Extreme Day Returns on Stocks: Evidence from Sweden*

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Abstract

In this study we document that the frequency of extreme trading days, defined as a trading day when the absolute percentage return is equal to or greater than 1.5%, has increased on the Stockholm Stock Exchange in Sweden. For a sample of 1,317 extreme trading day returns between 1939 and 2006, we show that the frequency, as well as the magnitude, has increased over time. For instance, in the 1990s, the proportion of extreme days increased to 15.2% compared to the 1980s level of 10.5%. In recent years, the frequency of extreme day returns is even higher. We find a negative correlation between overall market returns and negative extreme day returns for the first two trading days after the extreme date. In our analysis we document that an equally weighted portfolio of negative (positive) extreme cumulative day returns remains negative (positive) 3 months after the initial extreme day return. We also find that the frequency of extreme daily returns in a year is positively correlated to the frequency in the preceding calendar year. Overall, our results provide new insights into how extreme day returns on the stock market influence the asset management industry and that asset managers, and specifically risk mangers, should pay attention to time periods which are characterized by high volatility.

Keywords: Volatility, Distribution, Extreme Value, Stock Market

I. Introduction

The risk and return concept in securities markets have received a great deal of attention in the asset management industry in recent years due to the substantial growth of assets under management and the increasing complexity and sophistication in investment strategies. In addition, stock brokers own trading in equities and options, and lack of appropriate risk control, can cause substantial changes in the management by official watch dogs.[1] In this paper, we bring new evidence related to extreme day returns of stocks in order to get some insight on the behaviour of market participants in distressed situations.

Empirically research in financial economics has shown that it is possible to predict future stock returns by using past returns. If so is the case, we are also able to monitor risk. For instance, it is well documented that a portfolio consisting of long positions in stocks which have outperformed their benchmarks (winners) and short positions in stocks which have underperformed their benchmarks (losers) will, on average, show superior returns. Thus, by implementing trading strategies based on momentum, an investor can achieve abnormal returns which are not due to risk, see Grundy and Martin (2001) and Jegadeesh and Titman (2001). Also, previous research provide additional evidence of the persistence in these drift anomalies with the post-earnings announcement drift, suggesting that good-news firms outperform bad-news firms related to earnings information, see Francis et al. (2004). The finding of abnormal returns in various persistence anomalies, and the failure to attribute it to different risks, challenge the efficient market hypothesis. But what is an appropriate definition of risk? The standard answer to this question is that in finance, risk is measured by the standard deviation in the returns and by the covariance in returns between the asset and a

[1] In September 2007, the Swedish Financial Supervisory Authority (Finansinspektionen), issued a warning to the Swedish Investment Bank Carnegie (listed on the Stockholm Stock Exchange) due to serious deficiencies in its operations and risk management and required a replacement of the CEO. In addition, a financial penalty of 50 mSEK (approximately 7.8m US-dollar) was issued. The Authority also called for an Extraordinary General Meeting to elect new members to the Board of Directors.

benchmark return. Some studies report evidence that investors do not use traditional definitions of risk but instead apply explanations based on some type of bounded rationality (overconfidence), see Benartzi and Thaler (1995) and Barberis et al. (1998).

An alternative, or supplementary view of risk management focuses on analyzing outliers in the return distribution, using extreme value theory, an approach introduced already in the 1960s by Mandlebrot (1963). Given the empirical evidence of persistence anomalies, attention to extreme values should be of interest not only to short-term oriented investors but also to professional fund managers or institutional investors as they, in general, have long investment horizons, see Lucas and Klaassen (1998), Jones and Wilson (2000). In this study we argue that professional institutional investors should be able to take advantage of different market conditions and thereby impose restrictions on trading in periods characterized by high volatility. Thus, one advantage to define risk, based on extreme day returns, is to decompose the percentage of daily extreme day returns into a negative and a positive component and thereby introduce trading limits which easily can be implemented.

To the best of our knowledge, empirical studies based on extreme day returns are rare compared to studies examining volatility over different time periods. The price drop on most of the stock exchanges around the world in October 1987 questioned market efficiency and was followed by several studies examining volatility in different contexts. For instance, Shiller (1989) reports no significant change in the volatility of stock returns in the U.S. in the 1980s, a finding which is also supported by Schwert (1989, 1998), and Jones and Wilson (2000). The level of standard deviation in stock returns across bull and bear markets has been examined by Hardouvelis and Theodossiou (2002) who find higher volatility in bear compared to bull market periods as lower asset prices are associated with higher uncertainty but also that higher uncertainty and price sensitive information implies higher volatility. In other words, market participants have more difficulties analyzing price sensitive information in a bear than in a bull market, see also French and Roll (1986). In the analysis of extreme day returns in the U.S. starting in 1885 and ending in 2002, Jones et al. (2004), find that the frequency of extreme day returns, and the fraction of negative day returns, has increased in the period 1996 to 2002 but also that investors react differently to large changes in stock prices.

Broadly speaking, we follow the methodology proposed by Jones et al. (2004) and extend prior literature by analyzing the frequency of extreme day returns by calendar time but also stock market returns surrounding an extreme date using event-study methodology.

In this paper, we classify the daily return as an extreme return if the absolute percentage return is greater than or equal to 1.5% (see section II for a discussion). Accordingly, the examination of extreme day returns on the Stockholm Stock Exchange in Sweden shows that the frequency has increased over time. For the overall sample period, representing 17,733 trading days, we find that extreme day returns on average constitute 7.4% of all trading days. However, this frequency varies substantially, from 0.7% in the 1950s to 15.2% for the 1990s. After partitioning the extreme day returns into negative (lower tail) and positive returns (upper tail) we find that they are roughly evenly distributed but that negative returns are associated with a higher variability (standard deviation) compared to positive returns. Our analysis also shows that January exhibits most extreme returns, but also that most of them are positive and thus contribute to the well-known January effect. Furthermore, in a 60 day window after an extreme day, the mean cumulative return remains positive for positive extreme day returns but negative for negative extreme day returns for the overall sample period. In a cross-sectional analysis between the overall market return and the extreme date return in a five trading days window after the extreme date (day 0), shows a negative correlation between the returns for the first two trading days following the extreme date for returns located in the lower tail. Our evidence also supports that frequency of extreme day returns in a prior calendar year is a significant predictor of the percentage of extreme days the subsequent year. Thus, our overall assessment of the results is that the extreme day return measure should be an important ingredient within risk management for institutional investors, as first suggested by Jones et al. (2004), but also for stock broker firms which have an own trading book.

The remainder of the paper is organized as follows. In Section II, we describe our data, sample and methodology. Our main results are presented in Section III. Finally, we conclude with a summary and brief discussion of our results in Section IV.

II. Data, Sample and Methodology

The data for this study consist of daily return for the overall market return on the Stockholm Stock Exchange in Sweden for the 67-year period 1939-2006. All in all, we use a total of 17,733 daily observations for our sample period. Due to lack of one time series, reflecting the overall market return, two different time-series have been compiled and then merged. For the period 1939 to 1972 the *Jacobson & Ponsbach, (J&P)*, index is used. This index is a price weighted index of shares listed on the Stockholm Stock Exchange and is also the oldest available index with daily data reflecting the overall return on the market. From 1973 to 2006 the business magazine *Affärsvärldens Generalindex, (AFFGX)*, a value weighted index of shares listed on the Stock Exchange, is used. Both these series reflect only price changes and thus exclude cash dividends. The *J&P*-index data have been hand-collected from daily editions of the Swedish newspapers *Dagens Nyheter* and *Svenska Dagbladet* available from the National Library (Kungliga Biblioteket, KB) in Stockholm. Data for the *AFFGX*-index have been collected from the homepage of the business magazine *Affärsvärlden*. Throughout the paper we use daily data.

The largest price movement in our sample occurred on Thursday 29 October 1987, when the market index dropped from 44.0632 to 40.2126 which corresponds to an arithmetic percentage return of -8.7388%. However, to return to the original level, a price appreciation of 9.5756% is required. In other words, the arithmetic return is not symmetric. We can circumvent this by computing the geometric instead of the arithmetic return. In this case the price drop is accompanied by a geometric return of -9.1444% which is symmetric as it will bring the index to its original level when a continuous compounding is performed. Thus, our analysis, as well as in most studies of short-term share price volatility, rests on daily continuously compounded returns as follows (where the price level of the index, *P*, is the daily closing value at day *t* and *t-1* respectively):

$$R = \ln\left(\frac{P_t}{P_{t-1}}\right). \tag{1}$$

Unfortunately, no precise definition of an extreme day return is provided in the literature or in previous research. Jones et al. (2004) define, and use for their sample, an extreme day as a trading day with an absolute daily percentage change greater than or equal to 1.5% whereas Pactwa and Prakash (2004) use three different definitions, 2%, 3% and 4% respectively. Thus, prior research seems to define an extreme day with a return which varies between 1.5% and 4%. For our overall sample period, 80.1% of all daily returns are within one standard deviation from the mean and 94.9% are within two standard deviations from the mean. If we apply an absolute level of 2%, 3% and 4% for our full sample period, the number of extreme days will constitute 3.6%, 1.2% and 0.4% of total trading days for our sample. Obviously, there is a trade off between definitions and number of observations. After this examination, we decided to use an absolute level of 1.5% as the definition of an extreme day in our study which gives us a total of 1,317 extreme day returns which represents 7.43% of all trading days over our sample period. In our analysis we classify an extreme day return with a value of -1.5% or less as located in the lower tail while returns with a value of 1.5% or more are located in the upper tail.

III. Results

We present summary statistics for the overall period, 1939-2006, in Table 1. A few important points can be noticed with respect to our observations. As reported, for all observations, the mean (median) logarithmic daily percentage change is 0.0332% (0.0445%). Thus, our data do not support the general view that returns are normally distributed around the mean. Instead, we find evidence of a negatively skewed distribution with fat tails.[2] As reported in Panel A, we see that the mean (median) logarithmic daily percentage change is -2.33% (-1.97%) for negative extreme day returns and 2.28% (1.96%) for positive extreme day returns over the sample period. Also, standard deviation in these returns is higher for negative (1.0484%) compared to positive (0.9703%) returns. The lowest return in the lower tail is -9.14% and represents October 29th 1987 whereas in the upper tail, October 12th 1998 is accompanied with the highest return, 9.82%.

In Panel B we report the distribution of our returns. As shown, and not surprisingly, we see a substantial dispersion in the returns. For instance, the 5% percentile values are -4.2068% for the lower tail and 1.5350% for the upper tail. In a similar way, the 95% percentile has a value of -1.5243% and 4.0354% respectively. This confirms our earlier finding that the distribution of returns is skewed.

In Table 2, we compare the frequency of extreme day returns for the full sample period, 1939-2006, as well as for the periods 1940-49, 1950-59, 1960-69, 1970-79, 1980-89, 1990-99 and 2000-2006. As shown in Panel A, the frequency of extreme day returns, defined as

[2] Further analysis shows that 21 trading days report a return of -5% or less and 19 trading days report a return equal to or higher than 5%. Actually, 1.77% of the observations are outside a +/- 3 standard deviation range.

number of extreme day returns divided by trading days for each sub-period, varies between 0.70% for the period 1950-59 to 15.23% for the period 1990-99. The mean percentage of extreme days is 7.43% for the full sample period. Note, however, that in the most recent period, 2000 to 2006, shows the highest frequency of extreme day returns, 20.43%. Also, there is a strong time trend in the frequency of extreme day returns in our sample. For instance, over the last 25 year period, 1982 to 2006, 18 of the calendar years have a frequency of extreme day returns higher than the mean for the overall sample period. Actually, for this specific time period, the mean percentage of extreme days is 16.19% which is more than twice the figure for the overall sample period. Column 4 and 5 give the minimum and maximum value for our extreme day returns with a lowest value of -9.1444% and a highest value of 9.8155%. In Panel B, we sort the extreme days by calendar months. As reported, the frequencies of extreme day returns seem to coincide when most firms listed on the Stock Exchange release their financial results for the business year (in January), but also the half-year and 9-months financial report (September and October respectively). Finally, Panel C sorts the extreme day by weekdays where our data set suggests that an extreme day is more likely to occur on Mondays. Trading on Saturdays on the Stock Exchanged ceased on May 27th 1961.

To get an insight of the magnitude of extreme day returns over our sample period, we also use a simple time-series analysis of our data. Figure 1 shows the frequency of extreme day returns expressed as a percentage of all trading days for each calendar year and support our earlier findings that the frequency of extreme days has increased over time. As can be clearly seen from the figure, the frequency of extreme days started to increase in the beginning of the 1980s and reached high levels in the calendar years 2000, 2001 and 2002 where the percentage of extreme days was 39.04%, 43.20% and 37.60% of all trading days respectively. Since then, the proportion of extreme trading days has declined to roughly 10%

of the trading days. The horizontal line in Figure 1 show the median value (4.43%) for the full sample period and reinforce our finding that since the beginning of the 1980s, the frequency has indeed increased. Additional evidence of the content of the extreme day returns is provided in Figure 2 which decomposes the percentage of extreme day returns in a year into the percentage of negative and positive returns. As the graph indicates, it is obvious that a higher proportion of the extreme days is associated with a negative return. To be more specific, in the years 2000, 2001 and 2002, negative extreme day returns represented 19.9%, 22.8% and 22% of all trading days. Thus, on average, and during this period, one trading day in a week is associated with a price drop less than or equal to -1.5% of the market index.

The conclusion drawn from Table 2 and Figure 1 and 2, can be summarized as follows. First, there is clear evidence that the frequency of extreme day returns have increased over time. Second, even if the distribution of negative and positive extreme day returns is fairly even distributed over the sample period the magnitude of negative extreme day returns is substantial. Third, our results suggest that there is a calendar pattern in the distributions with high frequency of extreme day returns when firms present their financial results. No such strong pattern seems to exist for calendar days.

To further investigate stock returns, and possible momentum effects following an extreme date, we examine the mean and cumulative return on the market portfolio after an extreme date. Thus, in our cross-sectional analysis we first compute the average return for a total of 651 negative and 666 positive extreme dates for the first five trading days. Next, we cumulate the average returns over the three window periods, periods (0, 10), (0, 20) and (0, 60). As Figure 1 indicate that the frequency of extreme dates has increased since the 1980s, and we have reason to believe different perceptions of these events, we examine the returns for two 25 year periods, 1957-1981 and 1982-2006, respectively.

Table 3 details the mean cumulative market returns for our overall sample period but also for our two sub periods. We report the cross-sectional mean of market returns and mean cumulative market returns for different event windows following extreme dates located in the lower and upper tail. Panel A, representing the period 1939-2006, reports that the average return on day 1, is -2.36% for returns located in the lower tail and also statistically significant at the 1% level (*t*-statistic = -41.90). For extreme dates located in the upper tail, the average market return is 2.29% on day 1 and also statistical significant at the 1% level (*t*-statistic = 50.60). Panel A shows also that for extreme dates located in the lower tail and during the first trading week, all days have a negative mean return but only three days show a statistically significant negative return. For our observations located in the upper tail, mean market daily return remains positive for all trading days in the subsequent week but only statistically significant different from zero for the first two days.

In Panel B and C we report the findings for the period 1957-1981 and 1982-2006. Generally speaking, the data shows that the magnitude of the extreme date return has increased over time and specifically for returns located in the upper tail. For instance, the median return on an extreme date in 1957-1981 was 2.26% and increased to 2.52% for 1982-2006. For returns located in the lower tail, the median value was more or less the same (-2.00% and -1.96% respectively).

In Panel D we report the mean cumulative market return for three different event windows, (0,10), (0,20) and (0,60). For the overall sample period, and for returns located in the lower tail, the mean cumulative return is -4.29%, -4.41% and -1.57% for our three windows. The estimates are also statistically significant. For returns located in the upper tail we see a monotonic and a statistically significant increase in the returns for the three windows. Thus, after three months, the value remains negative (positive) for returns located in the lower (upper) tail. For the most recent period, 1982-2006, returns located in the lower tail turns into a positive value after sixty days (actually after day +41). Based on these findings, the evidence suggests that price changes in the overall market return following extreme dates exhibit a momentum pattern and specifically following positive extreme date returns.

An alternative way to examine the overall market returns surrounding an extreme date is to compare the stock market return with the extreme date return. Hence, we address two questions, (a) is there a correlation in returns surrounding extreme days and (b) is there a spill-over effect of frequency of extreme days from one year to another year? A way to answer the first question is to examine the relationship between overall market returns and extreme date returns by using a simple OLS-regression model.

Table 4 reports the estimated coefficients of our regression model of extreme market return (the independent variable) on the overall market return (the dependent variable). In our analysis we confine the surrounding period to five trading days after the extreme day return, thus we examine the returns in the window *t+1* to *t+5*. We report our findings for three periods, the full sample period 1939-2006 and the sub periods 1957-1981 and 1982-2006 respectively. Our regression results imply some interesting inference. First, the estimated negative coefficient in the first two trading days following extreme dates located in the lower tail in Panel A are statistically significant at the 5% level (*t*-statistic = -3.89 and -2.19 respectively) whereas the estimated coefficients in Panel B are insignificant. For the period 1982-2006 (Panel C), the estimated coefficients for the first two trading days following an extreme date are statistically significant. These results imply that the overall return on the market, following a return located in the lower tail, also will be negative albeit at a higher level. Second, and for observations located in the upper tail, the overall return on the market is positively related to the extreme date return but the estimated coefficients are not statistically significant.

Overall, our results indicate that market participants react differently on positive and negative extreme date returns and that a negative return will be followed by some improvements but still negative.

Next, we estimate the predictive power of frequency of extreme dates to predict frequency of extreme dates. We use a simple OLS-regression model where the dependent variable is the ratio of the number of extreme days to the number of trading days in year *t* and our independent variable is the same variable but for the preceding year (*t-1*).

Table 5 reports estimation results for our OLS-model and for several periods. As indicated by the estimated regression coefficient, we obtain statistically significant estimates for three sub-periods, 1939-71, 1972-2006 and for the overall sample period 1939-2006. The estimated coefficient suggests a positive trend in frequency of extreme day returns. Furthermore, the correlation has increased over time. These results confirm that the frequency of extreme days in the current year is correlated with the frequency the prior year and thus exhibits some predictive power.

Some authors argue that stock market volatility is different in bull and bear markets. For instance, Veronsi (1999) argues that investors have different reactions to price sensitive information in different market conditions, i.e., a bull or a bear market. On the other hand, there seems to be no general accepted definition of a bull and bear market. For instance, a bull market is often characterized by an extended period of rising security prices. Jones et al. (2004) define a bull market where stock prices for a calendar year increase by more than 40% and a bear market when the overall return is less than -15%. In this study, we define a bear market as a calendar year when the overall return on the market drops by more than 10% and a bull market when the overall market return is equal to or more than 40%. To check whether a bear market implies more extreme days we add a dummy variable to our basic model where we regress the frequency of extreme days in a year on the frequency of extreme days in the prior year. More specifically, the dummy variable takes the value of 0 if the year is classified as a bull year and 1 if it is a bear year. Applying this model yields the following results (*t*-statistics within parentheses).

$$Freq_{Xdays,t} = \underset{(0.92)}{0.0313} + \underset{(3.90)}{0.6614}(Freq_{Xdays,t-1}) + \underset{(1.33)}{0.0564}(Bear_t) + e$$

As shown, the estimated coefficient for a bear market is positive and has the predicted sign but is statistically insignificant (*t*-statistic = 1.33). In other words, we are unable to conclude if the frequency of extreme day returns is related to a bear market in the preceding year even if our estimated coefficient indicates that, in a bear market year, the frequency of extreme days will increase. However, despite lack of statistical significance of the bear market coefficient, our R-square is relatively high, 0.60, and implies that more than half of the variation of extreme day returns can be explained by this simple model.

In addition to our previous definition of bear and bull markets, we also use a symmetric definition of 10%, 15% and 20% overall market return. The results of this approach indicate that our estimated coefficient for bear market yields a statistically significant estimate with values of 0.0818 and 0.1164 respectively (*t*-statistic = 2.80 and 3.72 respectively) when a 10% and 20% level is used. Overall, our robustness check, and the predicted sign of the estimated coefficient are consistent with the results in Jones et al. (2004) and indicates that there is a spill-over effect in the frequency of extreme days from bear-market years.

IV. Conclusions

In this paper we examine the frequency of extreme date returns, defined as a trading day when the absolute logarithmic percentage change on the market return is equal to or greater than 1.5%. We also investigate if these returns are correlated to stock market performance. For a sample of 17,733 observations of daily stock market return over the sample period 1939-

2006, we find that the frequency of extreme day returns has increased over time. The relationship between the extreme date return and the stock market performance five trading days following the extreme date is examined. For returns located in the upper tail, we find a negative correlation in the first two trading days after the extreme date. We also find that the frequency of extreme date returns in a year is positively correlated to the frequency of extreme days the prior year. Moreover, we document that a bear year contribute to this volatility (albeit not statistically significant). Our results, although reflecting a smaller stock market and a shorter sample period, are broadly consistent with prior literature and reinforce the importance of examining extreme day returns.

Overall, our evidence suggests that the concept of extreme day returns, and hence the opportunity to decompose volatility into a negative and positive part easily can be integrated into the risk management function for financial institutions.

References

Barberis, N., A. Shleifer, and R. Vishny, 1998, A model of investor sentiment, *Journal of Financial Economics* (49), 307-343.

Benartzi, S., and R. Thaler, 1995, "Myopic Loss Aversion and the Equity Premium Puzzle", *Quarterly Journal of Economics* (110), 73-92.

Francis, J., R. LaFond, P.M. Olsson, and K. Schipper, 2004, "Cost of Equity and earnings attributes", *Accounting Review* (79), 967-1010.

French, K. R. and R. Roll, 1986, "Stock return variances: The Arrival of information and reaction of traders", *Journal of Financial Economics* (17), 5-26.

Grundy, B.D., and J.S. Martin, 2001, "Understanding the nature of the risks and the source of the rewards to momentum trading", *Review of Financial Studies* (14), 29-78.

Hardouvelis, G.A. and P. Theodossiou, 2002, "The Asymmetric Relation Between Initial Margin Requirements and the Stock Market Volatility Across Bull and Bear Markets", *Review of Financial Studies* (15), 1525-1560.

Jegadeesh, N., and S. Titman, 2001, "Momentum", Working paper, University of Illinois.

Jones, C. P. and J. W. Wilson, 2000, "Stock Returns in the 1990s: Implications for the Future", *Journal of Private Portfolio Management,* Spring, 51-60.

Jones, C. P., M. D. Walker and J. W. Wilson., 2004, "Analyzing Stock Market Volatility using Extreme-Day Measures", *Journal of Financial Research* (27), 585-601.

Lucas, A. and P. Klaassen, 1998, "Extreme Returns, Downside Risk, and Optimal Asset Allocation", *Journal of Portfolio Management,* Fall, 71-79.

Mandlebrot, B., 1963, "The Variation of Certain Speculative Prices", *Journal of Business* (36), 394-419.

Pactwa, T. and A. Prakash, 2004, "Using Extreme Value Theory to Value Stock Market Returns, Working Paper, Florida International University, Miami.

Schwert, G. W., 1989, "Why does stock market volatility change over times?", *Journal of Finance* (44), 1115-1153.

Schwert, G. W., 1998, "Stock market volatility: Ten years after the crash", National Bureau of Economic Research, Working Paper No. 6381.

Shiller, R. J., 1989, "Market Volatility", Cambridge, MIT Press.

Veronsi, P., 1999, "Stock Market overreaction to bad news in good times: A rational expectations equilibrium model", *Review of Financial Studies* (12), 97-107.

Table 1
Summary Statistics of Daily Returns on the Swedish Stock Market
Between 1939 and 2006

This table illustrates the distribution of daily logarithmic percentage changes on the Stockholm Stock Exchange during 1939 to 2006. Two different market indexes have been used. For the period 1939-1972, the Jacobson & Ponsbach price weighted index is used. From 1973 and onwards, the Affärsvärldens Generalindex, a value-weighted index is used. An extreme day return is defined as a logarithmic percentage change less than or equal to -1.5% (lower tail) or equal to or more than 1.5% (upper tail).

Panel A: Statistics of daily logarithmic percentage changes, in percent

	All observations,	Lower tail,	Upper tail,
Mean	0.0332	-2.3282	2.2786
Standard Deviation	0.8750	1.0484	0.9703
Median	0.0445	-1.9698	1.9565
Skewness	-0.2365	-2.6251	3.0310
Kurtosis	10.7312	9.1810	8.3200
Number of observations	17,733	651	666

Panel B: Distribution of daily logarithmic percentage changes, in percent

Percentile	All observations	Lower tail	Upper tail
1%	-2.4710	-7.2636	1.5032
5%	-1.2391	-4.2068	1.5350
10%	-0.8262	-3.5514	1.5692
50%	0.0445	-1.9698	1.9565
90%	0.9093	-1.5478	3.3802
95%	1.3267	-1.5243	4.0354
99%	2.4901	-1.5018	6.3023

Table 2
Frequency of Extreme Daily Returns on the Swedish Stock Market Between 1939 and 2006

This table displays the distribution of extreme day returns over various periods (Panel A) as well as calendar months (Panel B) and weekdays (Panel C) on the Stockholm Stock Exchange from 1939 to 2006. An extreme day return is defined as a logarithmic percentage change less than or equal to -1.5% (lower tail) or equal to or more than 1.5% (upper tail).

Panel A: By Periods

Period	% of Extreme Returns	Number of Negative Extreme returns	Number of Positive Extreme returns	Min. value of Extreme Returns (%)	Max. value of Extreme Returns (%)
1940-49	1.24	12	23	-7.7160	3.3802
1950-59	0.70	12	8	-4.3521	2.3718
1960-69	1.68	21	22	-3.3616	2.8912
1970-79	5.93	74	74	-4.1063	5.0680
1980-89	10.47	119	141	-9.1444	8.0519
1990-99	15.23	183	199	-7.3387	9.8155
2000-2006	20.43	219	140	-8.3180	7.3226
1939-2006	7.43	651	666	-9.1444	9.8155

Panel B: By Calendar Months

Calendar Month	% of Extreme Returns	Number of Negative Extreme returns	Number of Positive Extreme returns	Min. value of Extreme Returns (%)	Max. value of Extreme Returns (%)
January	12.50	65	95	-6.2300	7.1989
February	7.58	39	58	-5.4219	3.4209
March	8.67	52	59	-6.1300	4.2523
April	7.73	49	50	-7.7160	4.8908
May	6.41	46	36	-3.9829	3.5788
June	5.00	33	31	-3.8936	4.1736
July	4.92	31	32	-4.6497	7.3226
August	7.97	58	44	-6.6186	4.6295
September	10.23	80	51	-8.3180	6.3023
October	10.78	71	66	-9.1444	9.8155
November	10.94	59	81	-5.7099	8.4307
December	7.27	46	47	-4.6846	5.0680

Panel C: By Weekdays

Weekday	% of Extreme Returns	Number of Negative Extreme returns	Number of Positive Extreme returns	Min. value of Extreme Returns (%)	Max. value of Extreme Returns (%)
Monday	24.14	150	159	-7.7583	9.8155
Tuesday	20.55	137	126	-8.3180	5.9276
Wednesday	18.75	130	110	-5.8717	6.3905
Thursday	19.53	116	134	-9.1444	7.1989
Friday	16.72	95	119	-4.5857	8.4307
Saturday	0.31	1	3	-1.6262	1.9474

Table 3
Mean Stock Market Returns Following Extreme Dates

This table reports mean stock market returns and cumulative stock market returns following an extreme day on the Stockholm Stock Exchange over the sample period 1939-2006. An extreme day return is defined as a logarithmic percentage change less than or equal to -1.5% (lower tail) or equal to or more than 1.5% (upper tail). *, **, *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Daily Stock Market Returns following an Extreme Day, 1939-2006

	Lower Tail		Upper Tail	
Days	Mean	Median	Mean	Median
0	-0.0233***	-0.0197	0.0228***	0.0196
1	-0.0236***	-0.0119	0.0229***	0.0200
2	-0.0013	-0.0022	0.0033*	0.0046
3	-0.0019	0.0016	0.0003	0.0005
4	-0.0014*	0.0022	0.0004	0.0007
5	-0.0003	-0.0002	0.0006	0.0009

Panel B: Daily Stock Market Returns following an Extreme Day, 1957-1981

	Lower Tail		Upper Tail	
Days	Mean	Median	Mean	Median
0	-0.0216***	-0.0200	0.0203***	0.0226
1	-0.0020***	-0.0016	0.0044***	0.0067
2	0.0042***	0.0036	-0.0007**	-0.0001
3	0.0003	0.0006	-0.0001	0.0002
4	-0.0017***	-0.0023	0.0003	-0.0006
5	-0.0016***	-0.0012	0.0003	0.0008

Panel C: Daily Stock Market Returns following an Extreme Day, 1982-2006

	Lower Tail		Upper Tail	
Days	Mean	Median	Mean	Median
0	-0.0241***	-0.0196	0.0237***	0.0252
1	-0.0009	-0.0017	0.0030**	0.0044
2	0.0012	0.0023	0.0006	0.0003
3	0.0015*	0.0032	0.0006	0.0002
4	0.0002	0.0009	0.0007	0.0011
5	0.0001	0.0012	0.0010	0.0044

Panel D: Mean (Median) Cumulative Stock Market Returns following an Extreme Day

	1939-2006		1957-1981		1982-2006	
Event Windows	Lower Tail	Upper Tail	Lower Tail	Upper Tail	Lower Tail	Upper Tail
(0,10)	-0.0429**	0.0536**	-0.0214**	0.0258*	-0.0189***	0.0316*
	(-0.0319)	(0.0431)	(-0.0256)	(0.0244)	(-0.0199)	(0.0288)
(0,20)	-0.0441*	0.0581**	-0.0229**	0.0272*	-0.0129**	0.0405**
	(-0.0412)	(0.0419)	(-0,0311)	(0.0265)	(-0.0100)	(0.0376)
(0,60)	-0.0157*	0.0886**	-0.0137**	0.0224*	0.0145*	0.0788*
	(-0.0111)	(0.0615)	(-0.122)	(0.0221)	(0.0133)	(0.0557)

Table 4
Ordinary Least Square Regression (OLS) Results and Extreme Daily return on the Stockholm Stock Exchange from 1939 to 2006

This table displays OLS-regression results following daily extreme returns. The dependent variable is the overall market return on the first up to the fifth trading day following the extreme date and the dependent variable is the return on the extreme date. Results are presented for three different periods, 1939-2006, 1957-1981 and 1982-2006 and for each tail respectively. * denote significance at the 5% level.

Panel A: Extreme Daily Returns, 1939-2006

	Lower Tail					Upper Tail				
	t+1	*t+2*	*t+3*	*t+4*	*t+5*	*t+1*	*t+2*	*t+3*	*t+4*	*t+5*
Intercept	-0.0079*	-0.0019	0.0026	-0.0018	0.0028	0.0028	0.0005	0.0022	0.0000	0.0041
	(-4.25)	(-1.01)	(1.40)	(-0.96)	(1.54)	(1.91)	(0.40)	(1.55)	(0.03)	(3.07)
Coefficient	-0.2808*	-0.1638*	0.0527	-0.0618	0.1286	0.0248	-0.0078	-0.0791	0.0280	-0.1454*
	(-3.89)	(-2.19)	(0.73)	(-0.85)	(1.81)	(0.43)	(-0.15)	(-1.41)	(0.51)	(-2.70)
F-value	15.09	4.81	0.53	0.73	3.28	0.18	0.02	1.99	0.26	7.30
R-sqd	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01

Panel B: Extreme Daily Returns, 1957-1981

	Lower Tail					Upper Tail				
	t+1	*t+2*	*t+3*	*t+4*	*t+5*	*t+1*	*t+2*	*t+3*	*t+4*	*t+5*
Intercept	-0.0091*	-0.0024	-0.0025	-0.0063	0.0011	0.0113*	0.0048	0.0077*	-0.0003	-0.0027
	(-2.26)	(-0.57)	(-0.53)	(-1.78)	(0.26)	(3.14)	(1.47)	(2.01)	(-0.11)	(-0.73)
Coefficient	-0.3647	-0.3202	-0.1390	-0.2111	0.1162	-0.4127*	-0.2661	-0.3815*	0.0388	0.1510
	(-1.93)	(-1.64)	(-0.63)	(-1.27)	(0.57)	(-2.33)	(-1.65)	(-2.01)	(0.25)	(0.82)
F-value	3.72	2.68	0.39	1.61	0.33	5.41	2.73	4.04	0.06	0.68
R-sqd	0.04	0.03	0.00	0.02	0.00	0.05	0.02	0.04	0.00	0.01

Panel C: Extreme Daily Returns, 1982-2006

	Lower Tail					Upper Tail				
	t+1	*t+2*	*t+3*	*t+4*	*t+5*	*t+1*	*t+2*	*t+3*	*t+4*	*t+5*
Intercept	-0.0075*	-0.0033	-0.0034	-0.0008	0.0032	0.0018	0.0008	0.0025	0.0003	0.0050*
	(-3.37)	(-1.43)	(1.51)	(-0.35)	(1.46)	(1.07)	(0.53)	(1.52)	(0.19)	(3.13)
Coefficient	-0.2635*	-0.1924*	0.0699	-0.0324	0.1273	0.0514	-0.0075	-0.0832	0.0163	-0.1690*
	(-3.14)	(-2.20)	(0.83)	(-0.38)	(1.54)	(0.79)	(-0.13)	(-1.33)	(0.26)	(-2.77)
F-value	9.85	4.83	0.69	0.15	2.36	0.62	0.02	1.77	0.07	7.68
R-sqd	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01

Table 5
Ordinary Least Square Regression (OLS) Results and Frequency of Extreme Day Returns on the Stockholm Stock Exchange from 1939 to 2006

This table shows, for our overall sample period but also for several sub-periods, OLS-regression results where the dependent variable is the frequency of extreme days in year *t* and the independent variable is the frequency of extreme days in year *t-1*, *t*-statistics within parentheses. * denote significance at the 5% level.
Thus our model is as follows:

$$Freq_{Xdays,t} = a + b(Freq_{Xdays,t-1}) + e$$

Period	Intercept (*a*)	Estimated Slope Coefficent (*b*)	R-sqd	F-value
1940-49	0.0042 (0.58)	0.4762 (1.98)	0.33	3.90
1950-59	0.0070 (2.00)	0.0044 (0.01)	0.00	0.00
1960-69	0.0244 (2.15)	-0.6487 (-0.78)	0.07	0.61
1970-79	0.0654 (2.56)	-0.0779 (-0.22)	0.01	0.05
1980-89	0.1056 (2.44)	0.0010 (0.00)	0.00	0.00
1990-99	0.1343 (2.70)	0.1304 (0.42)	0.02	0.17
1940-1971	0.0084 (1.60)	0.5087* (3.30)	0.27	10.91
1972-2006	0.0515* (2.19)	0.6278* (4.56)	0.40	20.77
1940-2006	0.0191 (1.88)	0.7604* (9.29)	0.58	86.24

Figure 1
Percentage of Extreme Days Returns
on the Stockholm Stock Exchange from 1939 to 2006

This figure shows the development of extreme day returns on the Stockholm Stock Exchange from 1939 to 2006. The definition of an extreme day is as follows; the daily logarithmic return is equal to or less than -1.5% or equal to or greater than 1.5%. The percentage of extreme days is the ratio between the total number of extreme days divided by trading days for each calendar year. The median value of number of extreme days is 4.43% for the full sample period.

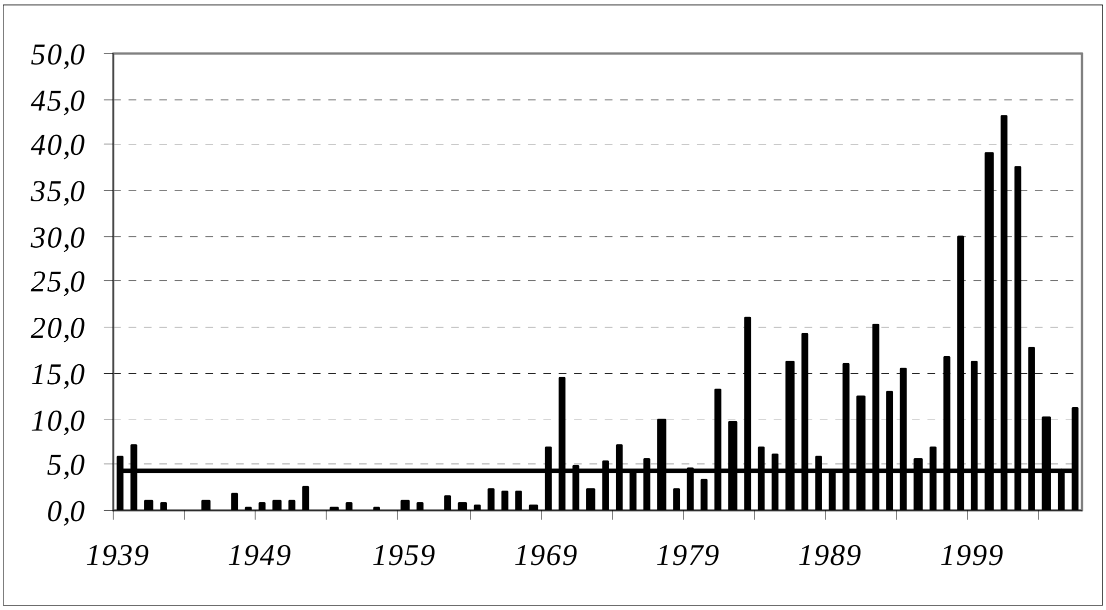

Figure 2
Percentage and Sign of Extreme Days Returns
on the Stockholm Stock Exchange from 1939 to 2006

This figure shows the development of extreme day returns, defined as a daily logarithmic return equal to or less than -1.5% or equal to or greater than 1.5% on the Stockholm Stock Exchange from 1939 to 2006 and its distribution into negative and positive values. In other words, this figure reflects the proportion of negative (below the zero-line) and positive (above the zero-line) extreme day returns from the bars in Figure 1.