STOCK MARKET VOLATILITY: TEN YEARS AFTER THE CRASH

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ABSTRACT

Stock volatility has been unusually low since the 1987 stock market crash. The large increase in stock prices since 1987 means that many days during 1996 and 1997 experienced near record changes in the Dow Jones Industrial Average, even though the volatility of stock returns has not been high by historical standards. I compare volatility of returns to U.S. stock indexes at monthly, daily, and intraday intervals, and I also show the volatility of returns to stock indexes implied by traded options contracts. Finally, I compare the volatility of U.S. stock market returns with the volatility of returns to stock markets in the United Kingdom, Germany, Japan, Australia, and Canada. All of the evidence leads to the conclusion that volatility has been very low in the decade since the 1987 crash. The mini-crash of October 27, 1997 reinforces the need to reevaluate the current system of circuit breakers so that they are triggered less easily. Part of the problem is caused by trigger points that are expressed as absolute, rather than percentage, changes in market indexes.

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1. Introduction

The stock market crash of October 19, 1987 attracted an immense amount of interest in the topic of stock market volatility. At the time, by a fluke of luck, I had already started research on the causes and consequences of volatility in U.S. stock markets. As a result, I published several papers in the years following the crash that have been cited many times in the academic literature (many of my papers on this topic, along with a sampling of the vast literature on this topic, are included in the references at the end of this paper). In the Fall of 1989, I was asked by the New York Stock Exchange (NYSE) to prepare a report summarizing the historical evidence concerning the volatility of the stock market in the United States, and a revised version of that paper was published in the *Financial Analysts Journal* [Schwert (1990)]. Last Spring I was invited to write a follow-up paper updating the historical evidence on volatility for the Brookings-Wharton Conference commemorating the 1987 Crash, and here it is.

Recent events in the stock market have renewed interest in stock market volatility. 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. Section 2 shows that this problem of "scale illusion" remains a serious impediment to public understanding of stock market volatility. In fact, even the large changes in stock indexes that have occurred since Spring 1997 are relatively small in ***percentage*** terms. While the volatility of stock market returns has increased slightly in the last year, it remains low by historical standards. Even the mini-crash of October 27, 1997, which was the largest absolute decline in the DJIA, was only the twelfth largest percentage decline.

Section 3 reviews many of the issues that 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 there is no evidence 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 remained at similar levels since that time. Also, I show the behavior of the earnings and dividend yields to the Standard & Poor's (S&P) composite index as indicators of the valuation of the stock market. There is nothing in the time series behavior of these data that makes the October 1987 crash stand out as a notable event.

Section 4 includes data on the historical behavior of stock volatility from other markets and countries, such as the Nasdaq market and the markets of the United Kingdom, Germany, Japan, Australia, and Canada. These countries and markets do not share all of the institutional and environmental factors that affect the NYSE. The evidence shows that most of these markets have been unusually quiet in the years since the 1987 crash. Section 5 contains brief concluding remarks.

2. Volatility: Large Percentage Changes in Prices

2.1. Have recent market movements been unusually large?

Volatility should be measured in percentage changes in prices, or *rates of return.*[1] If you invest $1,000 today in a portfolio of common stocks, the rate of return tells you the proportional change in the value of your investment at the end of the period. A 10% rate of return would mean an increase in value of $100 whether the DJIA was at 100, 1000, or 10,000. On the other hand, 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.

[1] 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.

Several times in the past I have suggested that 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.

Table 1 shows the largest and smallest 35 daily changes in the DJIA between February 1885 and November 1997. The approximately 550 point mini-crash that occurred two days before this Brookings Conference, October 27, 1997, was the largest one-day change in the DJIA out of more than 31,000 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 shows 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 35 largest increases in the DJIA have occurred in 1996-97 (shown in **bold** in Table 1). Similarly, 27 of the 35 largest decreases in the DJIA have happened in 1996-97. None of large changes in Table 1 dates before the 1987 crash. This is probably the starkest illustration of the problem of scale illusion that could be imagined. By this criterion, we are living in the midst of an incredibly chaotic period in stock market history.

In contrast, Table 2 shows the largest and smallest 35 daily percent changes in the DJIA between February 1885 and November 1997. The October 27, 1997 mini-crash is the only day on this list from the 1990s, as the twelfth largest percentage decline in the DJIA. In fact, the largest increase in the DJIA in Table 1 (which was a 4.71% increase) would have had to be almost one percent larger to make the bottom of the list of the top 35 daily percent changes. Similarly, the 247 point drop in the DJIA on August 15, 1997 (a 3.11% decrease) would have had to be almost twice as large to make the bottom of the list of the 35 largest percent declines in the DJIA.

The appendix contains Tables A1 and A2 that contain information about the largest absolute and

percent daily changes in the S&P composite index from 1928-97. The evidence in those tables corroborates the conclusions reached from the DJIA in Tables 1 and 2.

2.2. Historical evidence on stock volatility in the United States: Estimates from monthly returns

Figure 1 shows the standard deviation of monthly returns to an index of NYSE-listed stocks from 1803-1997. Each estimate uses the most recent 12 monthly returns to calculate the standard deviation. This plot shows that stock return standard deviations are about 4% per month. This means that most monthly returns were between 8% and –8% per month.[2] During the Great Depression, the standard deviation was around 10% per month, so most monthly returns were between 20% and -20% per month.

Comparing the plot in figure 1 with the extreme returns in table 2, it is easy to see that years with extreme returns also had high standard deviations, particularly the 1930s Depression years. It is also clear from Figure 1 that the period since the 1987 crash has not had unusually high volatility.

2.3. Historical evidence on stock volatility in the United States: Estimates from daily returns

Figure 2 shows the standard deviation of daily returns to an index of NYSE-listed stocks from 1885-1997. Each month the daily returns are used to calculate the standard deviation for the month. Since returns are not highly correlated through time, the standard 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.

There are over 1,350 standard deviation estimates in Figure 2, each based on about 21 trading days per month. In contrast, Figure 1 contains about 190 independent standard deviation estimates each based on 12 months per year. Thus, Figure 2 contains much more information about volatility. It is also clear that

[2] If stock returns had a normal distribution, about 1 out of 20 returns would be more than two standard deviations away from the average return, which is less than 1 percent per month.

months like 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%. 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% 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% per month.

2.4. *Historical evidence on stock volatility in the United States: Estimates from intraday returns to the S&P 500 index*

Figure 3 shows the standard deviation of daily returns to the S&P 500 index from 1983-95 based on the percent changes in the S&P index measured every 15 minutes within the day. There are about 25 intraday returns used to calculate each daily standard deviation. To measure the daily standard deviation, the 15-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% (which corresponds to about 2.8% per month if there are 21 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. I have sometimes had people tell me that the long-term volatility evidence, like 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 evidence in Figure 3 confirms my suspicion that the intraday evidence is quite consistent with the interday and intermonth evidence that is available for longer periods. Gerety and Mulherin (1991) show that hourly data on the DJIA and on the composite of Dow Jones Industrial, Transportation, and Utility indexes from 1933-89 behaves much the same as the daily and monthly series shown here. In particular, the Depression period from 1933-40 experienced large intraday percent changes in the DJIA, and that volatility fell dramatically after that time.

Thus, I think there is no evidence for the claim that the day-to-day, or even month-to-month measures of volatility miss important aspects of intraday volatility that is 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 recent events in perspective by showing that the general level of stock return volatility has not risen. One issue that caused many debates following the 1987 crash was the role of options and futures markets in affecting volatility of stock returns. Section 3 addresses this question more fully, but first I want to use the data from options markets to extend the evidence on the recent behavior of volatility.

2.5. *Historical evidence on stock volatility in the United States: Estimates from daily prices of call and put options on the S&P index*

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). Since the volatility of the underlying asset is a key determinant of the value of an option contract, it has become common practice in financial markets to infer 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. I am grateful to Robert Whaley, who developed this statistic for the CBOE, for providing these data (see Fleming, Ostdiek, and Whaley (1995) for more information about this statistic).

Figure 4 shows the implied standard deviation of monthly returns to the S&P index from 1983-97.

The CBOE data are used for 1986-97. Before 1986, I use data from Goldman Sachs and from Day and Lewis (1988, 1992). While implied volatility seems to have risen slightly since mid-1986 in Figure 4, 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.

2.6. Summary of the historical evidence on stock volatility in the United States

What do these plots of standard deviations of returns tell us? They show that volatility measured using the standard deviation of rates of return has been stable since the mid-19th century in the United States. The major exception is the Great Depression period from 1929-39. Moreover, they show that the high levels of volatility following Black Monday, October 19, 1987, were extremely short-lived. Since the 1987 crash, volatility of U.S. stock market returns has been low by historical standards. Even the recent increase in the volatility of returns seems modest when compared with the normal behavior seen for the last 150 years. It is likely that the volatility of returns will return to lower levels following the recent 1997 mini-crash, as happened in 1987. These conclusions are not sensitive to whether volatility is measured from monthly returns, daily returns, 15 minute returns, or from the volatility implied by prices of traded options on stock indexes.

3. Economic Causes of Changing Stock Return Volatility

3.1. Does trading in index-linked derivatives affect volatility?

There has been much research 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 prices changes (even recent stories in the *Wall Street Journal* often repeat traders' concerns about this problem).

Edwards (1988a, 1988b) 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). 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 non-expiration days from 1983-86, particularly in the last hour of trading. Likewise, Stoll and Whaley (1987) find that for futures' expiration days from 1983-85, during the last hour of trading, share volume and volatility were higher. There was a tendency for prices to fall at the end of the day and reverse the fall at the opening of trading on the next day. They draw an analogy with block trades, where volume and volatility are temporarily high and followed by small price reversals. In effect, they argue that the effects of expiration of futures contracts are small and confined to brief periods of time. They reflect the costs of providing liquidity to futures traders.

In a follow-up study, Stoll and Whaley (1991) find that the change in expiration date settlement practices that occurred in June 1987 had a minimal impact on expiration day volatility.[3] They conclude (p. 70) that expiration effects are economically small and "the market appears to have adjusted reasonably well to expirations of index futures and options."

In my own 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 there were a few expiration days in the early and mid-1980s when volatility was temporarily high, there is no systematic pattern of higher volatility associated with expiration of futures and options contracts. I do not show the details of the statistical analysis because there are no "interesting" results.

While there is little evidence that triple witching days have higher volatility, there is strong evidence that the volume of trading is higher on expiration days, as traders unwind their hedged trades.

[3] In June 1997, 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 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.

Figure 5 shows the daily growth rates of NYSE share trading volume from 1983-97 (the dashed line), along with the triple witching expiration days (the solid dots). It is clear from this graph that volume is unusually high on expiration days. This corroborates earlier findings by Stoll and Whaley (1987, 1991), and others, that trading related to hedges between stock, options, and futures markets increases trading volume on the stock market.

Figure 6 shows the absolute daily percent changes to the S&P index from 1983-97 in the same format as Figure 5, with the triple witching days denoted by solid dots. This figure confirms the conclusion that volatility (as measured by the absolute percent change) is not unusually high on expiration days, even though volume is unusually high.

3.2. 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 crash. These measures were recommended by the Brady Commission [Presidential Task Force (1988)] to head off future crashes. Some analysts believe that these circuit breakers substantially reduce the likelihood of a recurrence of large short-term percent changes in market prices (e.g., Greg Ip, "Safeguards on the Market Make a Crisis Less Likely," ***Wall Street Journal***, August 25, 1997).

Table 3 shows the rules used to automatically limit trading that are triggered by movements in the DJIA (or the S&P index). 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. 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. As I argue above, it does not make sense to think about absolute changes in stock indexes, because the levels of the indexes change dramatically over time. In partial recognition of this fact, in February 1997 the SEC and the 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. Figure 7 shows the DJIA, the S&P 500 index, and the Chicago Board Options Exchange (CBOE) Market Volatility Index at 5-minute intervals from noon on Monday October 27 through about 4 PM on Tuesday October 28. What is clear from this graph is that 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.

In the first draft of this paper, before the October 27 mini-crash, I argued that "a 5% 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 is illuminating.

On the evening of October 27, officials of both the NYSE and the options and futures markets, and the original proponent of circuit breakers, Nicholas Brady, were quoted as saying that the circuit breakers worked just as they had been designed to do. Critics pointed out that there may have been a tendency for traders 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 (1988) that recommended circuit breakers, said the breaks weren't needed: "We intended them to be triggered very infrequently and only when the market is operating in a disorganized way (Wall Street Journal, October 29, 1997)."

By mid-November, NYSE and Securities and Exchange Commission (S.E.C.) 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 (as I argued in the first draft of this paper). I find it amazing, however, that officials such as Frank Zarb, chairman of the National Association of Securities Dealers, and Richard Lindsey, the S.E.C.'s 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 being discussed by the NYSE as of early December 1997 involve resetting circuit breaker trigger points at levels of approximately 10% and 20% 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 645 and 1,290 points, rather than 350 and 500 points.

The "collar" and "sidecar" rules that limit the ability to simultaneously trade stocks and futures electronically have not been amended. 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, since it raises the costs of trading in alternative markets, such as the futures exchanges.

Of course, 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. Since there have been some days where 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. On the other hand, there are as many examples of days where prices decreases continue, such as October 29, 1929. In other words, there is no systematic tendency for prices to fall too far, and therefore 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 are 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 over-reaction. It could lead to increased volatility. This description fits the facts of October 27-28 quite well, although it is risky to draw too many conclusions from a single observation.

3.3. Budget and trade deficits

At the time of the 1987 crash, there was much concern about the macroeconomic consequences of the large and growing budget and trade deficits in the United States. Apparently, there was fear 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 U.S. 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, it would be good news for its trading partners.

There was also concern about the U.S. budget deficit around the time of the 1987 crash. Figure 8 shows the quarterly seasonally adjusted U.S. budget (solid line) and trade (dashed line) deficits from 1960-97. While the budget and trade deficits have grown and fluctuated since the mid-1970s, the third quarter of 1987 does not stand out in Figure 8 as a dramatic episode in the history of these statistics. In particular, the budget deficit was relatively stable from 1983-87, 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, as shown in the prior figures.

3.4. Stock market valuation

Figure 9 shows the earnings yield (E/P) and the dividend yield (D/P) for the S&P composite index from 1926-97. 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 their levels at the end of 1986.

Is it obvious, even with hindsight, that stock prices were too high in September 1987? As shown 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 1960-72. Moreover, since January 1992 the earnings yield on the S&P index has remained below its lowest level in 1987 and since April 1995 the dividend 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 there has not been a large percentage drop in stock prices yet.

Thus, while there is evidence 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. Bierman (1991) provides an interesting analysis of stock market valuation before the October 1929 stock market crash that argues that crash was not foreseeable.

4. 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. Mitchell and Netter (1989) argue that tax legislation introduced in Congress in the week before October 19, 1987, contributed to the crash. 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 [including Amihud and Mendelson (1989), Amihud, Mendelson, and Wood (1990), Blume, MacKinlay, and Terker (1989), Furbush (1989), Grossman (1988), Harris (1989a,b), Jacklin, Kleidon, and Pfleiderer (1992), Kleidon (1992), Kleidon and Whaley (1992), Rubinstein (1988), and Tosini (1988).] Finally, there has been debate about the effects of margin regulations that limit the amount of leverage investors can use to purchase stocks [including Hardouvelis (1988, 1990), Hsieh and Miller (1989), Kupiec (1989, 1993), Kupiec and Sharpe (1991), Salinger (1989), Schwert (1989a,c), and Seguin and Jarrell (1993).] As noted by Roll (1988, 1989), 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 U.S.

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.

4.1 Nasdaq. stock return volatility

Figure 10 shows estimates of the monthly standard deviation of returns to the Nasdaq composite index based on daily returns for the prior month from 1984-97. There were many complaints about the Nasdaq market during the 1987 crash because the communication 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. Interestingly, 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. Since NYSE volatility did not rise at this time, this raises interesting questions 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.

4.2 U.K. stock return volatility

Figure 11 shows estimates of the monthly standard deviation of returns to a portfolio of United Kingdom stocks based on monthly returns for the prior year from 1811-1997. The U.K. monthly stock return series splices several different indexes to span this long period. This figure shows that volatility returned to normal levels quickly after the 1987 crash. It has been relatively low in the last couple of years. The 1973-75 OPEC crisis had a much larger affect on the volatility of U.K. stocks in Figure 10 than on U.S. stocks, although the effect is noticeable in Figure 1.

Figure 12 shows estimates of the monthly standard deviation of returns to the Financial Times All Shares index (FTSE) based on daily returns for the prior month from 1968-97. While volatility has increased in late 1997 compared with recent levels, it is low compared with the U.S., and low compared with the 1973-75 period of the first OPEC oil crisis. FTSE volatility fell back to normal levels after the 1987 crash by early 1988 and has been very low until the last few months.

4.3 German stock return volatility

Figure 13 shows estimates of the monthly standard deviation of returns to a portfolio of German stocks based on monthly returns for the prior year from 1871-1997. The German monthly stock return series splices several different indexes to span this long period. Of course, the periods during and after World Wars I and II were dramatic for the volatility of German stocks. Volatility has not been abnormally high in Germany since the 1987 crash.

4.4 Japanese stock return volatility

Figure 14 shows estimates of the monthly standard deviation of returns to the TOPIX-100 value-weighted index of Japanese stocks based on daily returns for the prior month from 1973-97. As with other countries, stock volatility returned to pre-crash levels quickly after the 1987 crash. However, the subsequent crash in the Japanese stock market in early 1990, that did not occur in the other major countries discussed in this paper, has also been associated with increased volatility.

4.5 Australian stock return volatility

Figure 15 shows estimates of the monthly standard deviation of returns to a portfolio of Australian stocks based on monthly returns for the prior year from 1875-1997. 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, Australian stock volatility returned to normal levels following the 1987 crash and has been relatively low since.

4.6 Canadian stock return volatility

Figure 16 shows estimates of the monthly standard deviation of returns to a portfolio of Canadian stocks based on monthly returns for the prior year from 1918-97. 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.

5. Summary

Looking across the volatility graphs in Figures 1-4 and 10-16, I conclude that the volatility associated with the 1987 crash was brief and transitory. Most other cases where volatility has risen to high levels are associated with substantial and sometimes prolonged declines in stock prices and with disruptions in the underlying economy (e.g., 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 17, 1997 mini-crash is similar to the October 1987 crash in that it does not seem to foreshadow a disruption of the real economy. Nevertheless, it is important to note that 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 a lot simply because the level of stock indexes like the Dow Jones Industrial Average is historically high. While many of the largest one-day changes in the DJIA have occurred in the last two years, only one of the largest stock returns (percent changes in prices) have 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. Since 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 mini-crash of October 1997 triggered circuit breakers for the first time. I believe a consensus is quickly forming, even among many of the people who originally advocated circuit breakers, that the trigger points are too low. There is even some agreement that a 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 there is more belief 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 changed much since the 1987 crash. Indeed, there has been much press discussion 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 50 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.

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Table 1

Largest Daily Decreases and Increases
in the Dow Jones Industrial Average, 1885-97

	Largest Increases				Largest Decreases			
Rank	Date	Dow Jones	Change	% Change	Date	Dow Jones	Change	% 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%**

Note: Days in 1996 or 1997 are shown in bold.

Table 2

Largest Daily *Percentage* Decreases and Increases in the Dow Jones Industrial Average, 1885-97

	Largest Percentage Increases				Largest Percentage Decreases			
Rank	Date	Dow Jones	Change	% Change	Date	Dow Jones	Change	% 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%

Note: Days in 1996 or 1997 are shown in bold.

Table 3

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

Circuit Breakers	Triggering Event	Circuit Breakers	Equivalent % Change in DJIA When Adopted	Frequency of Implementation*
		Rules introduced in 1990		
50 point collar	DJIA is up or down 50 points from prior close	Limits put on program-aided index arbitrage trades. Stays in effect until the DJIA is within 25 points of prior close or the session ends.	2%	50 times in 1991 38 times in 1992 29 times in 1993 75 times in 1994 126 times in 1995 234 times in 1996 232 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 1993 2 times in 1994 2 times in 1995 21 times in 1996 72 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
		New circuit breaker rules 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)

*Calculations based on the daily high, low, and closing values of the DJIA. Data through December 1, 1997.

Appendix

Supplementary Tables

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	% Change	Date	S&P	Change	% 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**	**-16.31**	**-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%**

Note: Days in 1996 or 1997 are shown in bold.

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	% Change	Date	S&P	Change	% 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%

Note: Days in 1996 or 1997 are shown in bold.

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

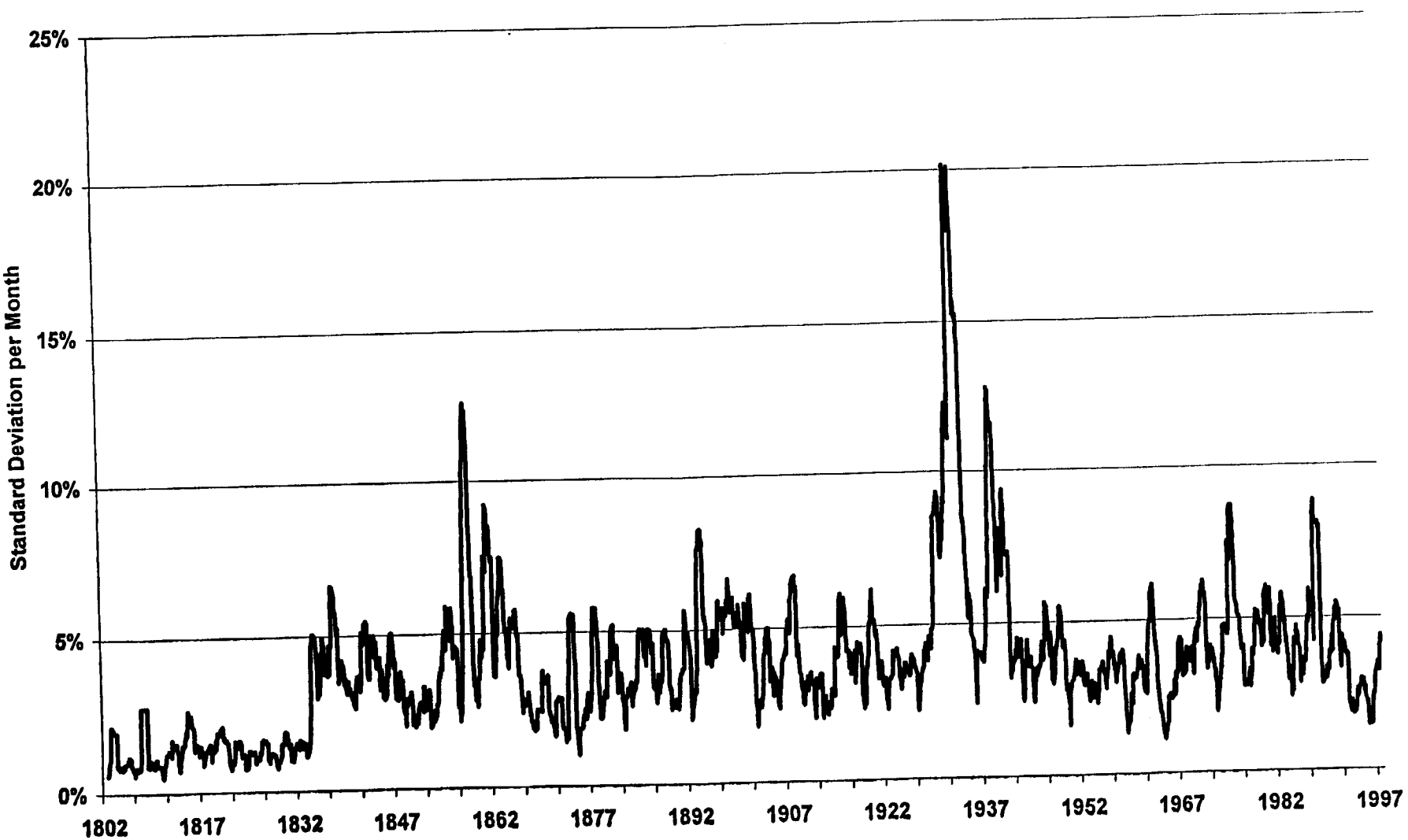

Fig. 2. Standard Deviation of Monthly U.S. Stock Returns from Daily Returns in the Month, 1885-1997

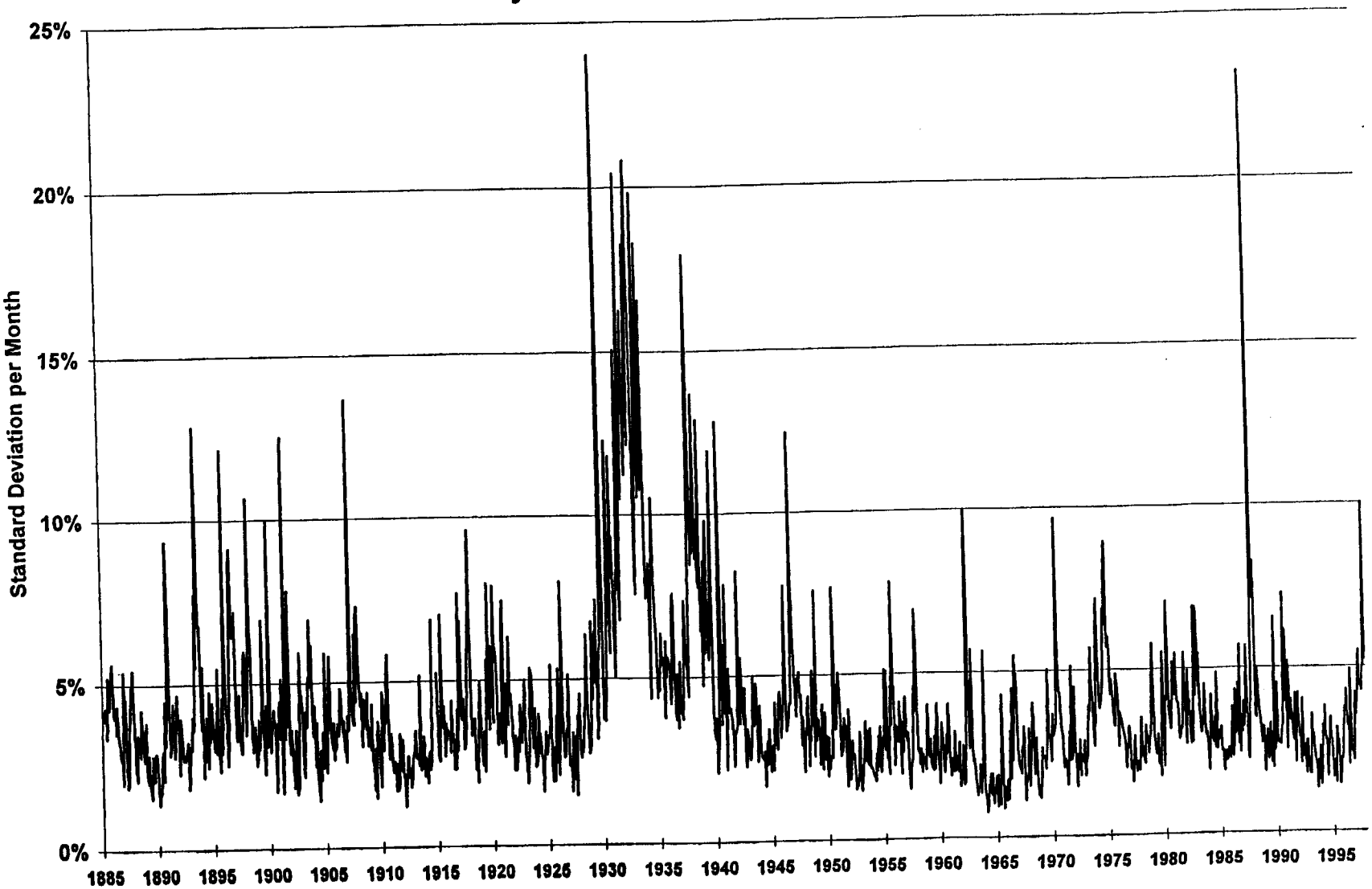

Fig. 3. Standard Deviation of Daily U.S. Stock Returns from 15 Minute Returns to the S&P 500 Index, 1983-95

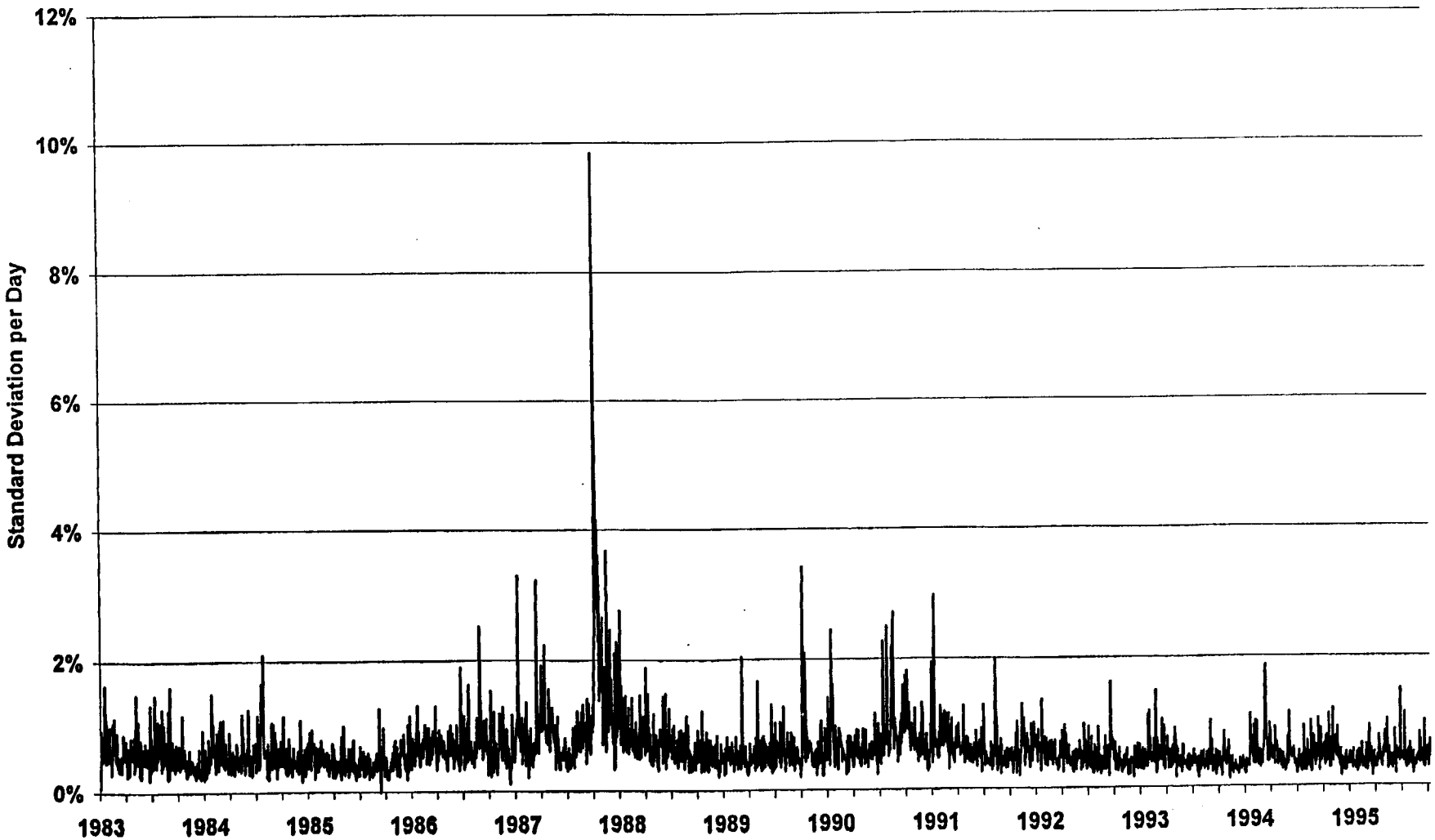

Fig. 4. Standard Deviation of Monthly U.S. Stock Returns Implied by Daily CBOE Call Options on the S&P 500 Index, 1983-97

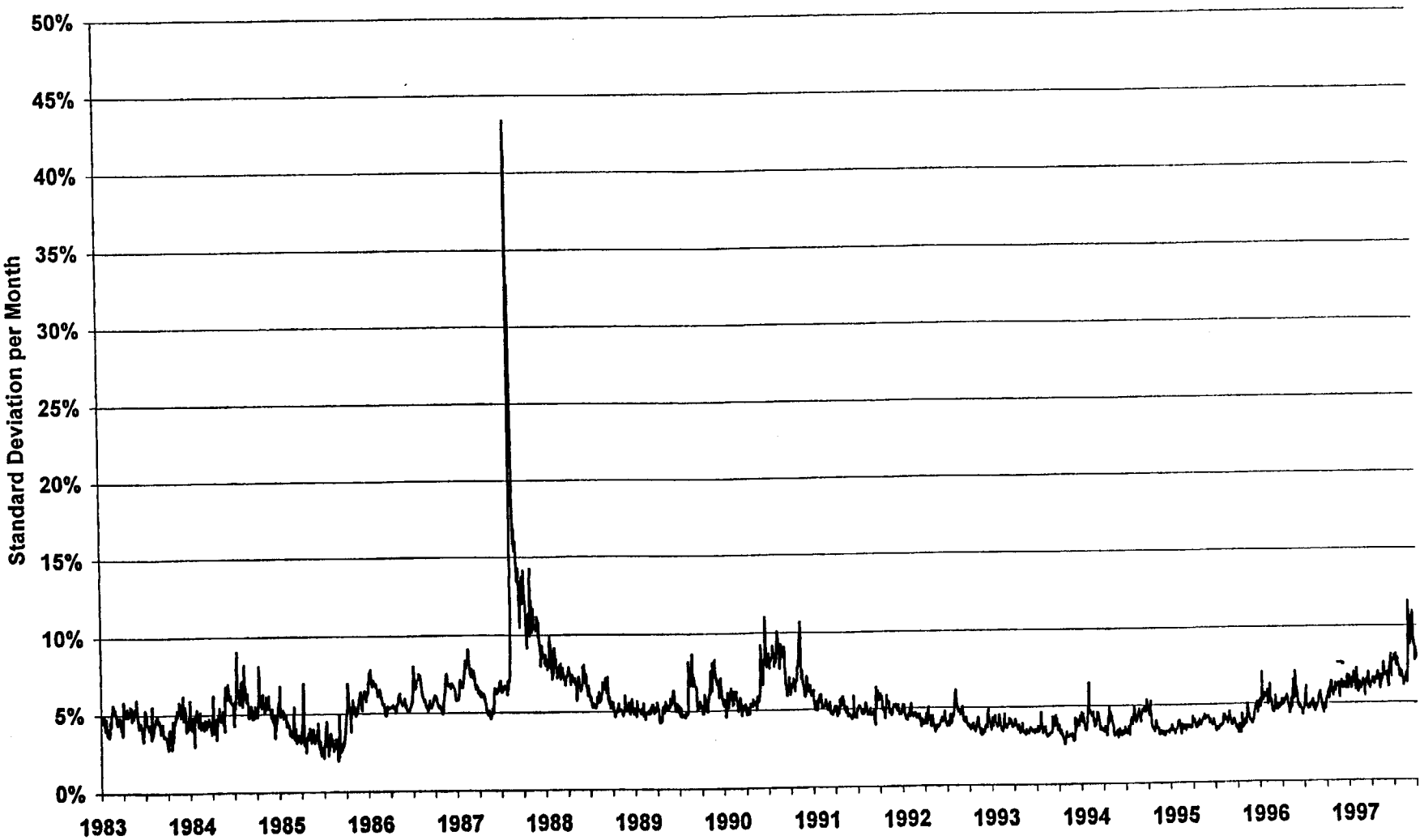

Fig. 5. Effects of Triple Witching Days on Daily NYSE Volume Growth Rates, 1983-97

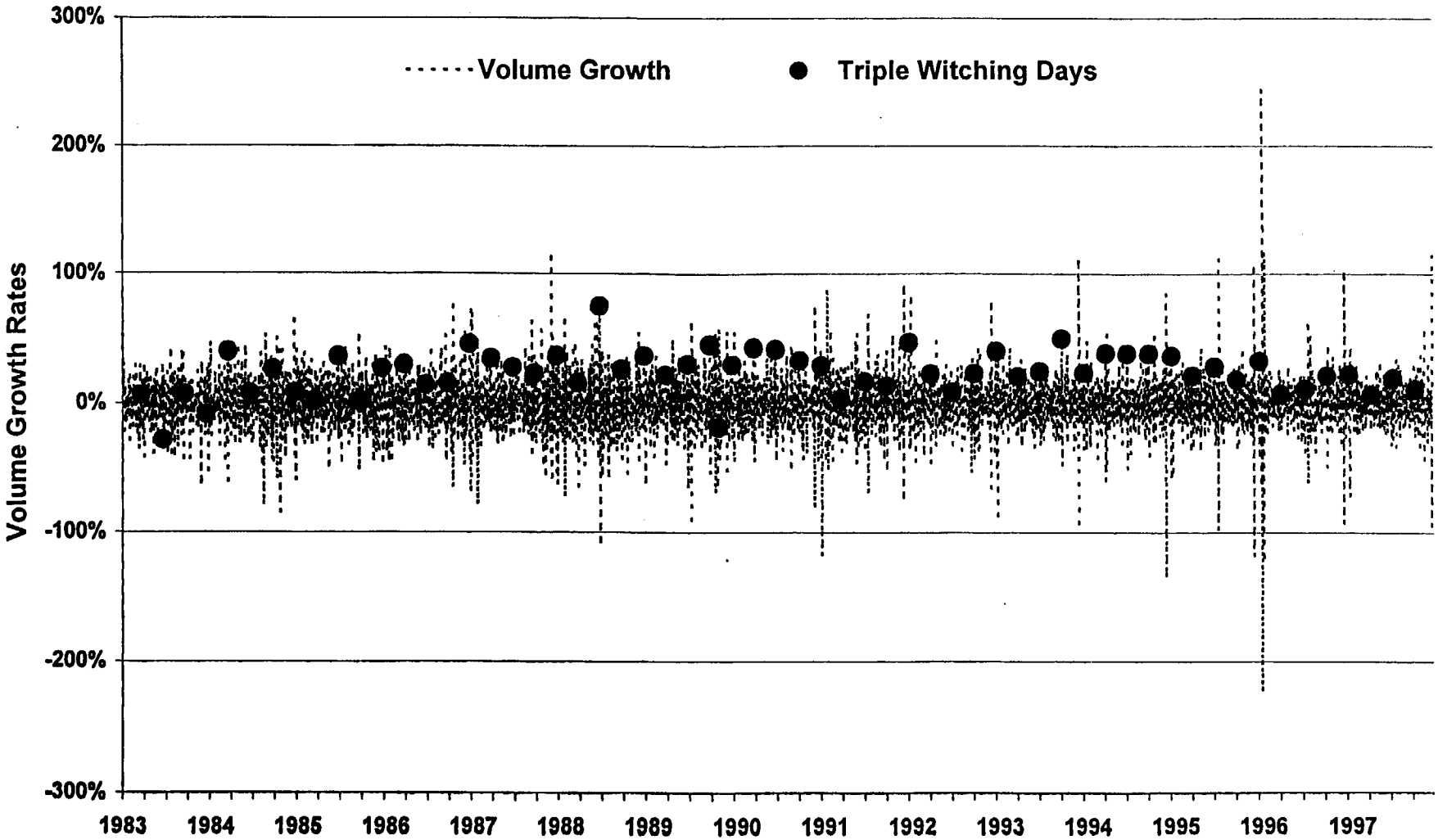

Fig. 6. Absolute Returns to the S&P 500 Index and Triple Witching Days, 1983-97

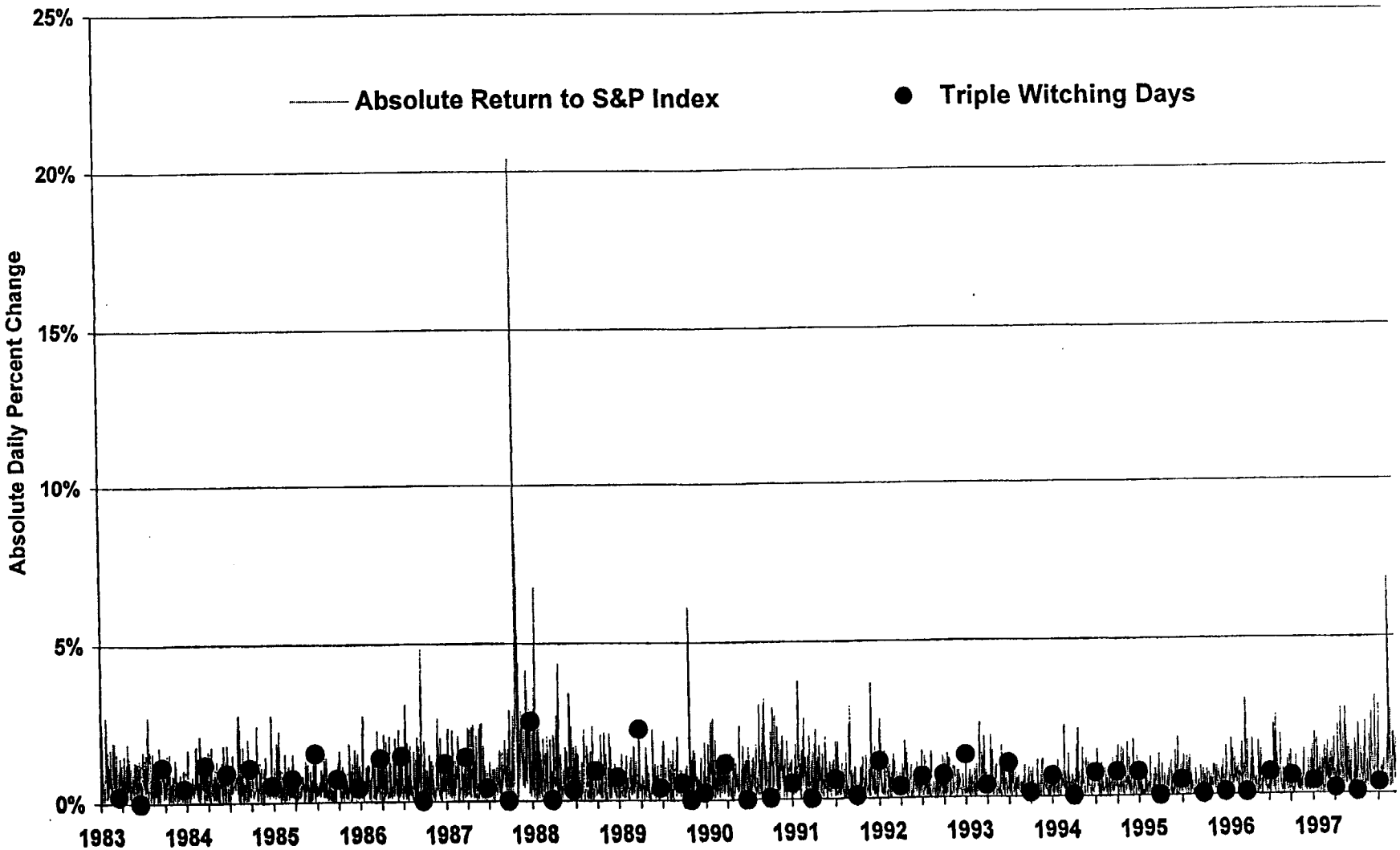

Fig. 7. Intraday Movements in the DJIA, S&P 500, and the CBOE Market Volatility Indexes, October 27 and 28, 1997

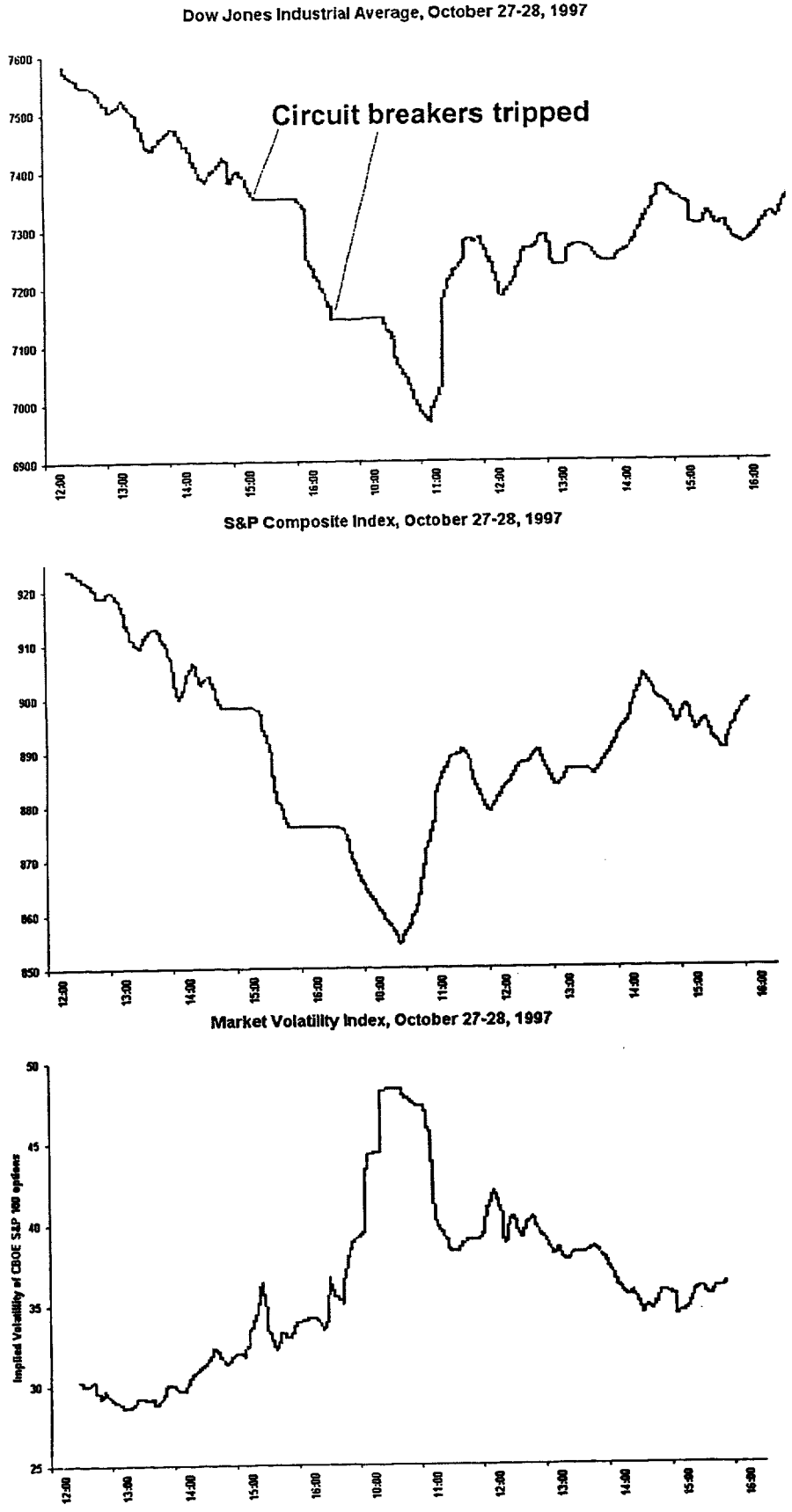

Fig. 8. U. S. Budget and Trade Deficits, 1960-97

(Quarterly Data, Seasonally Adjusted)

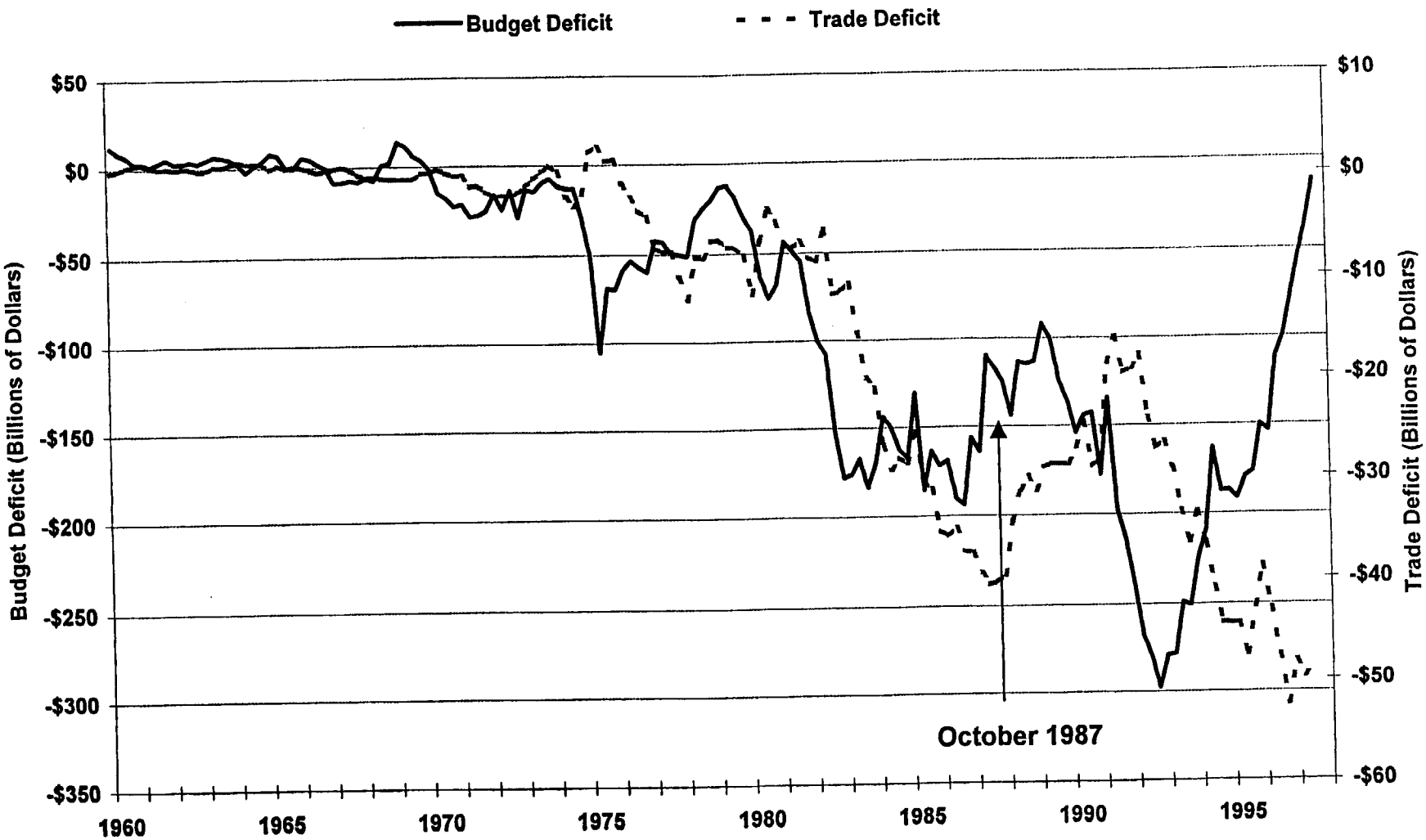

Fig. 9. Earnings Yield (E/P) and Dividend Yield (D/P) for the Standard & Poor's Composite Portfolio, 1926-97

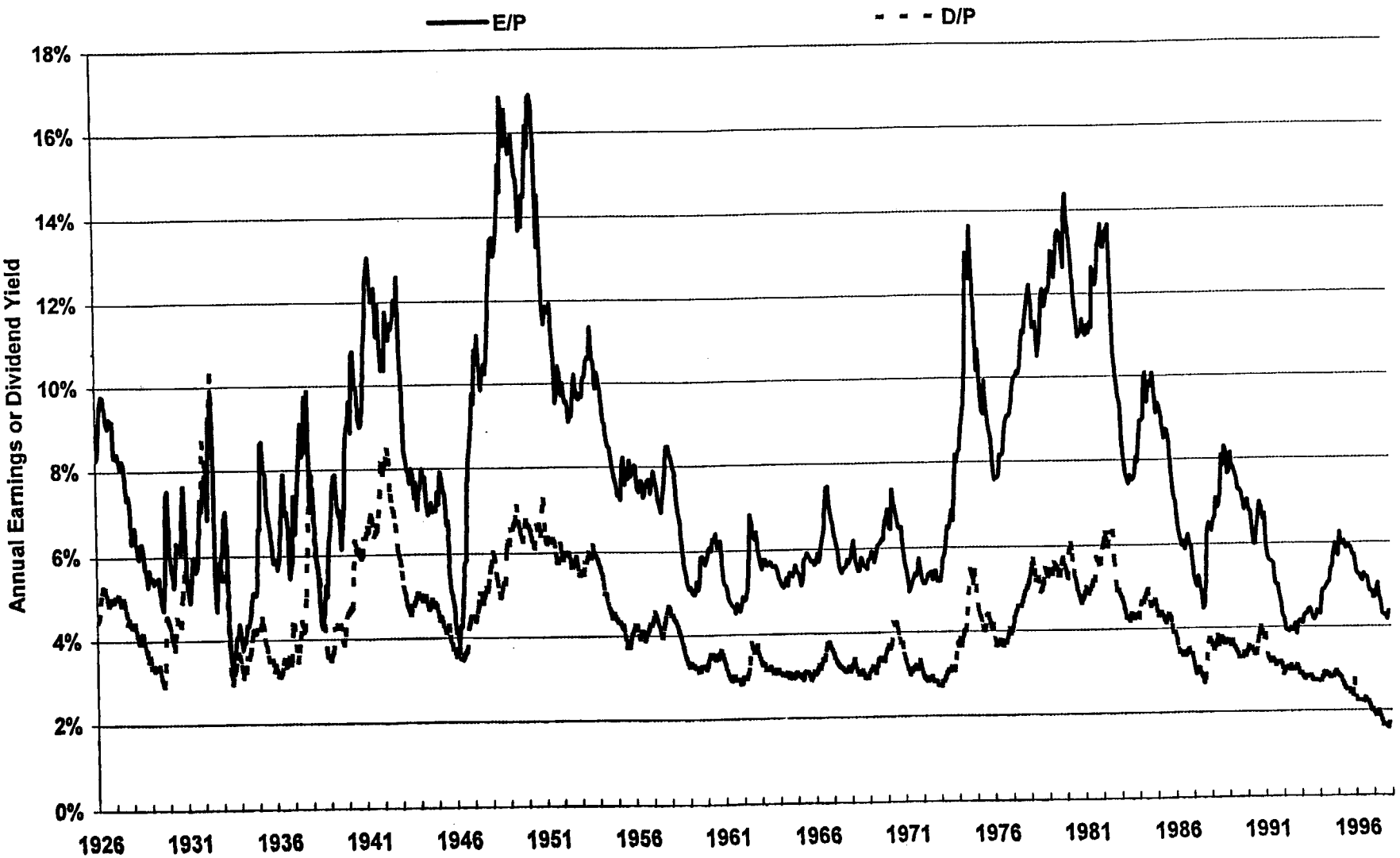

Fig. 10. Standard Deviation of Monthly Nasdaq Stock Returns from Daily Returns in the Month to the Nasdaq Composite Index, 1984-97

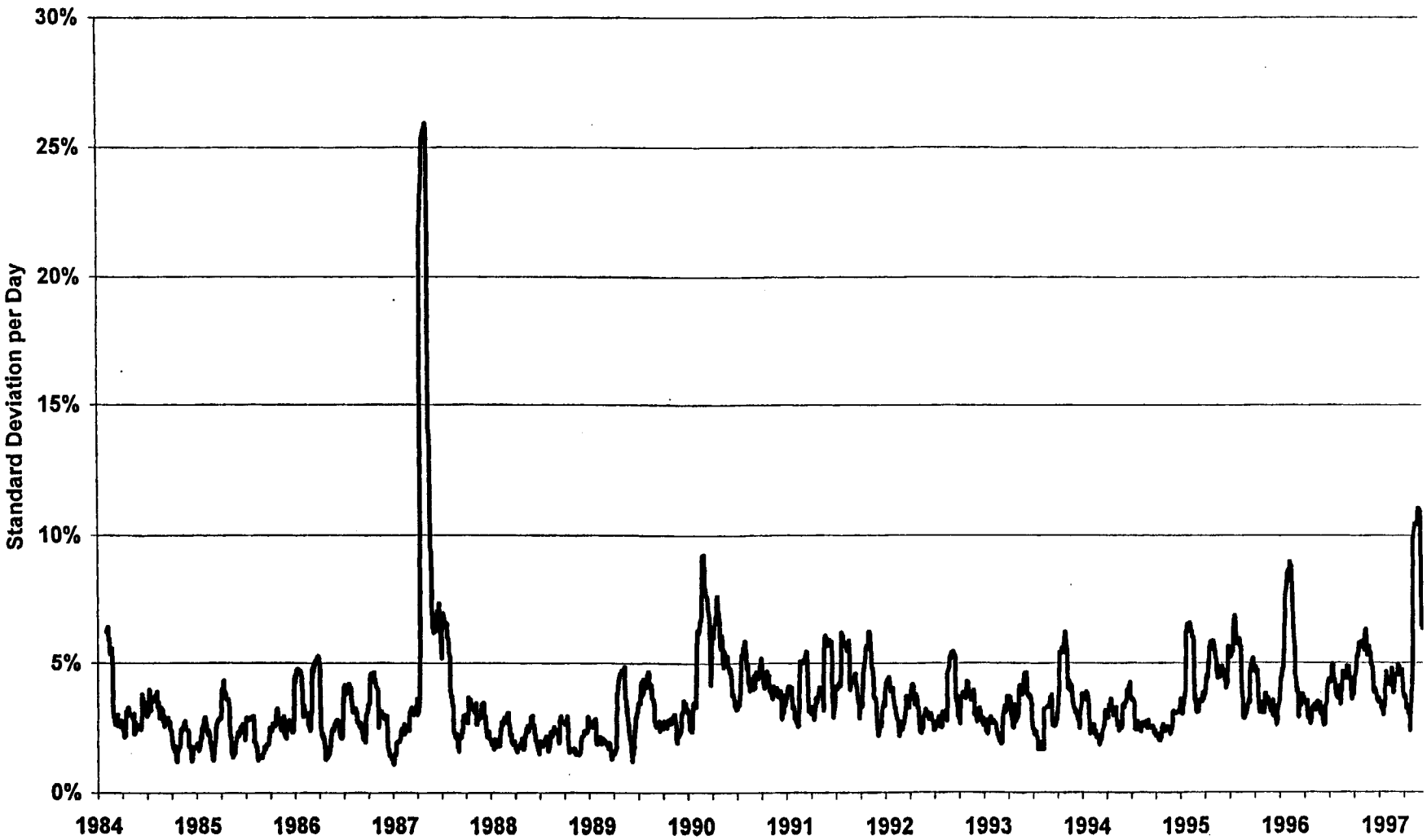

Fig. 11. Standard Deviations of Monthly United Kingdom Stock Returns from Monthly Returns in the Year, 1811-1997

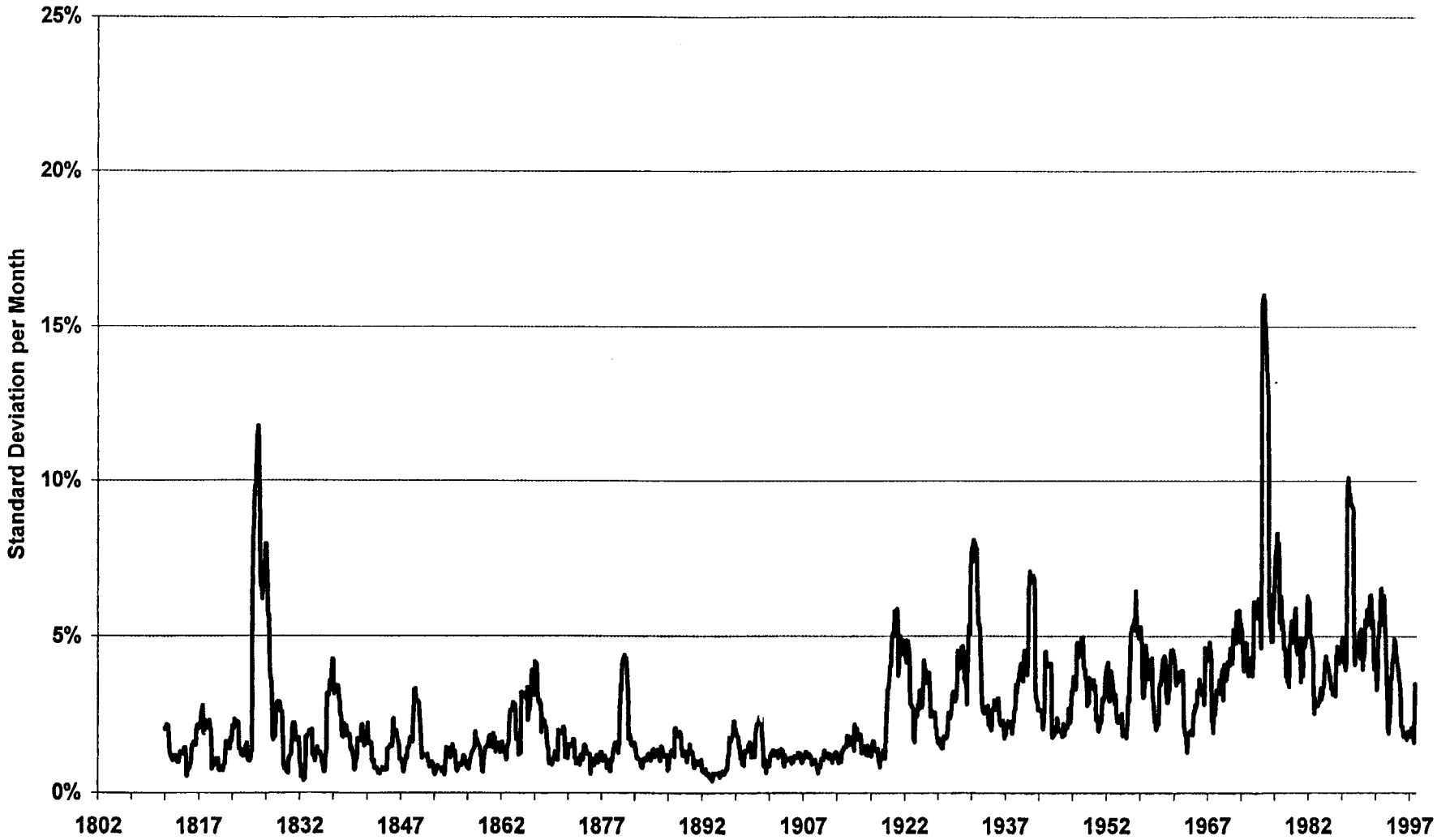

Fig. 12. Standard Deviations of Monthly U.K. Stock Returns from Daily Returns in the Month to the FTSE All Shares Index, 1968-97

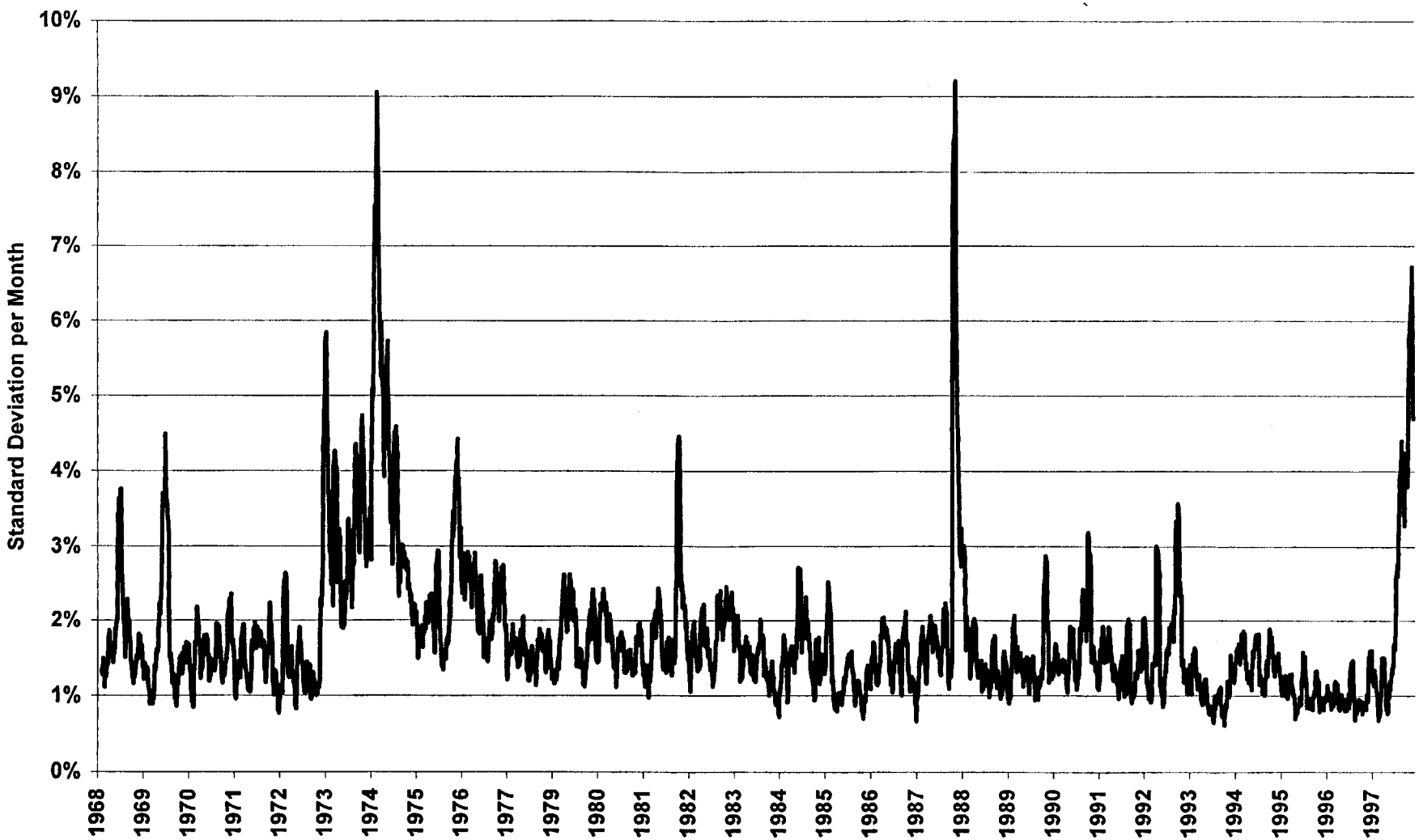

Fig. 13. Standard Deviation of Monthly German Stock Returns from Monthly Returns in the Year, 1871-1997

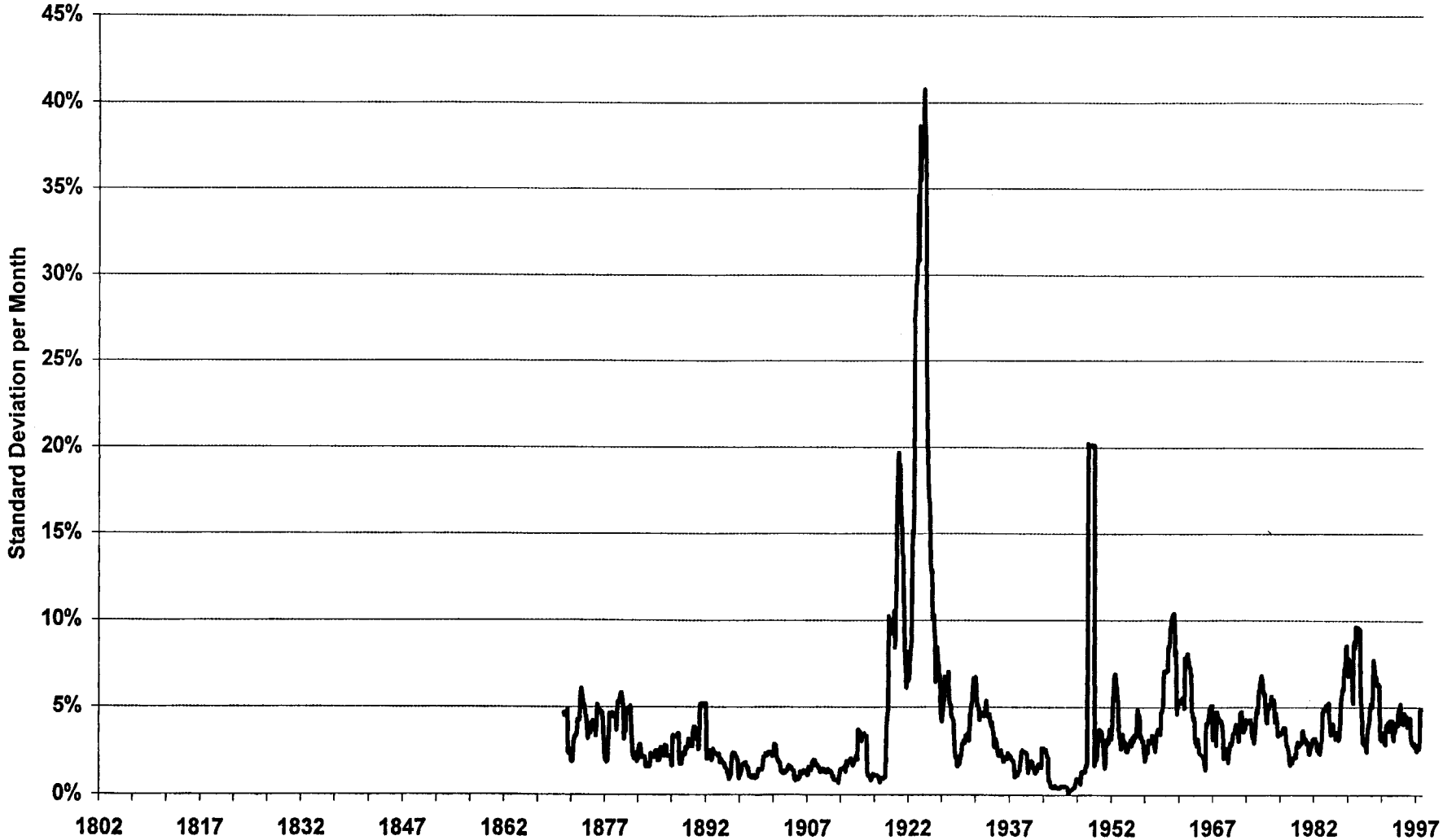

Fig. 14. Standard Deviation of Monthly Japanese Stock Returns from Daily Returns to the TOPIX 100 in the Month, 1973-97

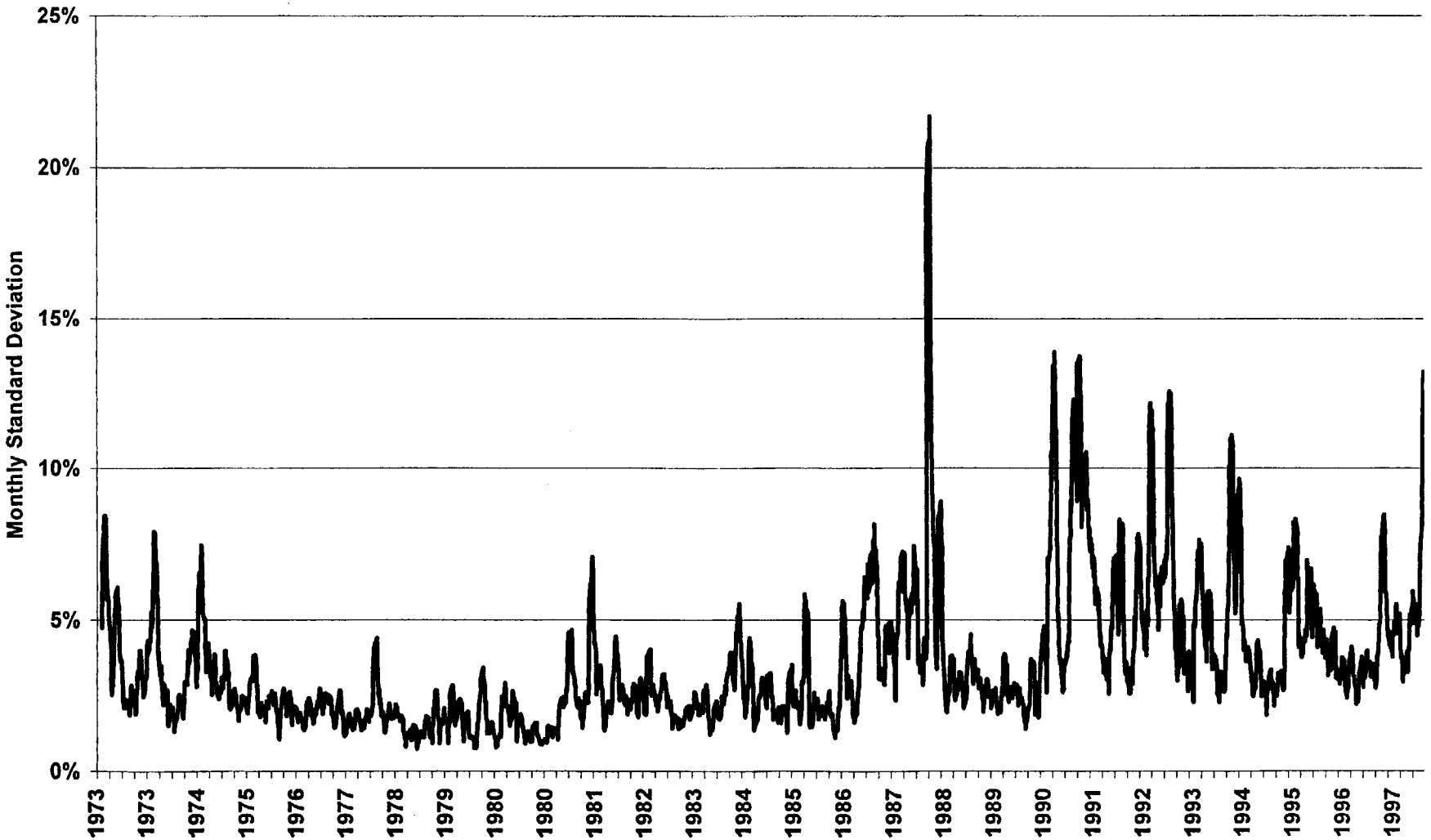

Fig. 15. Standard Deviation of Monthly Australian Stock Returns from Monthly Returns in the Year, 1875-1997

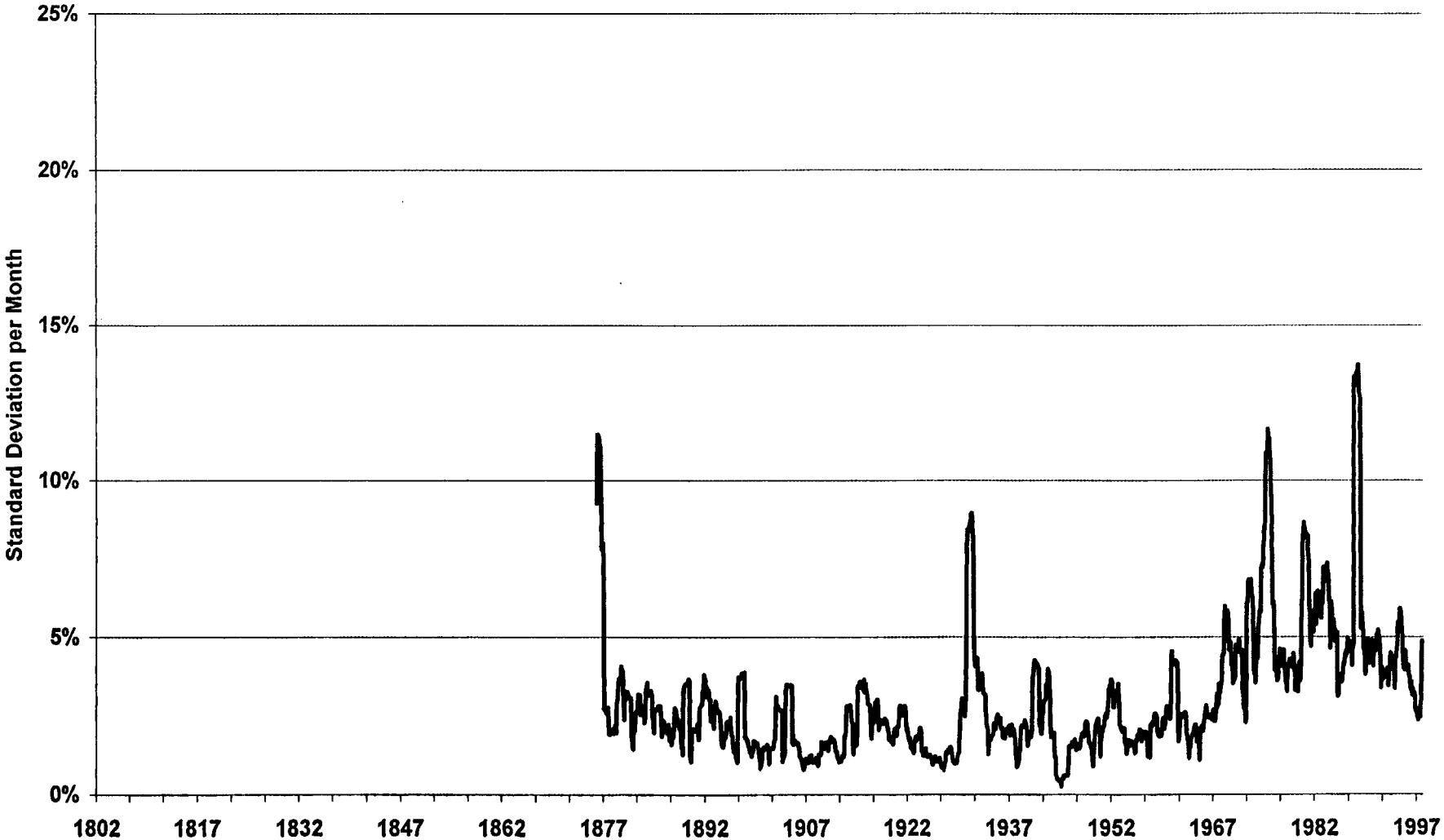

Fig. 16. Standard Deviation of Monthly Canadian Stock Returns from Monthly Returns in the Year, 1918-1997