.08***	-0.25	-0.23	-0.02
Mid Cap (2)	0.25	0.22	0.03	-0.21	-0.33	0.12***
Small Cap	0.29	0.14	0.15***	-0.29	-0.34	0.05

Table 3
Lagged returns and price pressure

This table shows the results for price pressure order imbalance in the five minute interval after an extreme positive/negative return interval. A five minute period is classified as a low return period of the corresponding return is below -2 times the standard deviation of the five minute return for that stock for the sample trading days. A five minute period is classified as a high return period of the corresponding return is above 2 times the standard deviation of the five minute return for that stock for the sample trading days. The data corresponds to a sample of "ban" and "control" stocks as determined by the September 18 emergency order. It covers the first 13 trading days of September (09/02/2008-09/18/2008). The price pressure order imbalance for each five minute interval is calculated by dividing the difference between the buyer- and seller- initiated trade volume and total trading volume within each five minute interval. A higher or less negative number suggests less price pressure. A stock is classified as large cap if the market capitalization on December 31 2007 is above $12.4 billion. Mid cap (1) stocks are those with market capitalization between $12.4 billion and $440million. Mid cap (2) stocks are those with market capitalization between $440 million and $102million. Stocks are classified as small cap if the market capitalization on December 31 2007 is below $102 million. Statistical significance of the differences are indicated by * for significance at the 10% level, ** for significance at the 5% level and *** for significance at the 1% level.

	Return level: High			Return level: Low		
	Price Pressure Short Sales (1)	Price Pressure Other Trades (2)	Diff (1)-(2)	Price Pressure Short Sales (1)	Price Pressure Other Trades (2)	Diff (1)-(2)
Ban Stocks						
Large Cap	0.02	-0.05	0.07***	0.04	0.00	0.04***
Mid Cap (1)	0.02	-0.03	0.06***	0.04	0.02	0.03
Mid Cap (2)	-0.03	-0.07	0.04	0.04	-0.01	0.05
Small Cap	0.01	-0.05	0.05	0.07	-0.08	0.15
Control Stocks						
Large Cap	0.06	-0.06	0.11***	0.08	-0.02	0.10***
Mid Cap (1)	0.03	-0.02	0.05***	0.07	0.04	0.02
Mid Cap (2)	0.07	-0.04	0.11***	0.06	0.01	0.04
Small Cap	0.13	0.04	0.09	-0.17	-0.04	-0.14