The Impact of Short Sales Restrictions

Ian W. Marsh and Norman Niemer[1]

30 November 2008

[1] This independent analysis was commissioned and funded by the International Securities Lending Association (ISLA) the Alternative Investment Management Association (AIMA) and London Investment Banking Association (LIBA). However, the results and interpretations are the independent work of the cited authors and are not necessarily those of any of the commissioning and funding organisations.

Introduction

Following sustained heavy stock market losses in September/October 2008 regulatory agencies in many jurisdictions instigated restrictions on the short selling of stocks, primarily in the financial sector. A detailed summary of the restrictions can be found in Clifford Chance (2008).

This report examines whether restrictions on short selling had an effect on the behaviour of stock returns in the initial aftermath of their introduction.

Academics have questioned the wisdom of imposing short sales restrictions, primarily because of the effect such restrictions have on the efficiency of markets. Miller (1977), Diamond and Verrecchia (1987), Duffie, Garlenu and Pedersen (2002) and Bai, Cheung and Wang (2006) all present theories suggesting that prices may not fully reflect information when agents have heterogeneous beliefs but some are prevented from trading to express those beliefs. Miller (1977) suggests prices will be biased upwards in the presence of short sales constraints. Diamond and Verrecchia (1987) argue that prices will not be higher but that the speed of adjustment to new information is slower. Bai et al. (2006) argue that prices may actually be driven down by short sales constraints since the market knows that some information is not priced and hence demands a higher risk premium.

These analyses relate to "normal" times. Recently, the government-inspired introduction of restrictions on short selling in many jurisdictions has been driven by decidedly abnormal market conditions. We hypothesise that one of the objectives of the restrictions is to reduce the volatility of, and probability of further large falls in, stock prices of certain companies. This should be manifested in the distributions of those companies' stock returns.

All other things equal, Miller's theory would suggest that the mean return should be higher for a restricted stock, while Bai et al. (2006) would suggest lower mean returns. Implications for standard deviations of returns are similarly unclear. Other things equal, Miller's higher price level would reduce the standard deviation of returns. Bai et al's lower price level would increase returns standard deviations but since informed investors (that wish to sell) are removed from the market the variance of expected prices of agents still in the market may be less, dominating the effect. It is highly unlikely in current market conditions that "all other things are equal". Hence we do not focus too much on the first two moments of returns. However, comparing the moments of stocks subject to the restrictions with those of stocks not subject to the restrictions is appropriate to the extent that new information reaching agents has similar implications for both groups of stocks.

Diamond and Verrecchia, along with Hong and Stein (2003), argue that constraints on short selling should make returns less negatively (or more positively) skewed. When short selling is banned, on this argument, pessimistic investors are removed from the market which reduces the probability of negative returns in the short term. This would also be detected by kurtosis measures as the probability of extreme (negative) returns has been removed. Of course, this could be offset by a higher probability of large positive returns, but this would make the positive shift in skewness even more apparent.

The efficiency implications of academic research are more unequivocal. All models argue that the efficiency of markets is reduced. As a simple measure of efficiency we will consider the first order autocorrelation of returns. In an efficient market autocorrelations at all orders should be zero as

yesterday's return would have no implications for today's returns. Thus an increase in the magnitude of the autocorrelation coefficient would indicate falling levels of market efficiency. The academic literature has recently focussed on the goodness of fit (R^2) of a regression of stock returns on a market index as an indicator of efficiency. One strand of the literature finds an empirical relationship such that lower R^2's are associated with higher levels of efficiency. Bris, Goetzmann and Zhu (2007) show that regimes when short selling is both legal and practised tend to have lower R^2's than periods where short selling does not take place. We also use R^2's as an indicator of market efficiency although the contradictions in this literature lead us to be cautious in interpreting these statistics.

In summary then, the literature would suggest that an effective restriction on short-selling should see an initial increase in skewness and a decrease in kurtosis, possibly at the cost of an increase in autocorrelation as markets lose efficiency.

1. Data Analysed

We use stock return data over the period 1 January 2008-31 October 2008 in the analysis. We use total return data (i.e. including dividend payments) downloaded from Datastream. In each country, a universe of stocks is selected. In the UK, for example, we use the FTSE-350 – the 350 largest UK listed stocks. From this we note those stocks subject to the restrictions (hereafter "restricted" stocks) and those not affected by the restrictions ("unrestricted" stocks). We split the full sample into three sub-samples: The period after restrictions were introduced (19 September-31 October 2008 for the UK, for example), the immediate pre-restrictions period (8 August-18 September 2008), and a longer pre-restrictions initial period (1 Jan-18 September 2008).

We calculate the following statistics for each stock in the universe over each sub-sample:

- Mean daily return
- Median daily return
- Standard deviation of daily returns
- Skewness of daily returns
- Kurtosis of daily returns[2]
- First order autocorrelation of daily returns[3]
- Goodness of fit for the market model of daily returns[4]

The problem of identifying the counterfactual is critical in this report. It is not obvious how we can say what the behaviour of returns on stocks subject to the short sales restrictions would have been in the absence of those restrictions. We make three comparisons in three dimensions to shed light on the issue. First, we compare the statistics for companies subject to the restrictions to those for companies from the same country not subject to the restrictions over the same time period(s). This relies on the comparability of the behaviour of stocks within the same country but from different sectors. Second, we compare the statistics for companies during the post-restrictions period with statistics for the same company during the pre-restrictions period. Any differences identified in this analysis could, however, be due to different shocks hitting the market in the different time periods. Third, we compare statistics for companies in one country to those for similar companies in other countries where the restrictions were less binding. This relies on the comparability of the behaviour of stocks in the same sector but from different countries. We hope that by combining all of these comparisons we can identify any effects which are truly due to the introduction of short sales restrictions.

[2] These first five statistics are calculated using the following Excel commands: average(), median(), stdev(), skew(), kurt().
[3] First order autocorrelation is calculated using the Excel command linest(sample range, lagged sample range).
[4] Goodness of fit is calculated as the squared correlation between the stock returns and the index return for the relevant universe of stocks. Correlation is calculated using the Excel code correl().

2. Results

2.1 United Kingdom

In the UK, short selling of designated financial sector stocks was restricted with effect from 19 September 2008. The restrictions prohibit the creation of, or increase in, a net short position giving rise to an economic exposure to shares in specific financial sector institutions. These restrictions are in force until a review scheduled for mid-January 2009. While some 34 financial UK companies were subject to the ban when initiated, we only analyse the largest 23 by market capitalisation. The remaining 11 companies are either not traded throughout the post-restriction period or are very small stocks that are not liquid enough to be included in the FTSE-350. Table 2 details the companies analysed.

Average statistics

We report the key statistics in Table 1 for the average restricted and unrestricted UK stock. That is, we calculate each statistic for each stock in all three periods. The statistics reported are average levels of each statistic for the relevant sample of stocks (restricted or unrestricted) in each sample period. Statistics for each firm in the restricted sample are reported in Table 2 and discussed below.

Table 1

This table reports the average levels of key statistics across 23 stocks subject to restrictions on short selling and 335 stocks not subject to the restrictions. Statistics are reported for three period: the 187 day period Jan 1-18 September 2008 before the restrictions were introduced ("Initial"), the 30 day period 8 August-18 September 2008 immediately prior to the introduction of restrictions ("Pre-rest") and the 31 day period 19 September-31 October 2008 over which the restrictions were effective ("Post-rest").

	Restricted stocks			**Unrestricted stocks**		
	Initial period	**Pre-rest**	**Post-rest**	**Initial period**	**Pre-rest**	**Post-rest**
Number	23	23	23	335	335	335
Mean return	-0.2%	-0.4%	-0.4%	-0.1%	-0.2%	-0.8%
Median return	-0.3%	-0.2%	-0.8%	-0.1%	-0.2%	-0.9%
Std. deviation	3.2%	3.6%	8.5%	2.7%	3.0%	5.5%
Skewness	0.12	-0.11	0.49	0.16	-0.02	0.23
Kurtosis	4.48	1.64	1.35	3.27	1.18	0.78
Abs(Autocorrelation)	0.095	0.135	0.165	0.090	0.132	0.135
Goodness of fit	50.9%	54.4%	44.5%	29.5%	31.8%	43.7%

The average mean and median returns are broadly comparable across restricted and unrestricted stocks, with the post-restrictions period showing noticeably larger losses for both groups than in previous periods. The standard deviation figures show that volatility had been increasing through time for both groups, although it is noticeably larger for restricted stocks in each sub-period.

Average levels of skewness rose in the post-restrictions period (for both groups) while kurtosis shows a downward trend over the year (again, for both groups). Higher skewness and lower kurtosis are consistent with the expected impact of the restrictions on short selling, since the restrictions could be expected to reduce the probability of large negative returns. However, the changes in both skewness and kurtosis are common to restricted and unrestricted stocks suggesting that any shifts are probably also due to market-wide factors.

The magnitude of autocorrelation is higher in the post-restrictions period than in either of the periods before the restrictions came into effect for restricted stocks and to a lesser extent for the unrestricted stocks. The magnitude of the autocorrelation is much lower for unrestricted stocks in the initial sample but approximately equal in the later, shorter samples. The goodness of fit statistics show less obvious patterns but have fallen sharply after the restrictions for restricted stocks to levels close to those reported for unrestricted stocks.

Individual firm statistics

Averages such as those reported in Table 1 can hide interesting variations so we also plot distributions of the main statistics in Figures 1-9. These graphs show the frequency distributions of the relevant statistic in the relevant sub-period for restricted and unrestricted stocks.

Figures 1-3 show the evolution of skewness. In the initial period, the restricted stocks tended to have a broadly similar level of skew to the unrestricted stocks, with some extreme outliers. Comparing Figures 1 and 3 we see that the distribution for restricted stocks is slightly right shifted in the post-restrictions period, particularly for the initially outlying stocks (Close Brothers and F&C). This is consistent with the average results above and is consistent with the expected impact of the restrictions on short selling. However, since the shift is also apparent for unrestricted stocks it is hard to conclude that the rise in skewness is due to the restrictions.

Clearly kurtosis is distributed differently in the post-restrictions period for both groups (Figures 4-6). The two distributions have similar patterns in the port-restrictions period, although restricted stocks maintain a right tail to a higher extent than unrestricted stocks. The large drop in average kurtosis noted above seems driven by the large outliers. F&C and St James's Place for financials having very high levels of Kurtosis in the initial period which disappear in the post-restrictions period. Similar companies exist in the non-financial group driving the similar rise in kurtosis for these stocks, although persistent outliers remain. Excluding these outliers, kurtosis appears to marginally increase after restrictions are introduced for financial stocks.

Consistent with the average absolute autocorrelation statistics reported above, the distributions of (signed) autocorrelation statistics for restricted and unrestricted stocks seems much more widely dispersed after the introduction of restrictions on short selling. The widening of the distribution of autocorrelation statistics is also apparent in the immediate pre-restrictions period, suggesting perhaps that any increased dispersion is related to the shorter sample period over which autocorrelations are estimated. Restricted stocks seem to have more negative autocorrelations than the unrestricted stocks in the post-restrictions period, but this is also true of the initial period.

Figure 1.

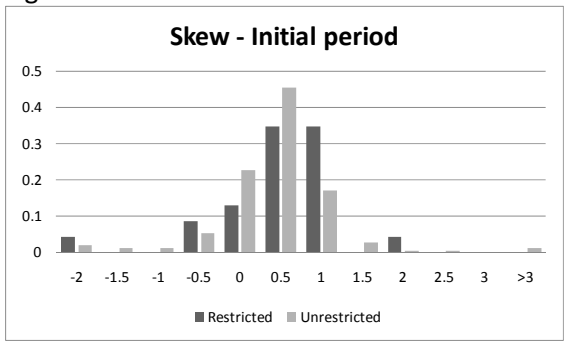


Figure 2.

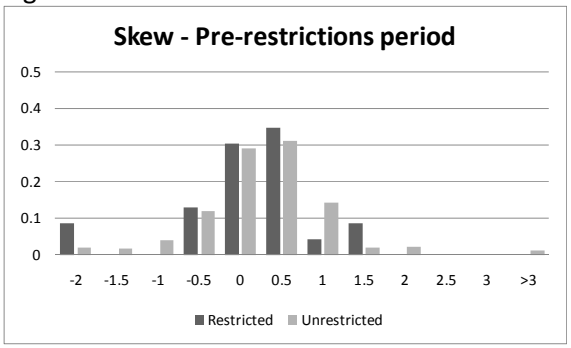


Figure 3.

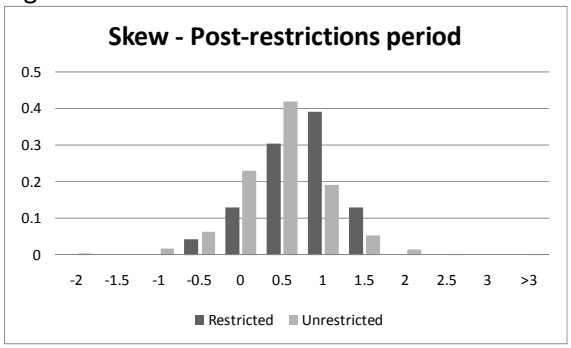


Figure 4.

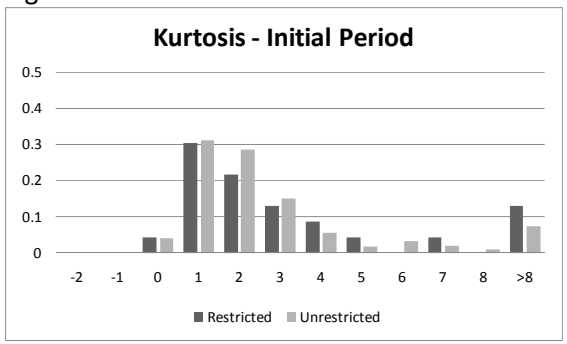


Figure 5.

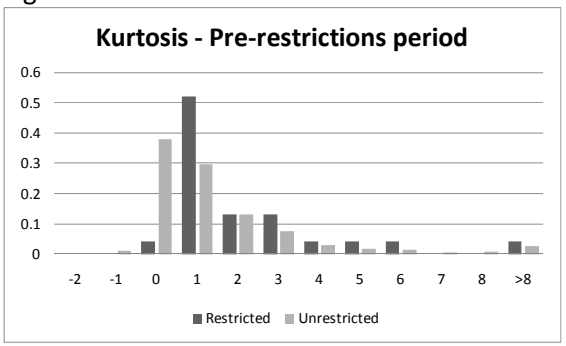


Figure 6.

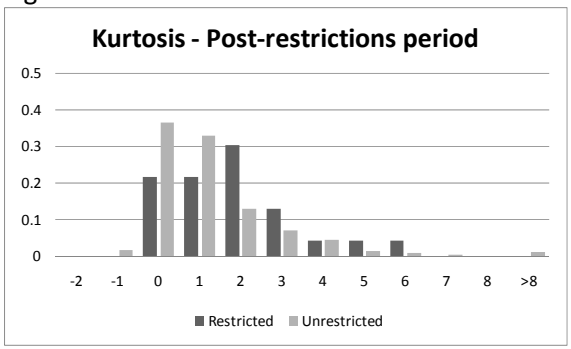


Figure 7.

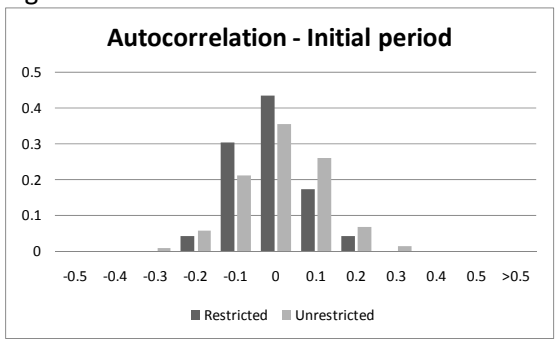


Figure 8.

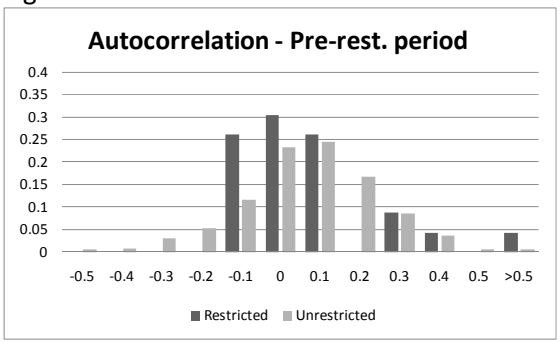


Figure 9.

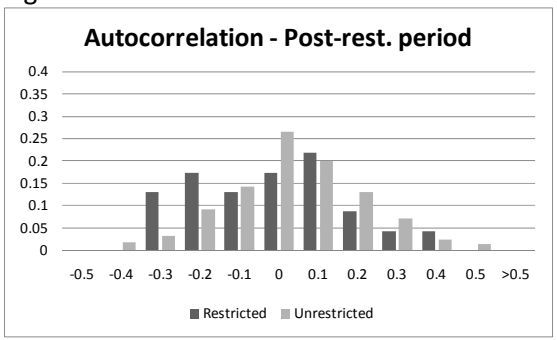


Table 2.

This table reports return distribution statistics for 23 UK stocks subject to restrictions on short selling. Statistics are reported for three periods detailed in Table 1. The second row of figures for each company give bootstrapped probability values based on 1,000 draws (with replacement) from the 187-day initial sample period, as detailed in the text.

	Post-restrictions period					Pre-restrictions period					Initial period				
Company Name	**Mean**	**Median**	**Stdev**	**Skew**	**Kurtosis**	**Mean**	**Median**	**Stdev**	**Skew**	**Kurtosis**	**Mean**	**Median**	**Stdev**	**Skew**	**Kurtosis**
ABERDEEN ASSET MAN.	0.34%	-0.79%	7.22%	1.17	4.82	-0.05%	0.00%	2.78%	-0.18	6.80	-0.10%	0.17%	2.70%	0.24	0.54
	70.7%	7.7%	99.8%	65.0%	59.1%										
ADMIRAL GROUP	-0.23%	-1.51%	6.07%	0.40	-0.21	-0.11%	-0.23%	1.67%	0.54	0.94	-0.39%	-0.36%	1.94%	0.31	0.02
	41.7%	0.0%	100.0%	51.3%	6.5%										
ALLIANCE TRUST	-0.39%	-0.81%	8.78%	0.85	1.28	-0.12%	-0.51%	3.03%	0.54	0.69	-0.19%	0.10%	3.84%	0.11	0.29
	37.5%	21.1%	100.0%	71.3%	38.6%										
AVIVA	-1.25%	-2.37%	9.45%	1.04	2.21	-0.15%	-0.62%	3.70%	0.61	0.88	-0.52%	-0.28%	4.43%	0.40	1.01
	13.6%	1.7%	100.0%	78.7%	68.3%										
BARCLAYS	0.07%	-0.91%	5.79%	0.42	3.50	-0.20%	0.00%	3.15%	-0.92	8.79	-0.11%	0.31%	2.68%	-0.56	0.22
	64.0%	7.1%	99.1%	56.7%	51.0%										
CLOSE BROTHERS GROUP	-1.02%	0.67%	8.53%	-0.75	1.10	-0.51%	-0.27%	2.92%	-5.19	45.27	-1.36%	-0.63%	3.36%	-2.18	5.90
	26.4%	99.4%	99.7%	57.6%	7.6%										
F&C ASSET MANAGEMENT	-0.15%	-2.01%	9.79%	1.09	1.44	-0.26%	-0.18%	3.39%	-0.53	4.97	0.04%	0.53%	4.47%	-2.17	8.17
	54.1%	0.2%	100.0%	70.7%	28.9%										
FRIENDS PROVIDENT	-0.16%	-1.38%	17.40%	-0.03	-0.08	-0.60%	-1.15%	5.24%	0.03	3.42	-1.87%	-1.22%	7.81%	-0.53	2.18
	62.2%	30.4%	100.0%	42.4%	1.7%										
HBOS	0.01%	-0.23%	5.57%	0.38	1.65	0.01%	0.00%	1.96%	0.26	1.27	-0.13%	0.09%	2.24%	0.11	0.77
	49.2%	20.8%	100.0%	58.3%	45.1%										
HSBC HDG. (ORD $0.50)	-0.55%	-1.04%	7.67%	0.37	0.57	-0.11%	-0.61%	3.85%	0.23	0.18	-0.50%	0.07%	4.64%	-0.47	0.53
	31.0%	25.3%	100.0%	62.6%	51.0%										
INVESTEC	-0.32%	-0.31%	8.19%	0.52	1.02	-0.15%	-0.23%	2.67%	0.51	2.38	-0.69%	-0.65%	3.22%	-0.19	0.01
	43.6%	39.5%	100.0%	62.4%	20.9%										
LEGAL & GENERAL	-0.26%	0.15%	8.28%	0.26	-0.11	-0.26%	-0.69%	3.49%	0.43	2.37	-0.87%	-0.55%	4.65%	-0.35	2.94
	49.2%	89.3%	100.0%	47.4%	6.1%										
LLOYDS TSB GROUP	-0.38%	-1.93%	11.68%	0.52	0.30	-0.39%	-0.50%	3.58%	-0.19	1.51	-0.95%	-1.11%	4.59%	-0.96	2.18
	48.9%	3.9%	100.0%	64.1%	13.5%										
OLD MUTUAL	0.03%	-0.32%	4.73%	-0.04	0.32	0.04%	-0.22%	2.55%	0.91	2.06	-0.40%	-0.31%	2.04%	0.12	0.28
	49.7%	37.1%	99.9%	23.9%	22.9%										
PROVIDENT FINANCIAL	-0.88%	-0.90%	10.35%	0.69	0.41	-0.14%	-0.23%	2.99%	0.18	0.36	-0.46%	-0.12%	3.64%	-0.04	0.90
	22.6%	13.5%	100.0%	65.7%	18.0%										
PRUDENTIAL	-0.50%	-1.52%	6.47%	0.96	2.04	0.03%	0.00%	2.71%	-0.01	1.82	0.78%	0.67%	2.90%	0.03	0.12
	23.3%	0.3%	100.0%	77.7%	45.6%										
RATHBONE BROTHERS	-1.90%	-0.70%	12.95%	-0.25	2.72	-0.33%	-0.90%	4.01%	0.41	0.70	-1.02%	-0.91%	4.75%	-0.05	0.76
	9.6%	63.4%	100.0%	40.2%	46.5%										
ROYAL BANK OF SCTL.GP.	-0.16%	0.00%	5.29%	0.28	-0.22	0.07%	-0.15%	2.65%	0.38	-0.12	0.37%	0.13%	2.92%	-0.28	-0.20
	36.0%	59.1%	100.0%	45.9%	22.4%										
RSA INSURANCE GROUP	-0.24%	-1.03%	9.24%	0.82	5.75	-0.09%	-0.38%	3.34%	0.79	1.64	-0.04%	0.05%	3.41%	1.49	4.33
	46.5%	11.7%	99.5%	58.9%	71.4%										
SCHRODERS	-0.33%	0.00%	6.34%	0.08	0.15	-0.05%	-0.11%	3.96%	1.77	11.35	-0.13%	0.22%	3.45%	-0.17	0.22
	37.7%	48.8%	95.1%	46.8%	21.6%										

ST.JAMES'S PLACE	-0.37%	-1.16%	10.56%	0.88	1.02	-0.11%	-0.27%	3.06%	0.42	0.93	-0.45%	-0.13%	3.36%	0.42	1.41
	39.3%	11.0%	100.0%	68.8%	23.1%										
STANDARD CHARTERED	0.51%	-0.92%	7.76%	0.63	-0.13	0.01%	-0.12%	3.13%	0.93	1.83	-0.25%	-0.42%	3.30%	1.39	3.92
	74.1%	14.3%	100.0%	47.0%	10.7%										
STANDARD LIFE	0.34%	-0.79%	7.22%	1.17	4.82	-0.05%	0.00%	2.78%	-0.18	6.80	-0.10%	0.17%	2.70%	0.24	0.54
	70.7%	7.7%	99.8%	65.0%	59.1%										

Table 2 reports the key distribution statistics for returns for the 23 firms subject to the restrictions on short selling in the UK sample in each of the three sub-periods. The first row of figures for each company allows us to compare statistics across the three periods for each individual company. Due to the number of figures reported, such comparisons are left to the reader. However, the general picture appears to be consistent with the discussion above.

Assessing whether the restrictions on short selling have had an effect in a statistical sense is of course difficult when there are only thirty-one post-restrictions observations. Usual statistical tests rely on large sample properties that are clearly inappropriate in this context. Instead we use a bootstrap technique to question whether an individual statistic for a particular company during the 31-day post-restrictions period is unusual when compared to observations for the same company from the initial period (which spans 187 days for the UK). We use the following technique:

- Compute the statistic based on returns from the 31-day post-restrictions period for a company
- Randomly select 31 returns (with replacement) from the initial 187-day period[5]
- Compute the statistic based on this draw of returns
- Repeat steps 2 and 3 one thousand times
- Rank the one thousand bootstrap statistics from high to low
- Compute the position in this ranking of the observed statistic from the post-restrictions period

If the observed statistic lies in one of the extreme tails of the ranked bootstrapped statistics then we conclude that the distribution during the post-restrictions period differs from that during the initial period. In Table 2 we report the percentile ranking of the post-restrictions statistics in the second row for each company. A high (low) percentile ranking would suggest that that statistic is unusually high (low) in the post-restrictions period.

Defining an extreme ranking as being one in either the upper or lower ten percentiles, only one of the 23 companies saw an unusually negative mean return over the post-restrictions period (Rathbone Brothers). That is, a mean return at or below the level observed in the post-restrictions period occurred fewer than 100 times in the 1,000 random 30-day samples drawn from the initial period. Median returns suggest unusually poor returns for eight companies (Aberdeen A.M., Admiral, Aviva, Barclays, F&C, Lloyds TSB, Prudential and Std. Life) and unusually good returns for just Close Brothers. Not surprisingly, every company saw an observed standard deviation in the upper extremes of the bootstrapped distribution. In many cases no draw from the initial period generated a volatility level as high as that observed post-restrictions (resulting in a 100% bootstrap level).

No company reports an unusual level of skew. Indeed the mean bootstrapped percentile for skew for restricted stocks is 57.4%. This suggests that, on average for the restricted stocks, the skewness of returns in the thirty-one days after restrictions were introduced were almost exactly what would have been expected based on randomly selected 31-day samples from the pre-restrictions period.

[5] When bootstrapping the first-order autocorrelation coefficient a matched lagged return is also extracted, and when bootstrapping the goodness of fit statistic the matched market index return is also extracted.

Four companies demonstrate unusually low levels of kurtosis post-restrictions – Admiral, Close Brothers, Friends Provident and L&G. The average bootstrapped percentile for kurtosis is 30.9% suggesting that post-restrictions kurtosis was lower than expected for this group of stocks on average even if the fall is only statistically significant in a handful of cases.

For comparison, 38% of the unrestricted sample of companies have mean returns in the lower ten percent of their bootstrapped distributions (none in the upper tail). Again, 90% of unrestricted companies have unusually high volatility post-restrictions (and just one company has unusually low levels of volatility). Most stocks, whether financials or non-financial, saw volatile returns in the post-restrictions period and non-financial stocks if anything seem to have fared worse than financial stocks. However, it is difficult to claim that this is due to short sales restrictions supporting the price of financial sector stocks given the information reaching the market on the evolution of the credit crunch and business cycle.

Only two companies (0.5% of the unrestricted sample) have unusual levels of skew post-restrictions, and the averaged bootstrapped skew percentile is 56.9%, almost identical to that seen for the restricted sample. Skewness of returns after the introduction of short sales restrictions in the UK appears entirely normal for both sets of stocks. This is a key result since a positive shift in skewness is strongly predicted by the short sales restriction literature.

A little over 30% of unrestricted companies report unusually low levels of kurtosis in the post-restrictions period. This compares with four out of twenty-three (17%) restricted stocks. It appears that the fall in kurtosis seen after the introduction of restrictions while prevalent among restricted stocks is, if anything, even more prevalent among those not subject to short sales regulations.

One potential downside of introducing restrictions on short selling is that markets become less efficient. This may be revealed by autocorrelations rising in magnitude, although Figures 7-9 above do not provide much evidence of this. The bootstrap tests suggest that no restricted stock gives an unusually high or low autocorrelation coefficient. Probability values range from 15.5-78.1% and average 48.7%. Similarly, while the average goodness of fit statistic for the restricted stocks is lower in the post-restrictions period than in the initial period (44.5% versus 51%) no individual stock has an unusually extreme figure as all bootstrap percentiles are above 20%.

Portfolio statistics

It is possible that large firm-specific innovations are obscuring some systematic effects of short sales restrictions. In this section we analyse the distributions of equally weighted portfolios of restricted and unrestricted stocks in the UK. Table 3 summarises the results.

Table 3.

This table reports the average levels of key statistics across an equally weighted portfolio of the 23 stocks subject to restrictions on short selling and an equally weighted portfolio of the 335 stocks not subject to the restrictions. Statistics are reported for three periods: the 187 day period Jan 1-18 September 2008 before the restrictions were introduced ("Initial"), the 30 day period 8 August-18 September 2008 immediately prior to the introduction of restrictions ("Pre-rest") and the 31 day period 19 September-31 October 2008 over which the restrictions were effective ("Post-rest"). The columns headed "Boot" give the bootstrapped probability value of the relevant statistic drawing from the 187 day initial period.

	Restricted stocks				Unrestricted stocks			
	Initial period	Pre-rest	Post-rest	Boot	Initial period	Pre-rest	Post-rest	Boot
Mean return	-0.15%	-0.41%	-0.39%	37.3%	-0.08%	-0.22%	-0.77%	2.8%
Median return	-0.26%	-0.14%	-0.47%	38.1%	-0.18%	0.10%	-0.04%	58.5%
Std. deviation	2.49%	2.85%	5.89%	100.0%	1.51%	1.64%	3.70%	100.0%
Skewness	0.68	0.33	0.77	67.5%	0.24	0.02	0.20	64.3%
Kurtosis	0.85	0.98	1.68	54.5%	0.09	-0.30	-0.21	10.5%
Autocorrelation	-0.06	0.04	0.00	59.5%	-0.06	0.14	0.04	54.5%

As expected, mean returns for both portfolios are low, especially for those stocks not subject to the restrictions, while standard deviations are exceptionally high. While the individual firm results point to a fall in skewness and kurtosis for restricted stocks, the portfolio of restricted stocks suggests higher skewness and kurtosis.[6] However, skewness and kurtosis of the portfolio of restricted stocks are not statistically unusual (bootstrapped probability values of 68% and 55%). This suggests that the general inference based on the individual firm results – that neither skewness not kurtosis are noticeably different from usual – is robust.

Autocorrelation of the restricted stocks portfolio has increased but is smaller in absolute value after the restrictions came into place. Again, this observed level of autocorrelation is not particularly unusual when compared to the initial sample. The portfolio of unrestricted stocks shows lower skewness and kurtosis and higher autocorrelation. The negative kurtosis observed in the post-restrictions period is marginally unusual according to the bootstrap.

To place the UK results in a wider context we now briefly present some statistics based on a wide sample of countries that adopted differing degrees of restrictions on short selling.

[6] We would expect the portfolio skewness and kurtosis to be lower than the average individual firm statistics due to the power of diversification. The fall in individual firm level kurtosis after the introduction of restrictions can be reconciled with an increase in portfolio kurtosis if the power of diversification is lessened by rises in inter-firm correlations.

2.2 United States

The US introduced a prohibition of naked and covered short selling for 306 financial stocks on 22 September 2008.[7] After 8 October the ban only applied to naked short positions. This gives us 12 trading days to analyse during which the tightest level of restrictions applied. We use the S&P1500 as the universe for the US which includes 144 of the restricted stocks (mainly because the full exemption list includes ADR securities). Table 4 gives the key statistics based on equally weighted portfolios of stocks subject to and exempt from the short sales restrictions.[8]

Table 4.

This table reports average key statistics for an equally weighted portfolio of the 144 stocks subject to restrictions on short selling and an equally weighted portfolio of the stocks not subject to the restrictions. Statistics are reported for three periods: the 188 day period Jan 1-19 September 2008 before the restrictions were introduced ("Initial"), the 30 day period 11 August-19 September 2008 immediately prior to the introduction of restrictions ("Pre-rest") and the 12 day period 22 September-7 October 2008 over which the restrictions were effective ("Post-rest"). The columns headed "Boot" give the bootstrapped probability value of the relevant statistic drawing from the 188 day initial period.

	Restricted stocks				Unrestricted stocks			
	Initial period	Pre-rest	Post-rest	Boot	Initial period	Pre-rest	Post-rest	Boot
Mean return	0.01%	0.47%	-2.26%	0.8%	0.01%	0.05%	-2.26%	0.0%
Median return	-0.07%	0.51%	-1.76%	4.2%	0.00%	0.25%	-1.90%	0.1%
Std. deviation	2.72%	3.92%	6.08%	98.7%	1.64%	2.09%	2.98%	83.1%
Skewness	0.85	0.57	0.49	56.2%	0.19	-0.02	0.20	60.7%
Kurtosis	1.99	1.22	1.47	55.0%	0.34	0.80	-0.67	17.0%

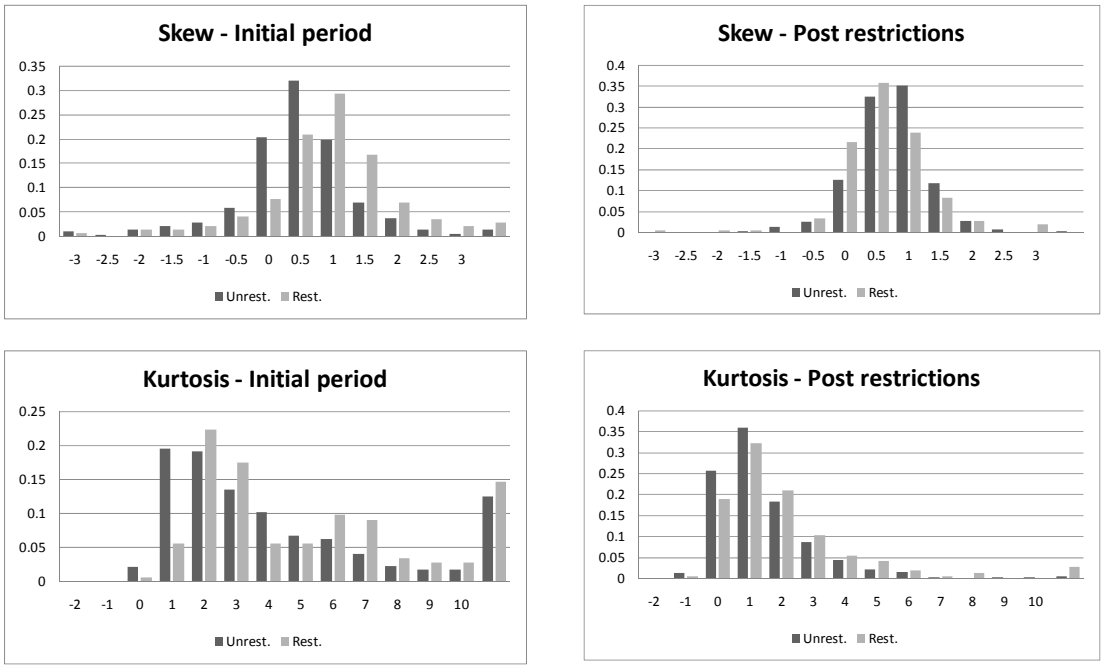
Returns after the restrictions were introduced are very negative for both portfolios, and standard deviations are high. All of these statistics are unusual when compared to the initial 188 day period according to the bootstrapped probability values. Skewness and kurtosis figures are only slightly different from the pre-restriction periods for financial stocks and the bootstrap suggests that these statistics are in line with the initial sample period. Kurtosis appears to have dropped noticeably for the unrestricted stocks in the post-restrictions sample but this is not statistically significant.

Figure 10 below plots the distribution of individual firm skewness and kurtosis statistics in the initial 188-day period and the post-restriction period. There has been little change in the distribution of skewness figures beyond a reduction in the dispersion for both restricted and unrestricted stocks. Kurtosis in the post-restriction period is much more tightly distributed and, on average, shifted to the left. However, this shift is apparent for restricted and unrestricted stocks and is therefore unlikely to be related to the short sale restrictions.

[7] According to Clifford Chance (2008) the initial SEC order came into effect on 19 September but was amended on 21 September. Short position taking in derivatives markets was prohibited from 22 September, hence we use this date as the start of the post-restriction period for the US.

[8] Since the US post-restrictions sample is so short we do not compute autocorrelation or goodness of fit statistics.

Figure 10. United States



2.3 *France and Germany*

For comparison, we also consider two major equity markets where less binding restrictions were introduced. France and Germany both introduced restrictions banning naked short sales of financial sector stocks from 22 September 2008 (subject to reviews in December 2008). The French ban relates to economic exposure while the German ban only covers physical short exposures. Our universe for France is the CAC All Share index which captures ten of the fifteen shares subject to short selling restrictions. The universe for Germany is the CDAX which captures all of the eleven financial companies subject to the German restrictions.

Table 5.

This table reports average key statistics across equally weighted portfolios of stocks subject to restrictions on short selling and stocks not subject to the restrictions in France and Germany. Statistics are reported for three periods: the 188 day period Jan 1-19 September 2008 before the restrictions were introduced ("Initial"), the 30 day period 11 August-19 September 2008 immediately prior to the introduction of restrictions ("Pre-rest") and the 30 day period 22 September-31 October 2008 over which the restrictions were effective ("Post-rest"). The columns headed "Boot" give the bootstrapped probability value of the relevant statistic drawing from the 188 day initial period.

	Restricted stocks				**Unrestricted stocks**			
France	**Initial period**	**Pre-rest**	**Post-rest**	**Boot**	**Initial period**	**Pre-rest**	**Post-rest**	**Boot**
Mean return	-0.13%	0.11%	-1.05%	8.3%	-0.12%	-0.13%	-0.86%	0.6%
Median return	-0.51%	-0.82%	-0.79%	28.7%	-0.08%	-0.12%	-0.55%	2.1%
Std. deviation	2.88%	4.51%	4.82%	98.1%	1.01%	0.94%	2.44%	100.0%
Skewness	1.39	1.95	0.01	39.2%	-0.94	0.53	0.43	80.4%
Kurtosis	6.96	6.70	-0.64	2.0%	6.15	0.95	0.54	14.6%
Autocorrelation	-0.03	-0.06	0.04	57.4%	0.12	-0.14	0.09	37.5%
Germany								
Mean return	-0.15%	-0.32%	-1.09%	8.4%	-0.06%	-0.14%	-0.63%	1.4%
Median return	-0.30%	-0.52%	-1.04%	1.7%	0.00%	-0.03%	-0.53%	0.1%
Std. deviation	2.13%	2.44%	7.09%	100.0%	0.81%	0.77%	2.90%	99.9%
Skewness	0.15	0.92	0.30	62.2%	-0.64	0.62	1.30	85.6%
Kurtosis	2.47	3.22	2.51	41.0%	5.97	2.68	4.12	57.0%
Autocorrelation	0.00	0.42	-0.03	29.4%	0.11	0.12	0.07	46.6%

Table 5 reports the key statistics for portfolios of restricted and unrestricted stocks for France and Germany. In line with other countries, returns were low and volatility was high for both countries in the post-restriction period. Skewness fell noticeably for French stocks subject to the restriction (and rose for stocks not subject to restrictions) but the bootstrapped probability values suggest that neither figure is particularly unusual. Kurtosis fell dramatically in the post-restrictions period for French stocks. Financial sector stocks were most affected and the bootstrap suggests that kurtosis is abnormally low in this case. The skewness and kurtosis of German stocks subject to the restrictions appear hardly affected. More dramatic changes are evident for unrestricted stocks but even these

are not particularly unusual. Autocorrelations are relatively stable for all portfolios and no autocorrelations in the post-restrictions period is even close to being statistically unusual.

Table 6.

This table reports changes in the distribution statistics for ten French stocks subject to restrictions on short selling. Changes are computed for the port-restriction period relative to the initial sample. Columns headed "Boot" give the probability value of observing the post-restriction statistic based on bootstrapping the initial period observations.

	Change in Stdev	Boot	Change in Skew	Boot	Change in Kurt.	Boot
AXA	4.27%	100.0%	-1.07	58.5%	-8.31	6.3%
BNP PARIBAS	2.17%	99.3%	-1.12	37.1%	-6.12	10.2%
CNP ASSURANCES	1.16%	94.7%	0.45	38.3%	-6.56	34.4%
CREDIT AGRICOLE	3.45%	99.0%	-1.73	40.5%	-10.36	2.6%
DEXIA (PAR)	4.20%	99.5%	-2.44	18.4%	-2.98	56.6%
EULER HERMES	1.72%	98.9%	-0.01	34.5%	-3.37	12.9%
NATIXIS	1.71%	88.5%	-1.45	27.0%	-4.45	17.8%
NYSE EURONEXT (PAR)	4.33%	99.9%	0.34	69.8%	-2.00	55.6%
SCOR SE	2.71%	99.9%	0.28	72.6%	-0.56	56.7%
SOCIETE GENERALE	3.39%	99.9%	-1.35	35.4%	-5.65	1.5%

Table 7.

This table reports changes in the distribution statistics for eleven German stocks subject to restrictions on short selling. Changes are computed for the port-restriction period relative to the initial sample. Columns headed "Boot" give the probability value of observing the post-restriction statistic based on bootstrapping the initial period observations.

	Change in Stdev	Boot	Change in Skew	Boot	Change in Kurt.	Boot
AAREAL BANK	10.57%	100.0%	0.39	67.2%	3.51	66.3%
ALLIANZ	4.64%	100.0%	0.61	73.4%	-1.59	38.6%
AMB GENERALI HDG.	1.93%	99.7%	-1.05	38.6%	-3.68	15.9%
COMMERZBANK	6.53%	100.0%	-0.13	61.8%	-1.54	26.0%
DEUTSCHE BANK	5.32%	100.0%	-0.31	61.1%	-2.05	2.6%
DEUTSCHE BOERSE	3.96%	100.0%	0.61	73.8%	-0.18	60.0%
DEUTSCHE POSTBANK	5.06%	100.0%	-1.07	37.4%	0.07	38.9%
HANNOVER RUCK.	3.09%	100.0%	-0.88	49.1%	-5.79	2.0%
HYPO REAL ESTATE HLDG.	16.99%	100.0%	0.68	40.8%	-8.10	42.3%
MLP	-0.10%	48.8%	-0.58	37.7%	-0.98	60.6%
MUENCHENER RUCK.	3.75%	100.0%	0.22	55.6%	-3.57	9.8%

Individual company level statistical results are presented in Tables 6 and 7 for French and German companies subject to the restrictions. In each case, the increase in volatility in the post-restriction period relative to the initial 188-day period is both large and statistically significant according to the

bootstrap. However, there are no instances where the change in skewness between the two periods is sufficiently large to be significant. In a few cases the drop in kurtosis is unusually large, however this is equally true of companies not subject to the short selling restrictions.

2.4 *Sweden and Japan*

Neither Sweden nor Japan changed their rules on short selling in response to the crisis. There are five financial institutions (and 13 non-financials) in the OMX index which we use as the Swedish universe. The Topix 150 index, which we use as the Japanese universe, contains 20 financial institutions.

Table 8 compares the usual statistics for the financial and non-financial portfolios for both countries using the period 22 September-31 October 2008 as the post-restrictions interval even though no restrictions apply for these countries. This gives us some information on whether the changes in returns distributions we have seen for countries that did apply short sale restrictions are due to the restrictions or simply the time period. Of course, since comparisons are between different countries with different characteristics any inference is not strong.

Table 8.

This table reports average key statistics for equally-weighted portfolios of financial sector and non-financial sector stocks in Sweden and Japan. Statistics are reported for three periods: the 188 day period Jan 1-19 September 2008 ("Initial"), the 30 day period 11 August-19 September 2008 ("Pre-rest") and the 30 day period 22 September-31 October 2008 ("Post-rest").

	Financial stocks			**Non-financial stocks**		
Sweden	**Initial period**	**Pre-rest**	**Post-rest**	**Initial period**	**Pre-rest**	**Post-rest**
Mean return	-0.12%	-0.29%	-1.33%	-0.12%	-0.30%	-0.76%
Std. deviation	2.65%	4.00%	7.46%	1.62%	2.26%	4.37%
Skewness	1.17	1.57	0.12	0.47	1.24	0.52
Kurtosis	4.06	4.56	0.45	1.80	3.34	0.42
Autocorrelation	-0.08	-0.07	0.29	-0.10	-0.13	0.18
Japan						
Mean return	-0.01%	0.02%	-0.41%	-0.10%	-0.26%	-0.74%
Std. deviation	1.04%	1.37%	2.25%	1.69%	1.73%	5.50%
Skewness	0.48	0.85	0.54	-0.26	0.29	0.63
Kurtosis	1.24	2.75	1.05	0.26	0.40	0.69
Autocorrelation	-0.06	-0.39	0.16	-0.09	-0.44	0.12

Once again, the table shows that average daily returns deteriorate strongly as time passes while volatility increases for both countries and both portfolios. Swedish financial stocks see a marked fall in skewness and kurtosis in the post-restriction period from initially high levels. Swedish non-financials see a fall in kurtosis to the same level but from a lower starting point while skewness remains at the level seen over the initial period. Japanese financial stocks see a mild increase in skewness and a fall in kurtosis. Japanese non-financials record increases in both skewness and kurtosis. Autocorrelation statistics show dramatic shifts in both countries across the periods analysed, generally suggesting that autocorrelations have increased in value and in magnitude for both countries and both groups of stocks. The increased magnitude of autocorrelation coefficients

in the later sample periods is suggestive of less efficient financial markets (and, possibly, the effect of short samples) but clearly this cannot be ascribed to short sales restrictions in these two countries and more likely reflects general market developments.

2.5 Summary

Looking at the six countries considered in depth we note the following:

1. In almost all cases, kurtosis falls after the international moves on restricting short selling. This pattern appears for portfolios of stocks subject to the restrictions and portfolios of stocks not subject to the restrictions. The fall in kurtosis is observed for countries with stronger restrictions (US), weaker restrictions (France and Germany) or no restrictions at all (Sweden and Japan). Kurtosis rises for the UK.

2. The response of skewness to the introduction of restrictions is mixed. In France and the US, the skewness of returns from portfolios of stocks subject to restrictions fell, while it rose in Germany and the UK. Again, this pattern does not align with the different type of restrictions introduced.

3. Changes in skewness observed over the introduction of the restrictions are not statistically significant according to bootstrap tests, either at the portfolio level or at the individual firm level. Only occasionally are the changes in kurtosis significant.

4. Changes in autocorrelation coefficients are not systematic and do not point to increased market inefficiencies as a result of the imposition of restrictions on short sales. In fact the clearest indications of increases in the magnitudes of autocorrelation coefficients are from the two countries that did not impose any restrictions.

3. Regression analysis

In this section we attempt a regression-based analysis of the impact of short-sales restrictions on securities' returns distributions across a panel of countries. The relevant portfolio statistics for the seventeen countries analysed are given in Table 9 while Table 10 notes the key characteristics of the restrictions brought in for each country.

Table 9.

This table reports key statistics for equally-weighted portfolios of financial sector and non-financial sector stocks in seventeen countries. Statistics are reported for two periods: the initial period and the post-restrictions period. The exact dating of these periods for each country corresponds to the period over which the restrictions were in force.

	Financial						Non-financial					
	Skewness		Kurtosis		Autocorrelation		Skewness		Kurtosis		Autocorrelation	
	Initial	Post-rest.	Initial	Post-rest.	Initial	Post-rest.	Initial	Post-rest.	Initial	Post-rest.	Initial	Post-rest.
Australia	0.179	-0.163	1.279	-0.762	0.135	0.101	-0.833	-0.036	8.011	-0.165	0.012	0.234
Austria	0.901	0.134	4.173	-0.861	-0.076	0.088	-0.417	0.933	2.687	2.143	0.049	0.183
Belgium	1.235	-0.894	8.693	0.801	0.000	0.128	0.393	0.225	0.568	-0.612	-0.012	0.089
Canada	0.565	0.743	2.144	-0.120	0.035	0.017	-0.062	-0.485	2.170	-0.893	0.057	-0.199
France	1.389	0.014	6.962	-0.643	0.048	-0.296	-0.936	0.432	6.155	0.542	0.117	0.088
Germany	0.147	0.304	2.467	2.515	0.019	0.189	-0.639	1.301	5.972	4.124	0.110	0.068
Greece	0.950	0.764	3.668	8.985	-0.047	0.082	0.677	0.179	2.995	0.229	-0.022	0.104
Ireland	1.316	0.499	7.426	0.476	-0.010	-0.028	0.007	-0.218	1.900	-0.681	0.142	-0.101
Italy	0.352	-0.510	0.661	-0.616	-0.034	-0.008	-0.590	-0.602	5.151	-0.753	0.125	0.096
Japan	0.476	0.540	1.244	1.051	-0.084	0.285	-0.262	0.626	0.259	0.691	-0.091	0.122
Nether.	0.600	0.512	4.042	1.363	0.007	0.160	0.023	0.161	1.626	0.710	-0.006	0.015
Portugal	0.793	0.332	4.688	1.151	-0.057	0.157	-0.607	1.237	2.933	3.614	0.050	0.082
Spain	1.087	-0.038	5.408	-0.366	-0.063	0.002	-0.033	0.867	1.057	2.413	-0.040	0.034
Sweden	1.167	0.122	4.059	0.446	-0.068	-0.311	0.469	0.524	1.803	0.419	-0.103	0.177
Switz.	1.014	0.670	5.291	0.353	-0.033	0.044	0.254	0.504	1.250	0.032	-0.097	-0.014
UK	0.675	0.773	0.849	1.683	-0.001	-0.027	0.239	0.202	0.091	-0.208	-0.059	0.044
US	0.853	0.486	1.995	1.472	-0.204	-0.241	0.185	0.200	0.341	-0.674	-0.156	-0.144
Avg.	0.806	0.252	3.826	0.996	-0.025	0.020	-0.125	0.356	2.645	0.643	0.004	0.052
Change		-0.553		-2.831		0.046		0.481		-2.002		0.047

In the regressions below we use the change in the statistic under consideration as the dependent variable. The change is defined as the post-restriction level minus the initial period level. When we look at autocorrelation coefficients we consider the change in the absolute value of the statistic since the sign is immaterial to the analysis.[9]

[9] Note that since we take the change in the statistic relating to each portfolio as an observation in the regression this implies that the portfolio of, say, Greek shares has the same weight as, say, the portfolio of Japanese shares despite the disparity in the sizes of these economies and the number of companies in each portfolio. Given the dramatic changes in equity values observed over the year, the alternative of market cap weighting is not without problems.

The literature would suggest that an effective restriction on short-selling should see an increase in skewness and a decrease in kurtosis, possibly at the cost of an increase in autocorrelation as markets lose efficiency.

Table 10.

This table summarises the nature of the restrictions adopted in each country. The first column in each section ("Ban") notes whether a new restriction was placed on short selling financial and non-financial stocks respectively. The second and third columns denote whether this was a ban on naked and/or covered short selling. The fourth and fifth columns denote whether the ban related to physical or economic positions.

	Financials					Non-financials				
	Ban	**Naked**	**Cover**	**Phys**	**Econ**	**Ban**	**Naked**	**Cover**	**Phys**	**Econ**
Australia	Y	Y	Y	Y	N	Y	Y	Y	Y	N
Austria	N	N	N	N	N	N	N	N	N	N
Belgium	Y	Y	N	N	Y	N	N	N	N	N
Canada	Y	Y	Y	N	Y	N	N	N	N	N
France	Y	Y	N	N	Y	N	N	N	N	N
Germany	Y	Y	N	Y	N	N	N	N	N	N
Greece	N	N	N	N	N	N	N	N	N	N
Ireland	Y	Y	Y	N	Y	N	N	N	N	N
Italy	Y	Y	N	Y	N	N	N	N	N	N
Japan	N	N	N	N	N	N	N	N	N	N
Nether.	Y	Y	N	Y	N	N	N	N	N	N
Portugal	Y	Y	N	N	Y	N	N	N	N	N
Spain	N	N	N	N	N	N	N	N	N	N
Sweden	N	N	N	N	N	N	N	N	N	N
Switz.	Y	Y	N	Y	N	Y	Y	N	Y	N
UK	Y	Y	Y	N	Y	N	N	N	N	N
US	Y	Y	Y	N	Y	N	N	N	N	N

The independent variables in the regression are:

- "initial" this gives the level of the statistic in the initial period. A negative coefficient on this variable would suggest some form of global mean reversion in that portfolios with a high (low) initial level of the statistics tend to see that statistic fall (rise) in the post-restrictions period.

- "fin" is a dummy variable that takes the value 1 if the dependent variable is for a portfolio of financial stocks and 0 otherwise. The coefficient on this variable gives the global change in the statistic for portfolios of financial stocks irrespective of whether they were subject to restrictions.

- "non-fin" is a dummy variable that takes the value 1 if the dependent variable is for a portfolio of non-financial stocks and 0 otherwise. The coefficient on this variable gives the global change in the statistic for portfolios of non-financial stocks irrespective of whether they were subject to restrictions.

- "ban" is a dummy variable that takes the value 1 if the stocks in the portfolio are subject to a new restriction on short selling in the post-restriction period and 0 otherwise.

- "covered" is a dummy variable taking the value 1 if restrictions exist and they also extend to include covered short selling, and 0 otherwise.

- "econ" takes the value 1 if restrictions exist and extend to economic interests in the stock and 0 otherwise.

The coefficient on the "ban" variable can be thought of as the impact of a restriction on naked short selling of the physical asset while those on "covered" and "econ" are the extra effects of extending the ban to be more restrictive. Results are given in Table 11.

Table 11.

This table reports the results of an ordinary least squares regression of the change in the relevant statistic on a set of explanatory variables. The first column of each pair gives the coefficient estimate ("Coeff.") and the second column the associated t-statistic ("t-stat"). Coefficients significant at the ten percent level are made bold. "initial" gives the level of the statistic in the initial period. "fin" ("non-fin") is a dummy variable that takes the value 1 if the dependent variable is for a portfolio of financial (non-financial) stocks and 0 otherwise. "ban" is a dummy variable that takes the value 1 if the stocks in the portfolio are subject to a new restriction on short selling in the post-restriction period. "covered" is a dummy variable taking the value 1 if restrictions exist and they also extend to include covered short selling, while "econ" takes the value 1 if restrictions exist and extend to economic interests in the stock. The "ban" variable can be thought of as the impact of a restriction on naked short selling of the physical asset. The row denoted "Adj. R2" gives the adjusted goodness-of-fit statistic for the regression and the row denoted "F-test" gives the probability value of the joint significance of all the regressors.

	Skew		**Kurtosis**		**Abs(A/C)**	
	Coeff.	**t-stat**	**Coeff.**	**t-stat**	**Coeff.**	**t-stat**
initial	**-1.163**	**-5.733**	**-0.982**	**-6.131**	-0.458	-1.455
fin	0.447	1.886	1.748	1.794	**0.134**	**3.605**
non-fin	**0.351**	**2.574**	0.632	0.993	0.051	1.510
ban	-0.258	-0.940	-1.150	-1.094	-0.027	-0.604
covered	0.167	0.526	-0.382	-0.332	-0.049	-1.009
econ	0.154	0.459	0.225	0.195	0.021	0.452
Adj. R2	60.7%		69.6%		32.8%	
F-test	0.0%		0.0%		0.6%	

The first pair of columns relate to changes in skewness. The only significant variables in the regression are "initial" with a negative coefficient and "non-fin" which takes a value +0.351. The negative coefficient on "initial" suggests that portfolios with initially high (low) levels of skewness tended to see falls (rises) in skewness in the post-restriction period. The positive coefficient on "non-fin" suggests that across the seventeen countries analysed, other things being equal, returns

on a portfolio of non-financial stocks saw an increase in skewness of 0.351 after the introduction of restrictions irrespective of whether restrictions were in place on trading those stocks. The skew of returns on financial company portfolios were barely affected. The ban dummy is insignificant but negative, suggesting that a ban on naked shorting of physical interests in equities reduced skewness but not in a statistically significant way. This is the incorrect sign if restrictions on short selling were effective. Extending the ban to covered short selling had a small positive but insignificant effect on the skewness of returns. The distinction between economic and physical interest is also insignificantly small.

The second pair of columns relate to kurtosis. Only the initial level of kurtosis is significant. The negative coefficient suggests that initially high kurtosis tended to result in falls in kurtosis in the post-restriction period for all portfolios. None of the other variables is significant. Again the ban dummy has an insignificantly negative coefficient, suggesting that restrictions on naked short selling reduced kurtosis but that the impact is not statistically significant. The same argument applies to extending the ban to covered shorts and to economic interest.

Both the skewness and kurtosis results are robust to changes in the exact nature of the regression. For example, if only the ban dummy is included alongside the initial level and financial/non-financial dummies the marginal significance level of “ban” is 0.58 and 0.18 for skew and kurtosis respectively. Similarly, when we only consider the effect of restrictions on covered shorting (by only including the indicators “covered” and “econ”) we still find no significant effect on either skewness or kurtosis.

The final two columns relate to the change in the absolute value of the autocorrelation coefficient. Financial portfolios experienced a rise in autocorrelation magnitudes of an economically large 0.134 after the restrictions were introduced. However, this is a general effect and is once more not influenced by the nature of the restrictions. In a more parsimonious regression which only includes the initial level of autocorrelation, financial and non-financial dummies and the ban dummy, the coefficient on ban remains insignificant (p-value is 0.33) and the coefficient remains negative, not what was expected if restrictions had been detrimental to market efficiency.

The F-test and Adj. R2 statistics suggest that the regressions are performing a good job in explaining changes in these statistics. We have run relatively simple regressions here but since the results are in line with the other statisticals presented above in not finding any clear relationship between the restrictions and the distributional properties of the returns we would not expect the key conclusions to change even in a richer analysis.

4. Discussion

Restrictions on short selling financial sector stocks were introduced in the UK on 19 September 2008. Several countries followed this move, though to different extents. In this report we analyse the impact these restrictions had on the behaviour of stock returns. We characterise stock returns using standard moment definitions (mean, median, standard deviation, skewness and kurtosis). The literature on the impact of constraints on short selling would suggest that we might initially expect to see higher skewness in the returns of stocks subject to the restrictions, probably in conjunction with lower kurtosis. This would result from the exclusion of pessimistic investors from the market. Other things equal, mean returns should be higher and standard deviations should be lower.[10] Given the extraordinary nature of economic and financial news during this period, the other things equal assumption is even more heroic than usual and we do not focus extensively on these two moments.

We also consider first-order autocorrelation coefficients and the strength of the correlation between individual stock returns and the market index return (a goodness of fit statistic). If the imposition of restrictions excludes a class of participants with relevant information, it might be expected that the efficiency of the market declines. This would be reflected in an increase in the magnitude of autocorrelation coefficients and, more controversially, by a rise in the goodness of fit statistics.

Our main findings can be summarised as follows:

1. We find no strong evidence that the imposition of restrictions on short selling in the UK or elsewhere changed the behaviour of stock returns. Stocks subject to the restrictions behave very similarly both to how they behaved before the imposition of restrictions and to how stocks not subject to the restrictions behave.

2. Further, comparing behaviour across countries where the nature of the restrictions differs, we fail to find systematic patterns consistent with the expected effect of the new regulations.

3. We also find no sign of the expected detrimental impact of constraints. Autocorrelation coefficients and goodness of fit statistics are if anything slightly lower in the post-restrictions period.

4. Regression analysis suggests that any change in the key statistics is mainly driven by sector-wide influences than the restrictions on short selling. That is, some systematic changes in the behaviour of financial sector stocks could be discerned but no strong evidence of a systematic impact of the restrictions could be identified.

One major caveat to our analysis is worth mentioning. The post-restrictions period analysed is short in most countries (typically 30 or 31 days) and in some countries is extremely short (12 days in the US and Canada). Placing great emphasis on a statistical analysis of such short samples is foolish. Many of the statistics presented in this report are very sensitive to the addition or subtraction of one

[10] These are the implications of the most widely cited papers in this literature although papers making the opposite claim also exist.

or two days in the sample. However, we feel that the main thrust of the findings appears to be robust, even if the exact numbers are not.