Stock Market Volatility: Ten Years after the Crash

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THE STOCK MARKET CRASH of October 19, 1987, attracted an immense amount of interest in stock market volatility.[1] October 1997 events in the stock market have renewed interest in the topic. As the stock market has risen over the last decade, the frequency of large absolute changes in market indexes, such as the Dow Jones Industrial Average (DJIA), has increased. This problem of "scale illusion" remains a serious impediment to public understanding of stock market volatility. Even the large changes in stock indexes that occurred since spring 1997 are relatively small in percentage terms. While the volatil-

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1. At the time of the 1987 crash, I had started research on the causes and consequences of volatility in U.S. stock markets. Several of my papers were published following the crash; see Schwert (1989a, 1989b, 1989c, 1990c); Pagan and Schwert (1990); and Schwert and Seguin (1990). In the fall of 1989 I prepared a report summarizing the historical evidence concerning the volatility of the U.S. stock markets for the New York Stock Exchange (NYSE). A revised version of that paper subsequently was published in *Financial Analysts Journal*. See Schwert (1990b).

ity of stock market returns has increased slightly since 1996, it remains low by historical standards. Even the minicrash of October 27, 1997, which was the largest absolute decline in the DJIA, was only the twelfth largest percentage decline.

Many issues concerned regulators and the public following the 1987 crash. Triple-witching days (when options and futures on stock indexes expire) remain periods of high trading volume, but no evidence exists of abnormal volatility on those days. Circuit breakers and collars, which are designed to reduce the ability to perform certain types of automated trades following large absolute changes in the Dow index, are now triggered frequently because they have not been updated adequately to reflect the enormous increase in the level of the index. Moreover, the trade and budget deficits that attracted much attention around the time of the 1987 crash have continued to fluctuate and have often remained at similar, if not higher, levels since that time. Also, the behavior of the earnings and dividend yields to the Standard & Poor's (S&P) composite index are indicators of the valuation of the stock market. Nothing in the time-series behavior of these data makes the October 1987 crash stand out as a notable event.

The National Association of Securities Dealers Automated Quotations (NASDAQ) market and the markets of the United Kingdom, Germany, Japan, Australia, and Canada do not share all of the institutional and environmental factors that affect the New York Stock Exchange (NYSE). The evidence shows that most of these markets have been unusually quiet in the years since the 1987 crash.

Volatility: Large Percentage Changes in Prices

The term *volatility* is tossed about loosely in many discussions of stock market behavior. To have a sensible discussion of public policy as it relates to volatility, however, a common understanding must be reached of the definition of volatility and a sense of the facts about volatility.

Have Recent Market Movements Been Unusually Large?

Volatility should be measured in percentage changes in prices, or rates of return.[2] If you invest $1,000 today in a portfolio of common

2. The rate of return is the change in price plus the dividend received by stockholders during the period, all divided by the price of the investment at the beginning of the period.

stocks, the rate of return tells you the proportional change in the value of your investment at the end of the period. A 10 percent rate of return would mean an increase in value of $100 whether the DJIA was at 100, 1000, or 10,000. However, the vast majority of newspaper stories that report movements in stock market prices refer to absolute movements in the level of the DJIA or similar indexes. By focusing on the absolute level of the DJIA, the press and the public exaggerate the severity of recent volatility.

The problem of volatility could be solved if Dow Jones (the publisher of the *Wall Street Journal*) would simply do what the Bureau of Labor Statistics does periodically with the consumer price index: Rescale the index equal to 100 in some recent period. Then absolute changes in the price index would approximate percentage changes, so the press and the public would not be fooled when the level of the index is higher than it has been in the past.

The largest thirty-five daily increases and decreases in the DJIA between February 1885 and November 1997 are listed in table 1. The approximately 550-point minicrash that occurred on October 27, 1997, was the largest one-day change in the DJIA out of more than thirty-one thousand observations. The next largest change in the DJIA occurred during the 1987 crash, on October 19. The third largest change was October 28, 1997, when the DJIA rose more than 330 points. Table 1 also includes data on the level of the DJIA on each of the days associated with big changes and the percentage change in the index for that day.

All but three of the thirty-five largest increases in the DJIA have occurred in 1996–97 (shown in bold in table 1). Similarly, twenty-seven of the thirty-five largest decreases in the DJIA have happened in 1996–97. None of the large changes dates before the 1987 crash. This is probably the starkest illustration of the problem of scale illusion that could be imagined. By this criterion, the stock market is in the midst of an incredibly chaotic period in its history.

In contrast, the largest thirty-five daily percent increases and decreases in the DJIA between February 1885 and November 1997 are presented in table 2. The October 27, 1997, minicrash is the only day on this list from the 1990s, as the twelfth largest percentage decline in the DJIA. The largest increase in the DJIA in table 1 (which was a 4.71 percent increase) would have had to be almost 1 percent larger to make the bottom of the list of the top thirty-five daily percent changes. Sim-

Table 1. Largest Daily Decreases and Increases in the Dow Jones Industrial Average, February 1885 to November 1997

	Largest increases				*Largest decreases*			
Rank	*Date*	*Dow Jones*	*Change*	*Percent change*	*Date*	*Dow Jones*	*Change*	*Percent change*
1	**October 28, 1997**	**7498.32**	**337.17**	**4.71**	**October 27, 1997**	**7161.15**	**−554.26**	**−7.18**
2	**September 2, 1997**	**7879.78**	**257.36**	**3.38**	October 19, 1987	1738.74	−508.00	−22.61
3	**November 3, 1997**	**7674.39**	**232.31**	**3.12**	**August 15, 1997**	**7694.66**	**−247.37**	**−3.11**
4	**December 1, 1997**	**8013.11**	**189.98**	**2.43**	**June 23, 1997**	**7604.26**	**−192.25**	**−2.47**
5	October 21, 1987	2027.85	186.84	10.15	October 13, 1989	2569.26	−190.58	−6.91
6	**April 29, 1997**	**6962.03**	**179.01**	**2.64**	**October 23, 1997**	**7847.77**	**−186.88**	**−2.33**
7	**September 16, 1997**	**7895.92**	**174.78**	**2.26**	**March 8, 1996**	**5470.45**	**−171.24**	**−3.04**
8	**April 22, 1997**	**6833.59**	**173.38**	**2.60**	**July 15, 1996**	**5349.51**	**−161.05**	**−2.92**
9	**July 22, 1997**	**8061.65**	**154.93**	**1.96**	**March 13, 1997**	**6878.89**	**−160.48**	**−2.28**
10	**June 24, 1997**	**7758.06**	**153.80**	**2.02**	**November 12, 1997**	**7401.32**	**−157.41**	**−2.08**
11	**May 5, 1997**	**7214.49**	**143.29**	**2.03**	**March 31, 1997**	**6583.48**	**−157.11**	**−2.33**
12	**October 21, 1997**	**8060.44**	**139.00**	**1.75**	October 26, 1987	1793.93	−156.83	−8.04
13	**June 12, 1997**	**7711.47**	**135.64**	**1.79**	**August 8, 1997**	**8031.22**	**−156.78**	**−1.91**
14	**April 15, 1997**	**6587.16**	**135.26**	**2.10**	**April 11, 1997**	**6391.69**	**−148.36**	**−2.27**
15	**June 6, 1997**	**7435.78**	**130.49**	**1.79**	January 8, 1988	1911.31	−140.58	−6.85
16	**December 19, 1996**	**6473.64**	**126.87**	**2.00**	**March 27, 1997**	**6740.59**	**−140.11**	**−2.04**

17	**November 17, 1997**	**7698.22**	**125.74**	**1.66**	**May 7, 1997**	**7085.65**	**−139.67**	**−1.93**
18	**May 12, 1997**	**7292.75**	**123.22**	**1.72**	**May 16, 1997**	**7194.67**	**−138.88**	**−1.89**
19	**August 19, 1997**	**7918.10**	**114.74**	**1.47**	**September 10, 1997**	**7719.28**	**−132.63**	**−1.69**
20	January 17, 1991	2623.51	114.60	4.57	**October 24, 1997**	**7715.41**	**−132.36**	**−1.69**
21	**March 11, 1996**	**5581.00**	**110.55**	**2.02**	**July 18, 1997**	**7890.46**	**−130.31**	**−1.62**
22	**August 18, 1997**	**7803.36**	**108.70**	**1.41**	**October 30, 1997**	**7381.67**	**−125.00**	**−1.67**
23	**July 8, 1997**	**7962.31**	**103.82**	**1.32**	November 15, 1991	2943.20	−120.31	−3.93
24	**February 12, 1997**	**6961.63**	**103.52**	**1.51**	**July 9, 1997**	**7842.43**	**−119.88**	**−1.51**
25	**August 20, 1997**	**8021.23**	**103.13**	**1.30**	**October 16, 1997**	**7938.88**	**−119.10**	**−1.48**
26	October 20, 1987	1841.01	102.27	5.88	**July 5, 1996**	**5588.14**	**−114.88**	**−2.01**
27	**November 20, 1997**	**7826.61**	**101.87**	**1.32**	**November 24, 1997**	**7767.92**	**−113.15**	**−1.44**
28	**January 3, 1997**	**6544.09**	**101.60**	**1.58**	October 16, 1987	2246.74	−108.35	−4.60
29	**March 24, 1997**	**6905.25**	**100.46**	**1.48**	**November 7, 1997**	**7581.32**	**−101.92**	**−1.33**
30	**July 3, 1997**	**7895.81**	**100.43**	**1.29**	December 18, 1995	5075.21	−101.52	−1.96
31	**March 18, 1996**	**5683.60**	**98.63**	**1.77**	April 14, 1988	2005.64	−101.46	−4.82
32	**November 6, 1996**	**6177.71**	**96.53**	**1.59**	**August 12, 1997**	**7960.84**	**−101.27**	**−1.26**
33	**May 2, 1997**	**7071.20**	**94.72**	**1.36**	**December 31, 1996**	**6448.27**	**−101.10**	**−1.54**
34	**March 5, 1997**	**6945.85**	**93.13**	**1.36**	**December 12, 1996**	**6303.71**	**−98.81**	**−1.54**
35	**April 16, 1997**	**6679.87**	**92.71**	**1.41**	**January 10, 1996**	**5032.94**	**−97.19**	**−1.89**

Source: Author's calculations using data values of the Dow Jones Industrial Average.
Note: Days in 1996 and 1997 are shown in bold.

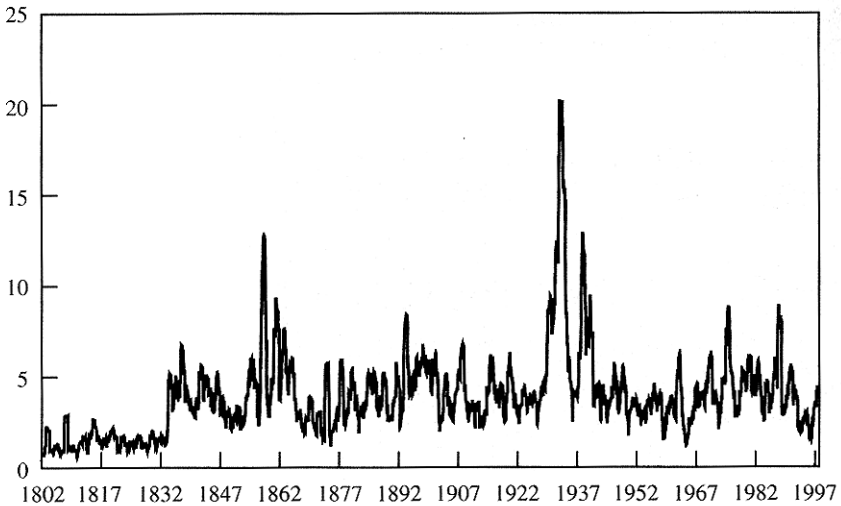
Table 2. Largest Daily Percentage Decreases and Increases in the Dow Jones Industrial Average, February 1885 to November 1997

	Largest percentage increases				*Largest percentage decreases*			
Rank	*Date*	*Dow Jones*	*Change*	*Percent change*	*Date*	*Dow Jones*	*Change*	*Percent change*
1	March 15, 1933	62.10	8.26	15.34	October 19, 1987	1738.74	−508.00	−22.61
2	October 6, 1931	99.34	12.86	14.87	October 28, 1929	260.64	−38.33	−12.82
3	October 30, 1929	258.47	28.40	12.34	October 29, 1929	230.07	−30.57	−11.73
4	September 21, 1932	75.16	7.67	11.36	November 6, 1929	232.13	−25.55	−9.92
5	October 21, 1987	2027.85	186.84	10.15	December 18, 1899	42.69	−4.08	−8.72
6	August 3, 1932	58.22	5.06	9.52	August 12, 1932	63.11	−5.79	−8.40
7	February 11, 1932	78.60	6.80	9.47	March 14, 1907	55.84	−5.05	−8.29
8	November 14, 1929	217.28	18.59	9.36	October 26, 1987	1793.93	−156.83	−8.04
9	December 18, 1931	80.69	6.90	9.35	July 21, 1933	88.71	−7.55	−7.84
10	February 13, 1932	85.82	7.22	9.19	October 18, 1937	125.73	−10.57	−7.75
11	May 6, 1932	59.01	4.91	9.08	February 1, 1917	88.52	−6.91	−7.24
12	April 19, 1933	68.31	5.66	9.03	**October 27, 1997**	**7161.15**	**−554.26**	**−7.18**
13	October 8, 1931	105.79	8.47	8.70	October 5, 1932	66.07	−5.09	−7.15
14	June 10, 1932	48.94	3.62	7.99	September 24, 1931	107.79	−8.20	−7.07
15	September 5, 1939	148.12	10.03	7.26	July 20, 1933	96.26	−7.32	−7.07
16	June 3, 1931	130.37	8.67	7.12	October 13, 1989	2569.26	−190.58	−6.91

17	January 6, 1932	76.31	5.07	7.12	July 30, 1914	52.32	−3.88	−6.90
18	October 14, 1932	63.84	4.08	6.83	January 8, 1988	1911.31	−140.58	−6.85
19	March 15, 1907	59.58	3.74	6.70	November 11, 1929	220.39	−16.14	−6.82
20	June 20, 1931	138.96	8.65	6.64	May 14, 1940	128.27	−9.36	−6.80
21	July 24, 1933	94.28	5.86	6.63	October 5, 1931	86.48	−6.29	−6.78
22	May 10, 1901	52.50	3.14	6.36	May 21, 1940	114.13	−8.30	−6.78
23	June 19, 1933	95.99	5.76	6.38	July 26, 1934	85.51	−6.06	−6.62
24	August 6, 1932	66.56	3.96	6.33	December 20, 1895	27.41	−1.94	−6.61
25	November 10, 1932	65.54	3.87	6.28	September 26, 1955	455.56	−31.89	−6.54
26	January 13, 1932	84.36	4.97	6.26	October 23, 1929	305.85	−20.66	−6.33
27	April 29, 1933	77.66	4.56	6.24	July 26, 1893	24.22	−1.63	−6.31
28	October 20, 1937	134.56	7.71	6.08	May 31, 1932	44.74	−2.96	−6.21
29	September 23, 1931	115.99	6.59	6.02	September 21, 1933	97.56	−6.43	−6.18
30	October 20, 1987	1841.01	102.27	5.88	December 14, 1904	48.18	−3.11	−6.06
31	October 31, 1929	273.51	15.04	5.82	May 9, 1901	49.36	−3.18	−6.05
32	April 20, 1933	72.27	3.96	5.80	December 12, 1929	243.14	−15.30	−5.92
33	October 25, 1937	134.43	7.28	5.73	November 19, 1937	118.13	−7.35	−5.86
34	May 2, 1898	35.60	1.90	5.65	November 23, 1932	59.47	−3.69	−5.84
35	August 2, 1893	26.77	1.42	5.62	June 16, 1930	230.05	−14.20	−5.81

Source: Author's calculations using data values of the Dow Jones Industrial Average.
Note: Days in 1996 and 1997 are shown in bold.

Figure 1. Standard Deviations of Monthly U.S. Stock Returns from Monthly Returns in the Year, 1803–1997



Source: Author's calculations using data values of indexes of New York Stock Exchange stock prices (see Schwert, 1990a) and he Center for Research in Securities Prices, University of Chicago Graduate School of Business, for monthly data after 1925.

ilarly, the 247-point drop in the DJIA on August 15, 1997 (a 3.11 percent decrease) would have had to be almost twice as large to make the bottom of the list of the thirty-five largest percent declines in the DJIA.

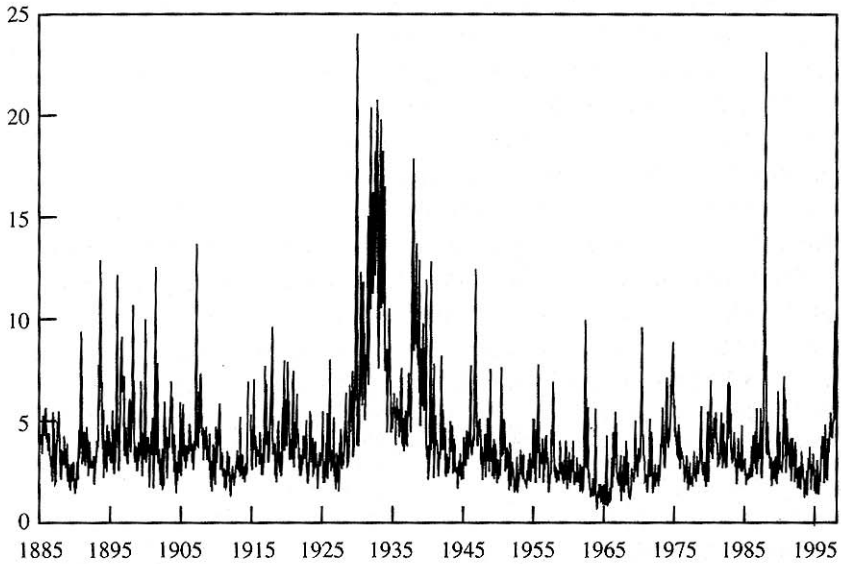
The appendix contains information about the largest absolute and percent daily changes in the S&P composite index from 1928 to 1997 (see tables A1 and A2). The data corroborate the conclusions reached from the DJIA in tables 1 and 2.[3]

Historical Evidence of Stock Volatility in the United States

The standard deviation of monthly returns to an index of NYSE-listed stocks from 1803 to 1997 is presented in figure 1. Each estimate uses the most recent twelve monthly returns to calculate the standard deviation. Stock return standard deviations are about 4 percent per month, which means that most monthly returns were between 8 percent

3. See Schwert (1990a) for a detailed discussion of the data.

Figure 2. Standard Deviation of Monthly U.S. Stock Returns from Daily Returns in the Month, 1885–1997



Source: Author's calculations using data values of indexes of New York Stock Exchange stock prices (see Schwert, 1990a) and the Center for Research in Securities Prices, University of Chicago Graduate School of Business, for daily data after 1962.

and −8 percent per month.[4] During the Great Depression, the standard deviation was around 10 percent per month, so most monthly returns were between 20 percent and −20 percent per month.

Comparing the plot in figure 1 with the extreme returns in table 2, the years with extreme returns also had high standard deviations, particularly the 1930s depression years. Furthermore, as evident from figure 1, the period since the 1987 crash has not had unusually high volatility.

The standard deviation of daily returns to an index of NYSE-listed stocks from 1885 to 1997 is presented in figure 2. Each month the daily returns are used to calculate the standard deviation for the month. Because returns are not highly correlated through time, the standard

4. If stock returns had a normal distribution, about one out of twenty returns would be more than 2 standard deviations away from the average return, which is less than 1 percent per month.

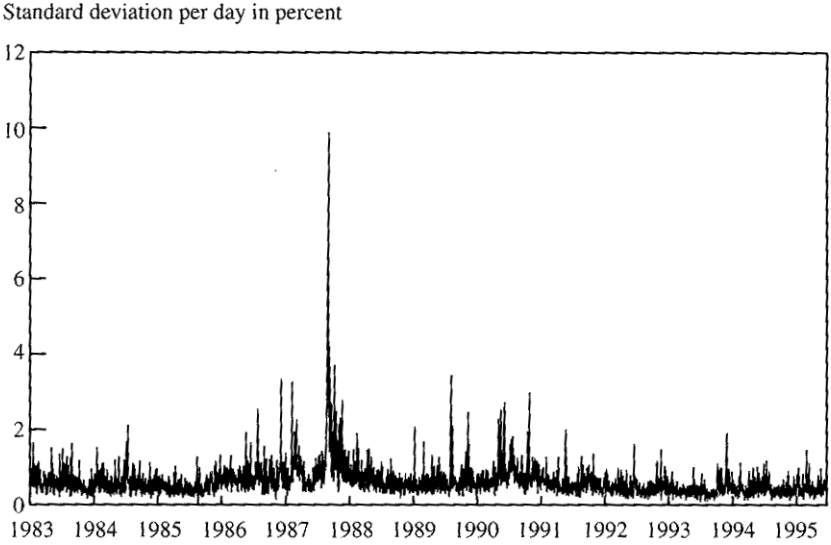
deviation of monthly returns is about equal to the standard deviation of daily returns times the square root of the number of trading days in the month. This transformation is used to create the plot in figure 2.

More than 1,350 standard deviation estimates are plotted in figure 2, each based on about twenty-one trading days per month. In contrast, figure 1 contains about 190 independent standard deviation estimates, each based on twelve months per year. Thus, figure 2 contains much more information about volatility. Months such as October 1929 and October 1987 show up more clearly in figure 2 because volatility was very high for brief periods. Otherwise, the results in figures 1 and 2 reinforce each other. The typical level of the monthly standard deviation is about 4 percent. Since the 1987 crash, with the exception of brief spurts in October 1989, August 1990, and October 1990, volatility has been low by historical standards. The standard deviation of the return to the S&P portfolio has been about 4.5 percent per month since March 1997, which is only about 1.1 times the long-run average. Only in October and November 1997 does the volatility plot in figure 2 rise above 6 percent per month.

The plot line in figure 3 represents the standard deviation of daily returns to the S&P 500 index from 1983 to 1995 based on the percent changes in the S&P index measured every fifteen minutes within the day. About twenty-five intraday returns are used to calculate each daily standard deviation. To measure the daily standard deviation, the fifteen-minute standard deviation is multiplied by the square root of the number of trading intervals (a procedure similar to that used in figure 2). The typical level of the daily standard deviation is about 0.6 percent (which corresponds to about 2.8 percent per month if there are twenty-one trading days per month).

Consistent with the evidence in figures 1 and 2, the intraday volatility of the S&P index was unusually low from mid-1991 though the end of 1995. Some have said that the long-term volatility evidence, such as figures 1 and 2, is interesting but misses the large intraday swings in stock prices that are frequently commented on in the business press. The data in figure 3 provide evidence that the intraday evidence is consistent with the interday and intermonth evidence that is available for longer periods. Mason S. Gerety and J. Harold Mulherin show that hourly data on the DJIA and on the composite of Dow Jones Industrial, Transportation, and Utility indexes from 1933 to 1989 behave much

Figure 3. Standard Deviation of Daily U.S. Stock Returns from 15-Minute Returns to the S&P 500 Index, 1983–95



Source: Author's calculations using data values of the S&P 500 index.
Note: S&P = Standard & Poor's.

the same as the daily and monthly series shown here.[5] In particular, the Great Depression period from 1933 to 1940 experienced large intraday percent changes in the DJIA, and volatility fell dramatically after that time. Thus, no evidence exists for the claim that the day-to-day, or even month-to-month, measures of volatility miss aspects of intraday volatility that are important to investors.

What has changed in recent years is not the existence of intraday volatility, but the speed with which it is communicated to large numbers of people. Computers, television, and other methods of information transfer have heightened the awareness of the public to stock market volatility, even if the behavior of volatility has not changed dramatically.

The historical stock return standard deviations in figures 1, 2, and 3 put October 1997 events in perspective by showing that the general level of stock return volatility has not risen. One issue that caused many

5. Gerety and Mulherin (1991).

debates following the 1987 crash was the role of options and futures markets in affecting volatility of stock returns.

An important source of information concerning the market's perception of stock market volatility is the volatility implied by the prices of call and put options traded on active markets, such as the S&P index contracts traded on the Chicago Board Options Exchange (CBOE). Because the volatility of the underlying asset is a key determinant of the value of an option contract, financial markets commonly inferred stock price volatility from option prices (hence the term *implied volatility*). In 1993, the CBOE began reporting the implied volatility of the stock market based on an average of S&P 100 index at-the-money put and call implied volatilities. This statistic is reported by the CBOE on a real-time basis under the ticker symbol VIX.[6]

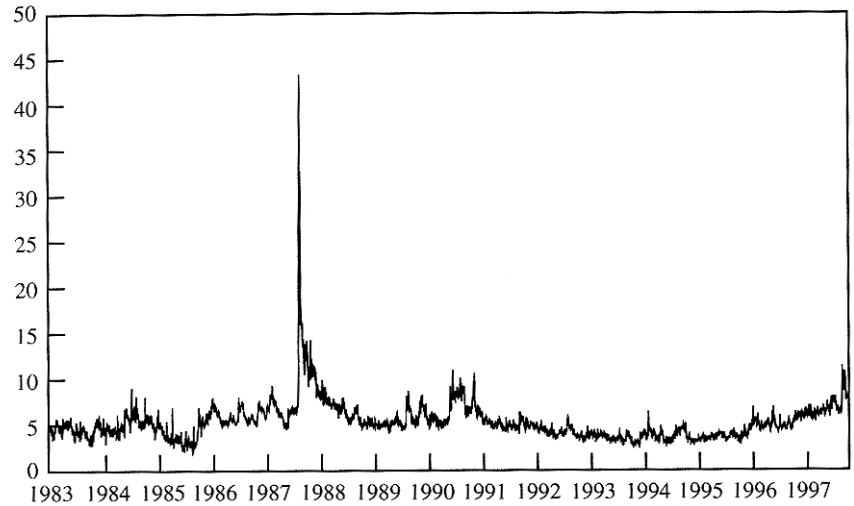
The implied standard deviation of monthly returns to the S&P index from 1983 to 1997 is presented in figure 4. The CBOE data are used for 1986–97. Before 1986, data from Goldman Sachs and from Theodore E. Day and Craig M. Lewis are used.[7] While implied volatility seems to have risen slightly since mid-1986, it does not seem unusually high compared with the entire 1983–97 experience. Moreover, the rise in volatility in October and November 1997 is less dramatic than shown in figure 2.

What do these plots of standard deviations of returns reveal? They show that volatility measured using the standard deviation of rates of return has been stable since the mid-nineteenth century in the United States. The major exception is the Great Depression period from 1929 to 1939. Moreover, they show that the high levels of volatility following Black Monday, October 19, 1987, were extremely short-lived. Since the 1987 crash, the volatility of U.S. stock market returns has been low by historical standards. Even the 1997 increase in the volatility of returns seems modest when compared with the normal behavior seen for the last 150 years. The volatility of returns likely will return to lower levels following the recent 1997 minicrash, as happened in 1987. These conclusions are not sensitive to whether volatility is measured

6. I am grateful to Robert Whaley, who developed this statistic for the Chicago Board Options Exchange (CBOE), for providing these data. See Fleming, Ostdiek, and Whaley (1995) for more information about this statistic.

7. Day and Lewis (1988, 1992).

Figure 4. Standard Deviation of Monthly U.S. Stock Returns Implied by Daily CBOE Call Options on the S&P 500 Index, 1983–97



Source: Author's calculations using data provided by Goldman Sachs and Day and Lewis (1988, 1992) for years 1983–85 and Robert Whaley, Chicago Board Options Exchange, for years 1986–97.
Note: CBOE = Chicago Board Options Exchange; S&P = Standard & Poor's.

from monthly returns, daily returns, fifteen-minute returns, or the volatility implied by prices of traded options on stock indexes.

Economic Causes of Changing Stock Return Volatility

Much research has been conducted on the question of whether trading in options or futures contracts increases the volatility of stock returns. The so-called triple witching days, when options, futures, and options on futures linked to stock indexes all expire, are often claimed to be associated with unusual volatility of price changes (even stories in the *Wall Street Journal* during 1997 repeat traders' concerns about this problem).

Frankin R. Edwards shows that stock return volatility has not been higher on average since the advent of trading of futures and options

(his sample ends before October 1987).[8] His results are similar to the conclusions one would draw from inspection of figures 1 through 4. Edwards does find that the volatility of stock returns was higher on average for futures' expiration days than for nonexpiration days from 1983 to 1986, particularly in the last hour of trading. Likewise, Hans R. Stoll and Robert E. Whaley find that for futures' expiration days from 1983 to 1985, during the last hour of trading, share volume and volatility were higher.[9] Prices had a tendency to fall at the end of the day and reverse at the opening of trading on the next day. Stoll and Whaley draw an analogy with block trades, where volume and volatility are temporarily high and followed by small price reversals. They argue that the effects of expiration of futures contracts are small and confined to brief periods of time. These effects reflect the costs of providing liquidity to futures traders.

In a follow-up study, Stoll and Whaley find that the change in expiration date settlement practices that occurred in June 1987 had a minimal impact on expiration day volatility.[10] They conclude that expiration effects are economically small and "the market appears to have adjusted reasonably well to expirations of index futures and options."

In my analysis of daily volatility measures since 1983, I find no reliable evidence of an increase in volatility on the days when futures and options expire. While a few expiration days occurred in the early and mid-1980s when volatility was temporarily high, no systematic pattern emerges of higher volatility associated with expiration of futures and options contracts. No noteworthy results came from the statistical analysis.

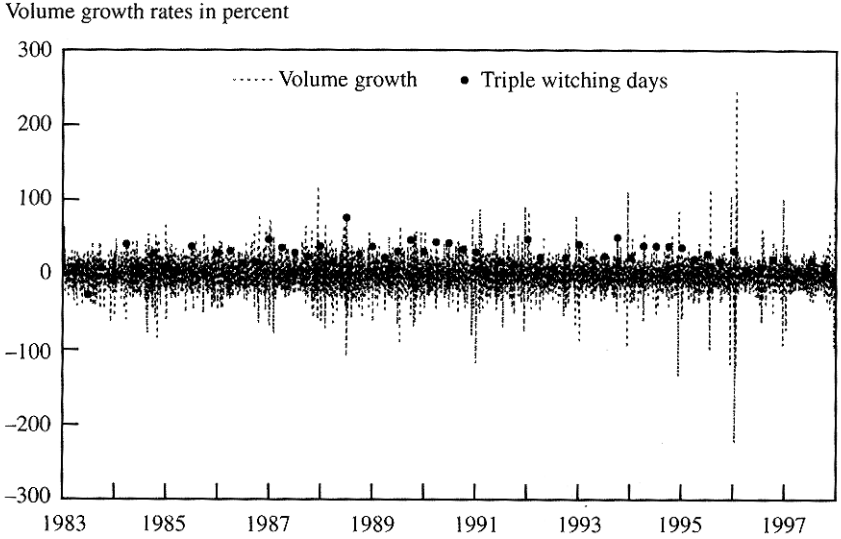
While triple witching days generally do not exhibit higher volatility, strong evidence exists that the volume of trading is higher on expiration days, as traders unwind their hedged trades. The data in figure 5 present the daily growth rates of NYSE share trading volume from 1983 to 1997

8. Edwards (1988a, 1988b).

9. Stoll and Whaley (1987).

10. In June 1987, the NYSE, Chicago Mercantile Exchange (CME), and the New York Futures Exchange (NYFE) changed the settlement of their index-linked contracts to the open of trading on the third Friday of the expiration month, so the last day of trading in the underlying stocks is Thursday. Also, the CBOE created a separate Standard & Poor's (S&P) 500 contract that expires at the open. Other index-linked futures and option contracts continue to settle at the close of Friday trading. See Stoll and Whaley (1991); quoted matter is on p. 70.

Figure 5. Effects of Triple Witching Days on Daily NYSE Volume Growth Rates, 1983–97



Source: Author's calculations using data values of NYSE share trading volume.
Note: NYSE = New York Stock Exchange.

(the dashed line), along with the triple witching expiration days (the solid dots). Volume clearly is unusually high on expiration days. This corroborates earlier findings by Stoll and Whaley, and others, that trading related to hedges between stock, options, and futures markets increases trading volume on the stock market.[11]

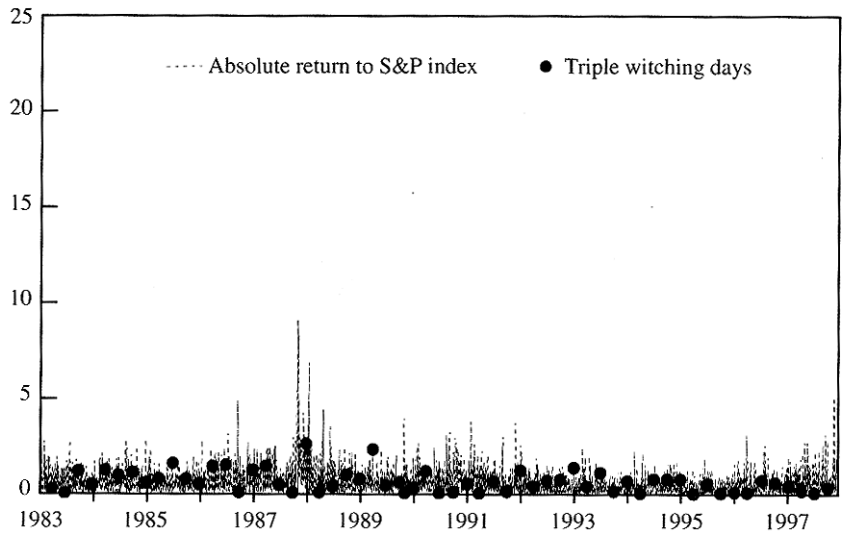
The information in figure 6, the absolute daily percent changes to the S&P index from 1983 to 1997, is presented in the same format as figure 5, with the triple witching days denoted by solid dots. Volatility (as measured by the absolute percent change) is not unusually high on expiration days, even though volume is unusually high.

Circuit Breakers, Collars, and Other Trading Halts

The NYSE and the futures exchanges began a variety of trading halts triggered by price changes (circuit breakers) after the October 1987

11. Stoll and Whaley (1987, 1991).

Figure 6. Absolute Returns to the S&P 500 Index and Triple Witching Days, 1983–97



Source: Author's calculations using data values of the S&P 500 index.
Note: S&P = Standard & Poor's.

crash. These measures were recommended by the Brady Commission to head off future crashes.[12] Some analysts believe that these circuit breakers substantially reduce the likelihood of a recurrence of large short-term percent changes in market prices.[13]

The rules used to automatically limit trading that are triggered by movements in the DJIA (or the S&P index) are summarized in table 3. One of the unusual aspects of the circuit breaker rules is that they are written in terms of absolute changes in the level of market indexes, such as a 50-point, a 100-point, a 250-point, a 350-point, a 400-point, or a 550-point change in the DJIA. The information in table 3 shows the equivalent size of the percent change in the DJIA at the time the rules were adopted in 1990, and when some of the rules were revised in early 1997. Thinking about absolute changes in stock indexes makes no sense, because the levels of the indexes change dramatically over

12. Presidential Task Force on Market Mechanisms (1988).

13. For example, Greg Ip, "The 1987 Market Peak and Crash—Ten Years After: Safeguards Make Crisis Less Likely," *Wall Street Journal*, August 25, 1997, p. C1.

Table 3. Circuit Breakers and Collars That Affect Trading on the NYSE and Futures Markets

Rule	*Triggering event*	*Description*	*Equivalent percent change in DJIA when adopted*	*Frequency of implementation*[a]
Introduced in 1990				
50-Point collar	DJIA is up or down 50 points from prior close	Limits puts on program-aided index arbitrage trades; stays in effect until the DJIA is within 25 points of prior close or the session ends	2	20 times in 1991 16 times in 1992 9 times in 1993 30 times in 1994 29 times in 1995 119 times in 1996 303 times in 1997
100-Point sidecar	S&P 500 futures contract is down 12 points from prior close	Program trading is halted on the NYSE	4	2 times in 1991 1 time in 1992 1 time in 1994 1 time in 1995 11 times in 1996 37 times in 1997
250-Point circuit breaker	DJIA is down 250 points from prior close	Trading halts on the NYSE for 60 minutes; trading of S&P 500 futures contract halts on CME	10	Never
400-Point circuit breaker	DJIA is down 400 points from prior close	Trading halts on the NYSE for 120 minutes; trading of S&P 500 futures contract halts on CME	16	Never
Effective February 1997				
350-Point circuit breaker	DJIA is down 350 points from prior close	Trading halts on the NYSE for 30 minutes; trading of S&P 500 futures contract halts on CME	5.2	Once (10/27/97)
550-Point circuit breaker	DJIA is down 550 points from prior close	Trading halts on the NYSE for 60 minutes; trading of S&P 500 futures contract halts on CME	8.1	Once (10/27/97)

Source: New York Stock Exchange amended rules 80A and 80B.
Note: NYSE = New York Stock Exchange; DJIA = Dow Jones Industrial Average; S&P = Standard & Poor's; CME = Chicago Mercantile Exchange.
a. Frequency of implementation numbers are from the NYSE webite—glossary of financial terms: circuit breakers [http://www.nyse.com/public/glossary/glsc06.htm].

time. In partial recognition of this fact, in February 1997 the Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC) approved changes in the largest circuit breaker rules to increase the triggering limits for trading halts to 350 and 550 points from 250 and 400 points. Nevertheless, in percentage terms the new limits are half as large as the original limits at the time they were adopted.

Both of the circuit breakers were triggered on the afternoon of October 27, 1997. The DJIA, the S&P 500 index, and the CBOE Market Volatility Index at five-minute intervals from noon on Monday, October 27 through about 4 p.m. on Tuesday, October 28 are presented in figure 7. Stock prices sped up their decline as they approached the trigger limits for the circuit breakers. Moreover, prices continued to decline for about the first half hour of trading on Tuesday before they rebounded dramatically. During and after the trading halts, volatility was much higher than before.

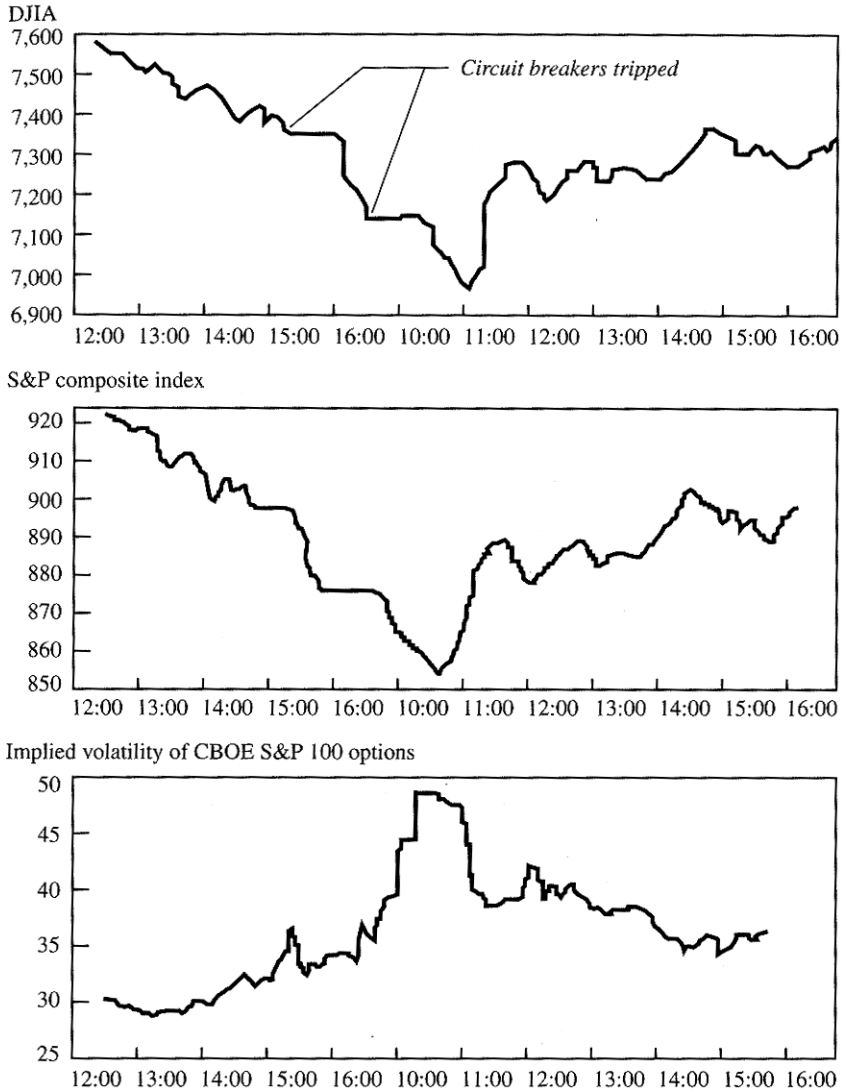
Before the October 27 minicrash, I posited that a 5 percent drop in the DJIA during a day is not an unknown event (as shown in table 2), so it is likely only a matter of time until this trigger is pulled. The response of the exchanges and regulators following the October 27 trading halts thus is illuminating.

On the evening of October 27, officials of both the NYSE and the options and futures markets as well as the original proponent of circuit breakers—Nicholas F. Brady—were quoted as saying that the circuit breakers worked just as they had been designed to do. Critics pointed out that traders may have tended to rush sell orders into the market to assure execution if they feared that a trading halt was imminent, but proponents of circuit breakers argued that the price drop might have been worse without the cooling-off period.

After the sharp rebound of stock prices on Tuesday morning, many people began to question whether the severity of the price drop on Monday was exacerbated because of the halt. Even Robert Glauber, who helped write the Brady Commission report that recommended circuit breakers, said the breaks were not needed: "We intended them to be triggered very infrequently and only when the market is operating in a disorganized way."[14]

14. Patrick McGeehan and Michael Schroeder, "The Market Bounceback: Big Board to Re-evaluate Rules on Circuit Breakers," *Wall Street Journal*, October 29, 1997, p. C17.

Figure 7. Intraday Movements in the DJIA, S&P 500, and the CBOE Market Volatility Indexes, October 27 and 28, 1997



Source: Fidelity Investment website [http:personal12.fidelity.com/news/indexes] provides intraday charts for these indexes. The graphics here were obtained October 28,1997.

Note: DJIA = Dow Jones Industrial Average; S&P = Standard & Poor's; CBOE = Chicago Board Options Exchange.

By mid-November, NYSE and SEC officials had begun discussing possible changes in circuit breakers. A consensus seems to have emerged that the trigger points for the circuit breakers are too low. I find it amazing, however, that officials such as Frank Zarb, chairman of the National Association of Securities Dealers, and Richard Lindsey, the SEC director of the division of market regulation, could argue that trigger points based on percentages would be too confusing for investors. As a result, the proposals discussed by the NYSE as of early December 1997 involve resetting circuit breaker trigger points at levels of approximately 10 percent and 20 percent of the DJIA, reset in absolute terms once per year. Thus, if this system had been in place during 1997, the trigger points would have been 772 and 1,544 points, instead of 350 and 500 points, respectively.

The collar and sidecar rules that limit the ability to simultaneously trade stocks and futures electronically were not amended until February 1998. This creates a situation where the 50-point collar is reached on most days, and the 100-point sidecar has been reached often in 1997. The constituency for these rules seems to be the NYSE, because it raises the costs of trading in alternative markets, such as the futures exchanges.

The important question is whether the circuit breakers decrease or increase volatility. If investors tend to panic and overreact, the notion of stopping trading so information can become widely disseminated and processed by securities markets would reduce volatility. This is the story often told by the proponents of circuit breakers. Because on some days the market has rebounded after a sharp fall in prices—such as October 30, 1929, and October 21, 1987 (see table 2)—the fall on the previous days may have been too large. However, on as many days, price decreases continue, such as October 29, 1929. In other words, no systematic tendency exists for prices to fall too far and then bounce back the next trading day.

If investors value the ability to transact quickly, however, prohibition of trading reduces the perceived and actual liquidity of securities markets and could increase volatility. It may also have the effect of lowering the prices of the securities that now have less liquidity.

If some investors value liquidity highly, and they fear that a trading halt will occur because they see prices starting to approach known limits, they will hurry to sell now to assure their ability to trade. Such behavior would speed up price declines and could lead to overreaction.

It could lead to increased volatility. This description fits the facts of October 27–28 well, although drawing too many conclusions from a single observation is risky.

Trade and Budget Deficits

At the time of the 1987 crash, the macroeconomic consequences of the large and growing trade and budget deficits in the United States were the focus of much concern. Apparently, the fear was that continuing large deficits would cause the value of U.S. securities to fall.

Foreign trade accounting requires that a merchandise deficit must be offset by a capital flow surplus; that is, more capital entering the United States than is leaving. Lowering the trade deficit is equivalent to lowering the capital surplus. Perhaps changes in the rate of capital inflows could affect investors' perceptions of the value of U.S. stocks. Unfortunately, this argument cannot explain why stock prices fell around the world by similar amounts in October 1987. Presumably if unexpected changes in the trade deficit (or capital surplus) were bad news for one country, they would be good news for its trading partners.

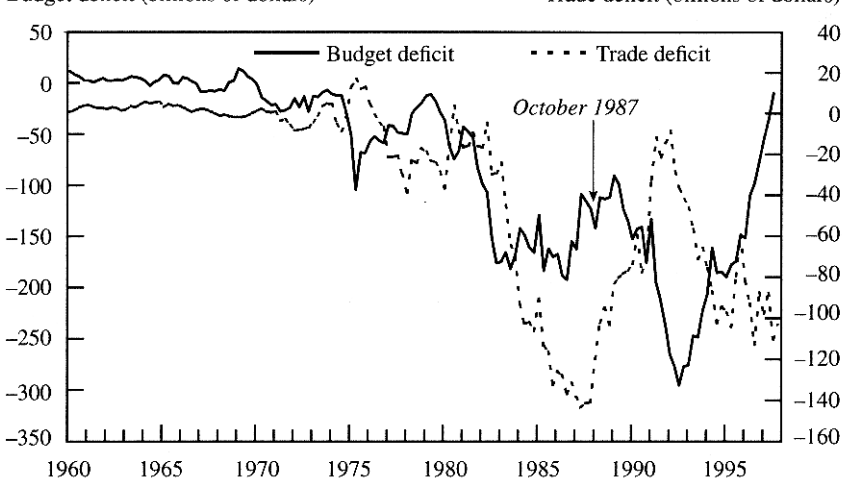
The quarterly seasonally adjusted U.S. budget (solid line) and trade (dashed line) deficits from 1960 to 1997 are displayed in figure 8. While the budget and trade deficits have grown and fluctuated since the mid-1970s, the third quarter of 1987 does not stand out as a dramatic episode in the history of these statistics. In particular, the budget deficit was relatively stable from 1983 to 1987, so it is hard to imagine what new information about budget deficits could have contributed to the 1987 stock market crash. Moreover, these deficits have grown larger and remained highly volatile since the October 1987 crash, while stock market volatility has been unusually low.

Stock Market Valuation

The data in figure 9 show the earnings yield (E/P) and the dividend yield (D/P) for the S&P composite index from 1926 to 1997. Both ratios fell during 1987 as stock prices rose faster than earnings or dividends, so by the end of September they were lower than they had been since the early 1970s. Because of the October 1987 crash, the E/P and D/P ratios returned to December 1986 levels.

Is it obvious, even with hindsight, that stock prices were too high in

Figure 8. U.S. Budget and Trade Deficits, 1960–97



Source: Budget deficit: Department of Commerce, Bureau of Economic Analysis, *National Income and Products Accounts*, various years, table 3.2. Trade deficit: Department of Commerce, Bureau of Economic Analysis, *National Income and Products Accounts*, various years, table 1.1.

Note: Quarterly data, seasonably adjusted.

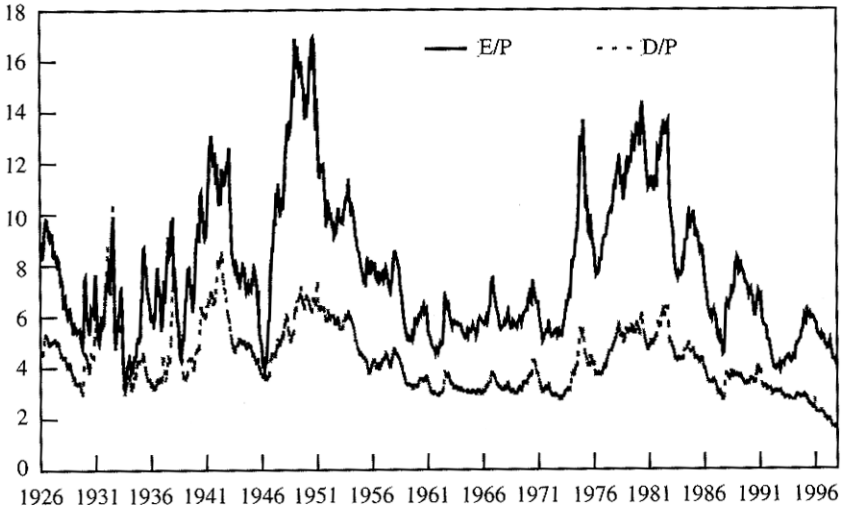
September 1987? On the one hand, as demonstrated by the information in figure 9, these ratios were approaching historically low levels. Similar behavior occurred before the October 1929 crash. On the other hand, similar earnings and dividend yields had been seen between 1960 and 1972. Moreover, since January 1992 the dividend yield on the S&P index has remained below its lowest level in 1987 and since April 1995 the earnings yield on the S&P index has been below its lowest level for 1987. These indicators have caused some market analysts to express concern that stock prices may be too high (so that another crash might lurk in the future), but a large percentage drop in stock prices has not yet been realized.

Thus, while evidence is available that stock prices reached high values compared with earnings or dividends in September 1987, similar levels of earnings or dividend yields before or since 1987 have not led to crashes. Harold Bierman analyzes stock market valuation before the October 1929 stock market crash and argues that that crash was not foreseeable.[15]

15. Bierman (1991).

Figure 9. Earnings Yield (E/P) and Dividend Yield (D/P) for the S&P Composite Portfolio, 1926–97

Annual earnings or dividend yield in percent



Source: Author's calculations using data values of the S&P composite index.
Note: S&P = Standard & Poor's.

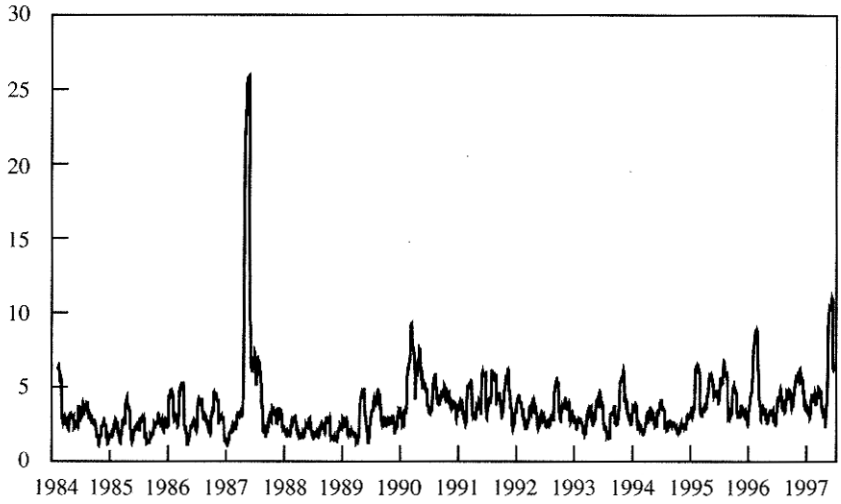
Stock Return Volatility in Other Markets and Countries

Many of the explanations for the 1987 stock market crash and the volatility associated with it are peculiar to financial institutions in the United States, and some to the New York Stock Exchange in particular. Mark L. Mitchell and Jeffry M. Netter argue that tax legislation introduced in Congress in the week before October 19, 1987, contributed to the crash.[16] Others have debated the effect of computerized trading linking stock, options, and futures markets, sometimes called index arbitrage or portfolio insurance, on the 1987 crash.[17] Finally, debate is heard over the effects of margin regulations that limit the amount of

16. Mitchell and Netter (1989).

17. For example, Amihud and Mendelson (1989); Amihud, Mendelson, and Wood (1990); Blume, MacKinlay, and Terker (1989); Furbush (1989); Grossman (1988); Harris (1989a, 1989b); Jacklin, Kleidon, and Pfleiderer (1992); Kleidon (1992); Kleidon and Whaley (1992); Rubinstein (1988); and Tosini (1988).

Figure 10. Standard Deviation of Monthly NASDAQ Stock Returns from Daily Returns in the Month to the NASDAQ Composite Index, 1984–97



Source: Author's calculations using data values of the NASDAQ composite index.
Note: NASDAQ = National Association of Securities Dealers Automated Quotations.

leverage investors can use to purchase stocks.[18] As noted by Richard Roll, the important fact that the 1987 crash was simultaneous and similar around the world challenges all of the explanations that are idiosyncratic to a specific country, even a country as large as the United States.[19]

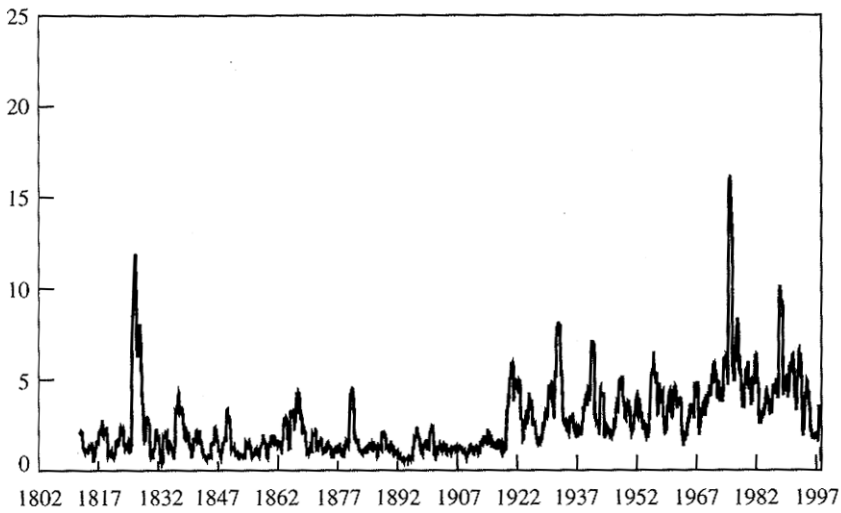
The following sections describe the time-series behavior of stock market volatility, both before and since the 1987 crash. I use monthly and daily stock return data from the NASDAQ market and from major markets in the United Kingdom, Germany, Japan, Australia, and Canada for this analysis.

Estimates of the monthly standard deviation of returns to the NASDAQ composite index based on daily returns for the prior month from 1984 to 1997 are presented in figure 10. Many complaints were lodged against the NASDAQ market during the 1987 crash because the com-

18. For example, Hardouvelis (1988, 1990); Hsieh and Miller (1990); Kupiec (1989, 1993); Kupiec and Sharpe (1991); Salinger (1989); Schwert (1989a, 1989b); and Seguin and Jarrell (1993).

19. Roll (1988, 1989).

Figure 11. Standard Deviations of Monthly United Kingdom Stock Returns from Monthly Returns in the Year, 1811–1997

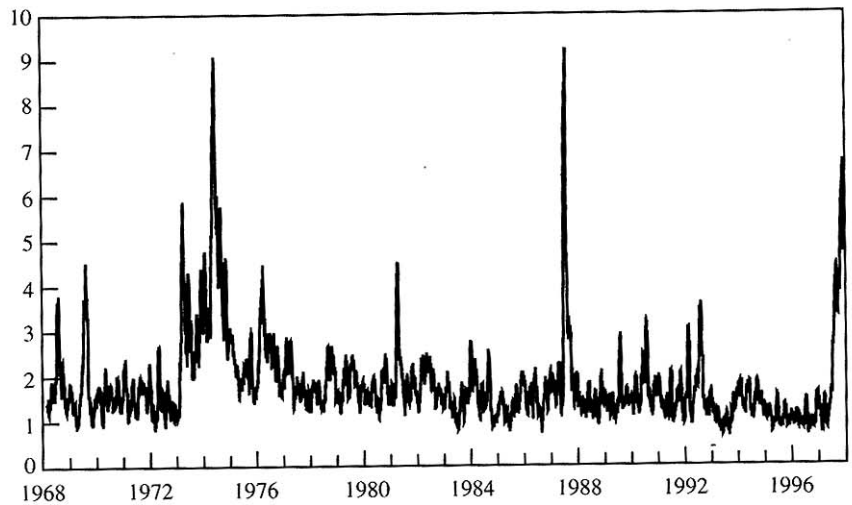


Source: Author's calculations using data values of several indexes of U.K. stocks.

munication and trading systems of NASDAQ dealers were unable to cope with the burst in volume. As a result, several reforms were introduced in the early 1990s, including the implementation of an electronic trading system for small orders. NASDAQ volatility returned to normal or below normal levels soon after the 1987 crash. In mid-1990, at about the time that some of the major NASDAQ reforms were implemented, NASDAQ volatility rose noticeably. Given that NYSE volatility did not rise at this time, questions are raised about whether the NASDAQ reforms contributed to the higher volatility of the NASDAQ index. Nevertheless, compared with late 1987, NASDAQ volatility has been very low.

The data in figure 11 show estimates of the monthly standard deviation of returns to a portfolio of United Kingdom stocks based on monthly returns for the prior year from 1811 to 1997. The U.K. monthly stock return series splices several different indexes to span this long period. Volatility returned to normal levels quickly after the 1987 crash. It has been relatively low in the last couple of years. The 1973–75

Figure 12. Standard Deviations of Monthly U.K. Stock Returns from Daily Returns in the Month to the FTSE All-Share Index, 1968–97



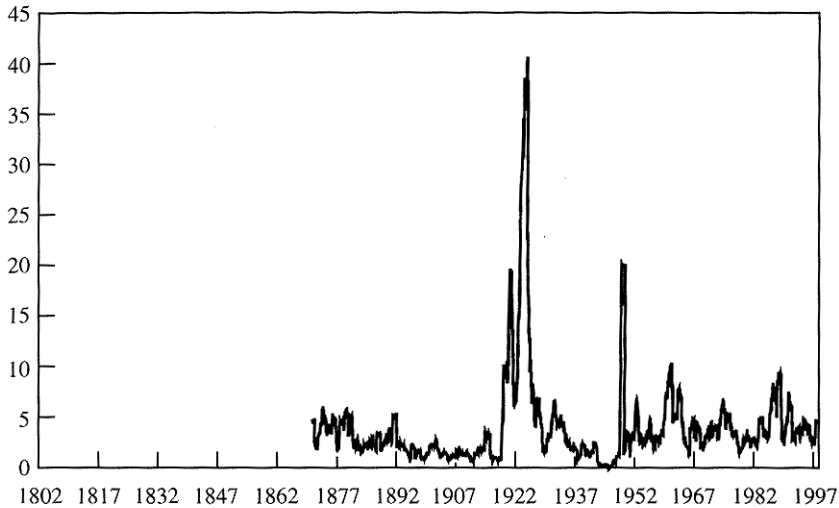
Source: Author's calculations using data values of the FTSE All-Share Index.
Note: FTSE = Financial Times Stock Exchange.

Organization of Petroleum Exporting Countries (OPEC) crisis had a much larger affect on the volatility of U.K. stocks included in figure 11 than on U.S. stocks, although the effect is noticeable in figure 1.

Estimates of the monthly standard deviation of returns to the Financial Times Stock Exchange (FTSE) All-Share Index based on daily returns for the prior month from 1968 to 1997 are displayed in figure 12. While volatility has increased in late 1997 compared with recent levels, it is low compared with the United States and low compared with the 1973–75 period of the first OPEC oil crisis. FTSE volatility fell back to normal levels by early 1988 and has been very low until the last few months.

The data in figure 13 are estimates of the monthly standard deviation of returns to a portfolio of German stocks based on monthly returns for the prior year from 1871 to 1997. The German monthly stock return series splices several different indexes to span this long period. The periods during and after World Wars I and II were dramatic for the

Figure 13. Standard Deviation of Monthly German Stock Returns from Monthly Returns in the Year, 1871–1997



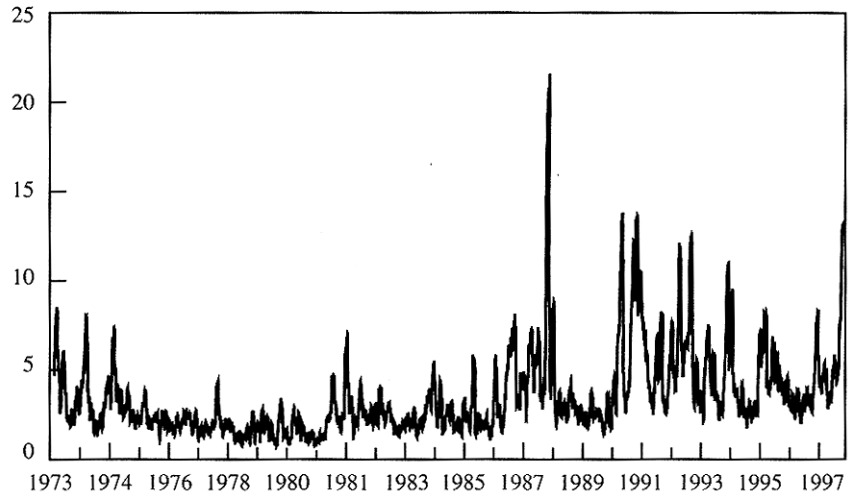
Source: Author's calculations using data values of several indexes of German stocks.

volatility of German stocks. Volatility has not been abnormally high in Germany since the 1987 crash.

Estimates of the monthly standard deviation of returns to the Tokyo Stock Price Index (TOPIX) 100 of Japanese stocks based on daily returns for the prior month from 1973 to 1997 are displayed in figure 14. As with other countries, stock volatility returned to precrash levels quickly after the 1987 crash. However, the subsequent crash in the Japanese stock market in early 1990, which did not occur in the other major countries discussed here, has also been associated with increased volatility.

Figure 15 contains estimates of the monthly standard deviation of returns to a portfolio of Australian stocks based on monthly returns for the prior year from 1875 to 1997. The Australian monthly stock return series splices several different indexes to span this long period. The 1987 crash was associated with the largest spike in volatility in this figure. Other episodes of high volatility are associated with the first year of stock trading in 1875–76, the Great Depression in the 1930s, and the OPEC oil crisis in 1973–75. As with the other countries, Aus-

Figure 14. Standard Deviation of Monthly Japanese Stock Returns from Daily Returns to the TOPIX 100 in the Month, 1973–97



Source: Author's calculations using data values of the TOPIX 100.
Note: TOPIX = Tokyo Stock Price Index.

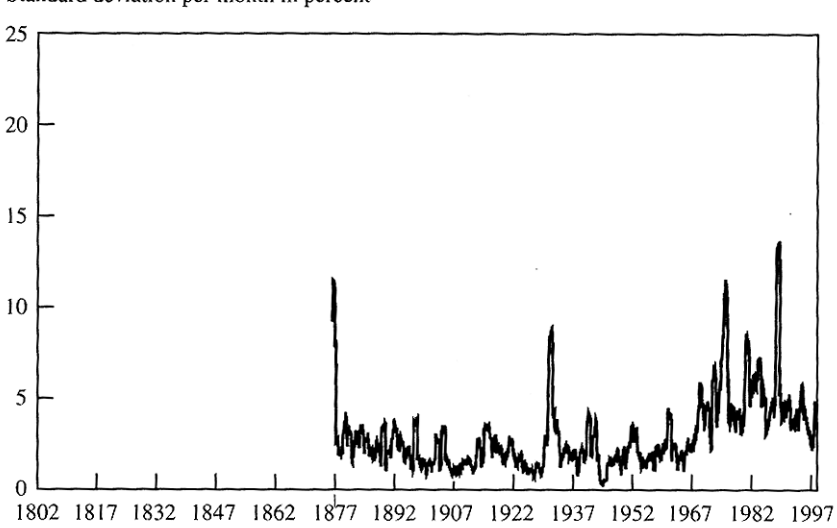
tralian stock volatility returned to normal levels following the 1987 crash and has been relatively low since.

The data in figure 16 show estimates of the monthly standard deviation of returns to a portfolio of Canadian stocks based on monthly returns for the prior year from 1918 to 1997. The Canadian monthly stock return series splices several different indexes to span this long period. The 1987 crash was associated with an increase in volatility to levels similar to the Great Depression in the 1930s and the OPEC oil crisis of 1973–75. Canada also experienced episodes of high stock volatility in 1980 and 1982. As with the other countries, Canadian stock volatility fell after the 1987 crash and has been low since.

Summary

The volatility associated with the 1987 crash was brief and transitory. Most cases of rising volatility are associated with substantial and some-

Figure 15. Standard Deviation of Monthly Australian Stock Returns from Monthly Returns in the Year, 1875–1997



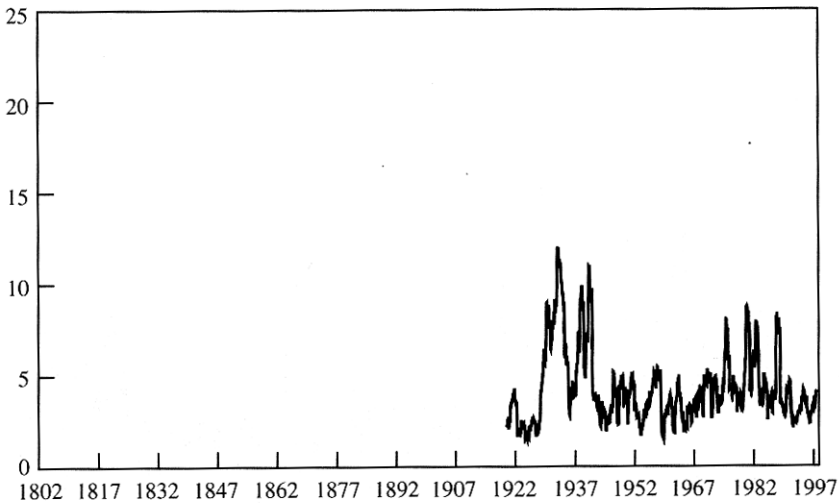
Source: Author's calculations using data values of several indexes of Australian stocks.

times prolonged declines in stock prices and with disruptions in the underlying economy (for example, recessions, depressions, or oil crises). The 1987 crash was unusual because none of these disruptions in the real economy accompanied it.

Since 1987, volatility has been relatively low and stable, with the exception of Japan, which experienced a substantial decline in stock values and high stock return volatility in the early 1990s. The recent episode of volatility that culminated in the October 27, 1997, minicrash is similar to the October 1987 crash in that it does not seem to foreshadow a disruption of the real economy. Nevertheless, the drop in prices in 1997 was only about a third as large as the drop in 1987.

Investors, regulators, brokers, dealers, and the press are all concerned with stock volatility. A large part of the problem is a perception that prices move demonstrably simply because the level of stock indexes, such as the Dow Jones Industrial Average, is historically high. While many of the largest one-day changes in the DJIA have occurred

Figure 16. Standard Deviation of Monthly Canadian Stock Returns from Monthly Returns in the Year, 1918–97



Source: Author's calculations using data values of several indexes of Canadian stocks.

since 1995, only one of the largest stock returns (percent changes in prices) has occurred in the 1990s.

One of the consequences of the 1987 crash is the legacy of rules and regulations that were promulgated to prevent a recurrence of this event. For example, circuit breakers, collars, and sidecars are rules triggered by absolute changes in the DJIA that restrict or inhibit computerized trading. They raise the costs of hedging across stock, options, and futures markets. Because these rules have not been updated adequately to reflect the increase in the level of stock indexes, they have become more restrictive over time.

The minicrash of October 1997 triggered circuit breakers for the first time. I believe a consensus is quickly forming, even among many people who originally advocated circuit breakers, that the trigger points are too low. Some are even arguing that trigger points that are defined as a percentage of the level of the index would be useful, so that changes in the index level do not change the sensitivity of the mechanism. Finally, I think more people now believe that the existence of trigger

points can speed up price declines as traders rush to execute orders before a circuit breaker is tripped.

Some of the macroeconomic and financial factors that investors linked to concerns about the stock market in 1987, such as the level of U.S. budget and trade deficits or the low levels of earnings and dividend yields, have not improved substantially since the 1987 crash. Press discussion has been heard of the high level of stock prices in 1997, compared with earnings or dividends. These statistics are a very unreliable indicator of impending stock market crashes; they would predict fifty out of the last two crashes.

Probably the biggest change that has occurred in recent years is the ease with which the general public learns about the intraday movements of stock market prices. Cable television, the Internet, and other forms of low-cost and high-speed communication provide much more information about stock volatility than has been available in the past. Thus, public perceptions of volatility are heightened, even if volatility itself is not unusually high.

APPENDIX

Table A1. Largest Daily Decreases and Increases in the Standard & Poor's Composite Index, 1928–97

	Largest increases				*Largest decreases*			
Rank	*Date*	*S&P*	*Change*	*Percent change*	*Date*	*S&P*	*Change*	*Percent change*
1	**October 28, 1997**	**921.85**	**44.86**	**5.12**	**October 27, 1997**	**876.99**	**−64.65**	**−6.87**
2	**September 2, 1997**	**927.58**	**28.11**	**3.13**	October 19, 1987	224.97	−57.73	−20.42
3	**September 16, 1997**	**945.64**	**25.87**	**2.81**	**August 15, 1997**	**900.81**	**−23.96**	**−2.59**
4	**November 3, 1997**	**938.99**	**24.37**	**2.66**	October 13, 1989	333.65	−21.74	−6.12
5	October 21, 1987	258.38	21.55	9.10	**April 11, 1997**	**737.65**	**−20.69**	**−2.73**
6	**April 29, 1997**	**794.05**	**21.09**	**2.73**	October 26, 1987	227.67	−20.55	−8.28
7	**July 22, 1997**	**933.98**	**21.04**	**2.30**	**March 8, 1996**	**633.50**	**−20.15**	**−3.08**
8	**December 1, 1997**	**974.77**	**19.37**	**2.03**	**June 23, 1997**	**878.62**	**−20.08**	**−2.23**
9	**November 17, 1997**	**946.20**	**17.85**	**1.92**	**November 12, 1997**	**905.96**	**−17.82**	**−1.93**
10	**June 24, 1997**	**896.34**	**17.72**	**2.02**	**October 23, 1997**	**950.69**	**−17.80**	**−1.84**
11	**May 5, 1997**	**830.24**	**17.27**	**2.12**	January 8, 1988	243.40	−17.67	−6.77
12	**June 6, 1997**	**858.01**	**14.58**	**1.73**	**August 8, 1997**	**933.54**	**−17.65**	**−1.86**
13	**May 2, 1997**	**812.97**	**14.44**	**1.81**	**March 31, 1997**	**757.12**	**−16.76**	**−2.17**
14	**November 20, 1997**	**958.98**	**14.39**	**1.52**	**March 27, 1997**	**773.88**	**−16.62**	**−2.10**
15	**April 22, 1997**	**774.61**	**14.24**	**1.87**	**November 24, 1997**	**946.67**	**−16.42**	**−1.70**
16	**December 19, 1996**	**745.76**	**14.22**	**1.94**	**July 15, 1996**	**629.80**	**−16.39**	**−2.54**

17	**June 12, 1997**	**883.48**	**13.91**	**1.60**	**July 18, 1997**	**915.30**	**−16.13**	**−1.75**
18	**August 19, 1997**	**926.01**	**13.52**	**1.48**	**October 30, 1997**	**903.68**	**−15.48**	**−1.68**
19	**August 20, 1997**	**939.35**	**13.34**	**1.44**	October 16, 1987	282.70	−15.38	−5.16
20	**February 12, 1997**	**802.77**	**13.18**	**1.67**	**July 5, 1996**	**657.44**	**−14.96**	**−2.22**
21	**July 2, 1997**	**904.03**	**13.00**	**1.46**	**March 13, 1997**	**789.56**	**−14.70**	**−1.83**
22	**July 3, 1997**	**916.92**	**12.89**	**1.43**	**September 10, 1997**	**919.03**	**−14.59**	**−1.56**
23	**May 12, 1997**	**837.66**	**12.88**	**1.56**	November 15, 1991	382.62	−14.53	−3.66
24	**August 2, 1996**	**662.49**	**12.47**	**1.92**	**December 31, 1996**	**740.74**	**−13.11**	**−1.74**
25	October 20, 1987	236.83	11.86	5.27	**May 7, 1997**	**815.62**	**−12.14**	**−1.47**
26	January 17, 1991	327.97	11.80	3.73	**May 16, 1997**	**829.75**	**−12.13**	**−1.44**
27	**November 14, 1997**	**928.35**	**11.69**	**1.28**	September 11, 1986	235.16	−11.90	−4.82
28	**August 18, 1997**	**912.49**	**11.68**	**1.30**	April 14, 1988	259.75	−11.80	−4.35
29	**January 30, 1997**	**784.17**	**11.67**	**1.51**	**April 8, 1996**	**644.24**	**−11.62**	**−1.77**
30	October 29, 1987	244.77	11.49	4.93	**December 12, 1996**	**729.33**	**−11.40**	**−1.54**
31	**May 23, 1997**	**847.03**	**11.37**	**1.36**	**July 9, 1997**	**907.54**	**−11.21**	**−1.22**
32	**September 12, 1997**	**923.91**	**11.32**	**1.24**	**May 2, 1996**	**643.38**	**−11.20**	**−1.71**
33	**March 18, 1996**	**652.65**	**11.22**	**1.75**	**October 17, 1997**	**944.16**	**−11.07**	**−1.16**
34	August 21, 1991	390.59	11.16	2.94	**February 5, 1997**	**778.28**	**−10.98**	**−1.39**
35	**March 5, 1997**	**801.99**	**11.04**	**1.40**	**January 10, 1996**	**598.48**	**−10.97**	**−1.80**

Source: Author's calculations using data values of the S&P composite index.
Note: Days in 1996 and 1997 are shown in bold. S&P = Standard & Poor's.

Table A2. Largest Daily Percentage Decreases and Increases in the Standard & Poor's Composite Index, 1928–97

	Largest percentage increases				*Largest percentage decreases*			
Rank	*Date*	*S&P*	*Change*	*Percent change*	*Date*	*S&P*	*Change*	*Percent change*
1	March 15, 1933	6.81	0.97	16.61	October 19, 1987	224.97	−57.73	−20.42
2	October 30, 1929	22.99	2.56	12.53	October 28, 1929	22.74	−3.20	−12.34
3	October 6, 1931	9.91	1.09	12.36	October 29, 1929	20.43	−2.31	−10.16
4	September 21, 1932	8.52	0.90	11.81	November 6, 1929	20.61	−2.27	−9.92
5	September 5, 1939	12.64	1.11	9.63	October 18, 1937	10.76	−1.10	−9.27
6	April 20, 1933	7.82	0.68	9.52	July 20, 1933	10.57	−1.03	−8.88
7	October 21, 1987	258.38	21.55	9.10	July 21, 1933	9.65	−0.92	−8.70
8	November 14, 1929	19.24	1.58	8.95	October 26, 1987	227.67	−20.55	−8.28
9	August 3, 1932	6.39	0.52	8.86	October 5, 1932	7.39	−0.66	−8.20
10	October 8, 1931	10.62	0.84	8.59	August 12, 1932	7.00	−0.61	−8.02
11	February 13, 1932	8.80	0.68	8.37	May 31, 1932	4.47	−0.38	−7.84
12	December 18, 1931	8.36	0.64	8.29	July 26, 1934	8.36	−0.71	−7.83
13	February 11, 1932	8.12	0.62	8.27	May 14, 1940	10.28	−0.83	−7.47
14	July 24, 1933	10.50	0.79	8.14	September 24, 1931	10.68	−0.84	−7.29
15	June 10, 1932	4.92	0.35	7.66	September 12, 1932	8.15	−0.63	−7.18
16	June 3. 1931	13.12	0.92	7.54	June 15, 1933	9.74	−0.73	−6.97

17	November 10, 1932	7.44	0.52	7.51	**October 27, 1997**	**876.99**	**−64.65**	**−6.87**
18	October 20, 1937	11.93	0.83	7.48	October 16, 1933	9.21	−0.67	−6.78
19	June 19, 1933	10.68	0.72	7.23	January 8, 1988	243.40	−17.67	−6.77
20	May 6, 1932	6.09	0.41	7.22	September 3, 1946	15.53	−1.12	−6.73
21	April 19, 1933	7.14	0.48	7.21	May 28, 1962	55.50	−3.97	−6.68
22	August 15, 1932	7.44	0.50	7.20	May 21, 1940	9.14	−0.65	−6.64
23	October 11, 1932	6.88	0.46	7.17	September 26, 1955	42.61	−3.02	−6.62
24	January 6, 1932	8.08	0.53	7.02	November 11, 1929	19.86	−1.32	−6.23
25	October 14, 1932	7.13	0.46	6.90	September 21, 1933	10.03	−0.66	−6.17
26	April 9, 1938	10.27	0.65	6.76	October 13, 1989	333.65	−21.74	−6.12
27	June 4, 1932	5.22	0.33	6.75	October 23, 1929	26.60	−1.67	−5.91
28	September 23, 1931	11.52	0.72	6.67	October 5, 1931	8.82	−0.55	−5.87
29	October 4, 1933	10.29	0.62	6.41	May 13, 1940	11.11	−0.69	−5.85
30	October 25, 1937	12.00	0.72	6.38	March 29, 1938	8.73	−0.54	−5.83
31	April 29, 1933	8.32	0.49	6.26	November 19, 1937	10.51	−0.65	−5.82
32	August 6, 1932	7.22	0.42	6.18	June 8, 1932	4.57	−0.28	−5.77
33	November 4, 1932	6.88	0.40	6.17	September 14, 1932	7.35	−0.45	−5.77
34	June 20, 1931	14.02	0.80	6.05	September 13, 1938	11.37	−0.69	−5.72
35	August 22, 1932	8.00	0.44	5.82	November 13, 1929	17.66	−1.07	−5.71

Source: Author's calculations using data values of the S&P composite index.
Note: Days in 1996 and 1997 are shown in bold. S&P = Standard & Poor's.

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