Coordinating Circuit Breakers In Stock and Futures Markets

By Charles S. Morris

Following the stock market collapse on October 19, 1987, the stock and futures markets adopted rules to temporarily restrict trading after large and rapid price declines. These rules, called circuit breakers, are designed to stop prices from falling in times of panic selling by providing a short cooling-down period.

Not everyone agrees circuit breakers can reduce price declines caused by panic selling. Nonetheless, most observers agree that if circuit breakers are to have any chance of success, they must be coordinated across both the stock and futures markets.

Of concern to some observers is that the circuit breakers currently in place are not adequately coordinated. As an example, they point to October 13, 1989, the first time the circuit breakers were tripped and when the Dow Jones Industrial Average dropped sharply by 191 points. As a result, it is charged that instead of reducing the size of a decline of stock prices in times of panic selling, the circuit breakers currently in place may actually increase the size of a decline.

This article argues that better coordination of circuit breakers could enhance their overall effectiveness. The first section of the article defines circuit breakers. The second section describes the circuit breakers in the stock and futures markets and explains why they are not fully coordinated. The third section shows how better coordination of circuit breakers could reduce the size of a decline in stock prices.

I. What Are Circuit Breakers?

In its report on the October 19, 1987 stock market collapse, the Presidential Task Force on Market Mechanisms, known as the Brady Commission, recommended that the stock and stock index futures exchanges adopt circuit breakers to help prevent future market collapses.[1] In October 1988, the New York Stock Exchange (NYSE) approved circuit breakers for stocks and the Chicago Mercantile Exchange (CME) approved circuit breakers for the most popular stock index

Charles S. Morris is a senior economist at the Federal Reserve Bank of Kansas City. Dan Roberts, a research associate at the bank, assisted in the preparation of this article.

futures contract, the Standard & Poor's (S&P) 500 futures contract (see box).

Circuit breakers are temporary trading restrictions that are usually imposed after large and rapid price declines. One common trading restriction is a price limit, such as currently in place in the futures market. For example, if the price of the S&P 500 futures contract falls 12 points below the previous day's closing price, the exchange prohibits trading at lower prices for a half hour. Another common circuit breaker is a trading halt, such as currently in place in the stock market. For example, if the Dow Jones Industrial Average stock index falls 250 points below the previous day's closing value, all trading on the NYSE must stop for one hour. The time limits imposed by circuit breakers are typically quite short, lasting from as little as five minutes to the remainder of a trading day.

Circuit breakers are designed to stop prices from falling in times of panic selling by providing a short cooling-down period for investors to reevaluate the situation. Large and rapid price declines in the stock market might cause investors to panic and sell their stocks before the price falls any further. By providing a short time-out, circuit breakers give investors time to evaluate and digest new information, to talk to other traders and find buyers, and to work out credit arrangements. After such a time-out, some investors might decide there really is no reason to sell. Some may even decide stocks are actually a bargain at the lower prices, causing them to buy stocks. In such cases, circuit breakers would stop prices from falling further.[2]

Circuit breakers are not meant to stop prices

The S&P 500 futures contract

The S&P 500 futures contract is one of several financial futures contracts. A financial futures contract is an agreement between two parties to buy or sell a financial asset, such as a Treasury bond or foreign currency, at a given time in the future for a predetermined price. Nothing is exchanged when a futures contract is written; instead, the buyer and seller simply agree to make an exchange at a future date. In an S&P 500 stock index futures contract, the underlying asset is the group of stocks included in the Standard & Poor's 500 Composite Stock Price Index.

The S&P 500 futures contract does not allow a seller to actually deliver the S&P 500 stocks at the future date because it would be impractical to deliver all 500 stocks in exactly the proportion in which they make up the index. Indeed, in most financial futures contracts, the physical exchange of the underlying asset rarely occurs because a buyer can offset his position simply by selling the same number of futures contracts that he bought, and a seller can offset his position simply by buying futures contracts. Because the S&P 500 futures contract does not allow delivery, sellers must settle their position by buying futures and buyers must settle by selling futures.

The price of the S&P 500 futures contract is simply the price that the buyer would pay the seller if the stocks were actually delivered. The price of the S&P 500 futures contract is quoted as an index, and the value of an S&P 500 index futures contract is $500 times the level of the index. For example, if the S&P 500 futures price is 320, the value of one contract would be $160,000. Thus, if the seller could deliver the stocks, the buyer would pay the seller $160,000 for the stocks when they are delivered at the future date. For a more complete discussion of stock index futures, see Morris 1989.

from falling when the decline is due to economic fundamentals. For example, suppose bad news about the economic outlook causes investors to sell stocks. If the sales lead to a large decline in prices, circuit breakers would be activated. During the time-out provided by the circuit breakers, investors would review the situation and see that prices were falling for an appropriate reason. When the circuit-breaker period ends, investors would continue to sell and prices would continue to fall, just as if the circuit breakers had never tripped.

II. Circuit Breakers in the Stock and Futures Markets

Most experts agree that to have any chance of success, circuit breakers must be coordinated across markets. Such coordination was sought by the NYSE and CME when they worked together to adopt circuit breakers for stocks and the S&P 500 futures contract (see appendix). However, these circuit breakers are not fully coordinated. The lack of coordination became clear on October 13, 1989, when circuit breakers were activated for the first time.

Why NYSE and S&P 500 futures circuit breakers are not coordinated

To be fully coordinated across the futures and stock markets, circuit breakers must impose the same trading restrictions in both markets at virtually the same time. Say, for example, the price of the S&P 500 futures contract falls 12 points below the previous day's closing price. This 12-point decline would trip a circuit breaker in the futures market and stop prices from falling for 30 minutes. To achieve coordination across markets, a circuit breaker in the stock market should also keep prices from falling for 30 minutes. Thus, for circuit breakers to be fully coordinated across the futures and stock markets, they must meet three criteria: (1) circuit breakers in one market must have counterparts in the other market, (2) counterpart circuit breakers must impose similar restrictions in both markets, and (3) counterpart circuit breakers must trip in both markets at the same time. The circuit breakers currently in place in the stock and futures markets do not meet all three criteria.

Counterparts. Two of the circuit breakers adopted by the CME for the S&P 500 futures do not have counterparts on the NYSE. The S&P 500 futures has an opening price limit that is five points above or below the previous day's closing price. The S&P 500 futures also has a maximum daily limit of 50 points above or below the previous day's closing price; that is, the S&P 500 futures price cannot change more than 50 points in a day. Counterparts for neither of these circuit breakers exist on the NYSE.[3]

Restrictions. While some of the CME circuit breakers do have counterparts on the NYSE, the counterparts do not always impose similar restrictions. For example, if the S&P 500 futures price falls 12 points from the previous day's close, such a decline would trip circuit breakers in both the futures and stock markets. The circuit breaker in the futures market keeps the S&P 500 futures price from falling further for 30 minutes or until 2:30 p.m. Chicago time, whichever comes first. The circuit breaker on the NYSE, however, only delays for five minutes program trading orders (simultaneous orders for 15 or more different stocks) for S&P 500 stocks entered through the exchange's computer system.[4] After five minutes, trading in any S&P 500 stock on the NYSE—not just stocks included in program orders—is halted if the price falls too much.[5]

The different restrictions imposed by a 12-point decline in the S&P 500 futures price make the circuit breaker in the futures market more restrictive than in the stock market. To see why, suppose the 12-point circuit breaker trips and the price floor for the futures contract is higher than the new equilibrium futures price.

Because the futures price at the price floor is too high, no one will want to buy the futures and trading will virtually stop. On the other hand, although a circuit breaker also trips on the NYSE, stock trading might continue with few interruptions for three reasons. First, the five-minute delay in executing orders applies only to stocks that are part of a program trade. Second, because program trading orders are delayed only if they are entered through the computer system, traders can avoid the delay by carrying the order by hand to the trading floor. And third, trading in a stock is halted only if a trade causes a stock's price to fall too much.

Timing. Circuit breakers imposing the same restrictions are not fully coordinated if they do not always trip at the same time. For example, one S&P 500 futures circuit breaker trips when the futures price falls 30 points from the previous day's closing price; another trips when the futures price falls 50 points. The NYSE counterparts to these circuit breakers trip when the Dow falls 250 and 400 points below the previous day's close. These circuit breakers are coordinated to some extent because, when the circuit breakers were adopted, a one-point change in the S&P 500 index was generally associated with an eight-point change in the Dow. But this eight-to-one relationship is not perfect, so the circuit breakers do not always trip at the same time. For example, if the futures price falls 30 points while the Dow falls less than 250 points, futures prices would be restricted from falling further for one hour; at the same time, stock prices could continue to fall until they were 250 points below the previous day's close.

A case study of circuit breakers: October 13, 1989

The first test of the circuit breakers adopted by the NYSE and CME came when the Dow fell 191 points on Friday, October 13, 1989. Circuit breakers tripped on two occasions that day: first, when a 12-point fall in the S&P 500 futures price tripped circuit breakers in both markets; and second, when a 30-point fall in the futures price tripped a circuit breaker in the futures market. On neither occasion were the circuit breakers fully coordinated.

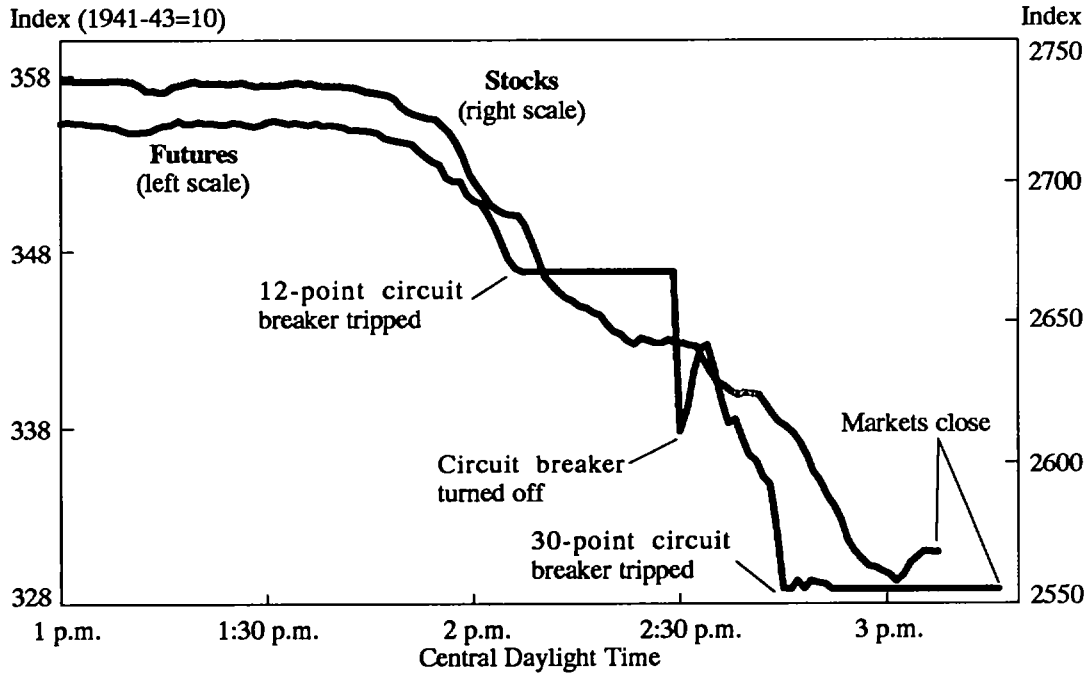
At 2:07 p.m. on October 13, 1989, the S&P 500 futures hit a price 12 points below Thursday's closing price, tripping circuit breakers in both the stock and futures markets at virtually the same time (Chart 1). The circuit breakers imposed different trading restrictions in the two markets; however, causing stock and futures prices to behave differently. Prices in the futures market held steady at the floor until the circuit breakers were relaxed at 2:30 p.m. Meanwhile, prices in the stock market continued to fall throughout the period, despite the five-minute delay on program trading orders entered into the NYSE computer system.

When the futures market circuit breaker was turned off at 2:30 p.m., futures prices plunged again, rose briefly, and then resumed their free-fall, hitting the 30-point price floor at 2:45 p.m. Once again, prices behaved differently, but this time it was because the NYSE counterpart to the CME's 30-point price floor did not trip at the same time. The 30-point decline tripped a one-hour circuit breaker in the futures market, and futures prices remained at the floor until the market closed at 3:15 p.m. But because prices in the stock market did not fall to their 250-point floor, the counterpart circuit breaker on the NYSE did not trip. Consequently, while futures prices held steady, stock prices continued to fall throughout the period.[6]

Summary

For circuit breakers in the stock and futures markets to stop price declines caused by panic selling, they must be coordinated. In other words, a circuit breaker in the futures market must have a counterpart in the stock market that

Chart 1
Stock and Futures Prices
October 13, 1989



Note: The futures price is the minute-by-minute average of the December 1989 S&P 500 stock index futures contract traded at the Chicago Mercantile Exchange. The stock price is the minute-by-minute average of the Dow Jones Industrial Average.

Source: Tick Data Inc., Lakewood, Colorado.

imposes similar restrictions at virtually the same time. Although the NYSE and CME attempted to coordinate their circuit breakers in this way, examination shows the circuit breakers are not fully coordinated for three reasons: (1) some S&P 500 futures circuit breakers have no counterparts on the NYSE, (2) some S&P 500 futures circuit breakers are more restrictive than their counterparts on the NYSE, and (3) circuit breakers in one market may trip more often or at different times than circuit breakers in the other market. Evidence from October 13, 1989, shows circuit breakers in the futures market are more confining than their counterparts on the NYSE because they are more restrictive and trip more often.

III. Uncoordinated Circuit Breakers and Stock Prices

Uncoordinated circuit breakers that are more confining in the futures market than in the stock market may actually increase the size of a price decline caused by panic selling. When panic selling causes futures prices to fall, traders in the futures market normally absorb some of the downward pressure on prices that otherwise would flow to the stock market. Uncoordinated circuit breakers that confine futures trading, however, prevent futures traders from absorbing any of this selling pressure. As a result, stock prices fall more when futures trading is confined. Better coordination would reduce the likelihood

circuit breakers would increase the size of a decline in stock prices.

How futures sales cause stock prices to fall

Under panic selling conditions, the behavior of futures market participants determines how much selling pressure is transferred to the stock market. The major participants in the futures market are investors, index arbitragers, and speculators. During times of panic selling, investors sell stock index futures, while index arbitragers and speculators buy stock index futures. Although both index arbitragers and speculators buy futures, their roles are different. Index arbitragers transfer selling pressure to the stock market. Speculators absorb selling pressure.

Investors. Investors use stock index futures as a hedging asset to protect their portfolios against a falling stock market. When the stock market falls, the value of most stock portfolios also falls.[7] In general, investors hedge against a falling market by buying or selling a hedging asset, such as stock index futures, so that profits on the hedging asset offset losses on the portfolio. Stock index futures are an effective hedging asset because the prices of stock index futures and stocks move in the same direction. This relationship makes it easy for investors to calculate how many futures contracts are needed to offset potential losses in the value of a stock portfolio.[8]

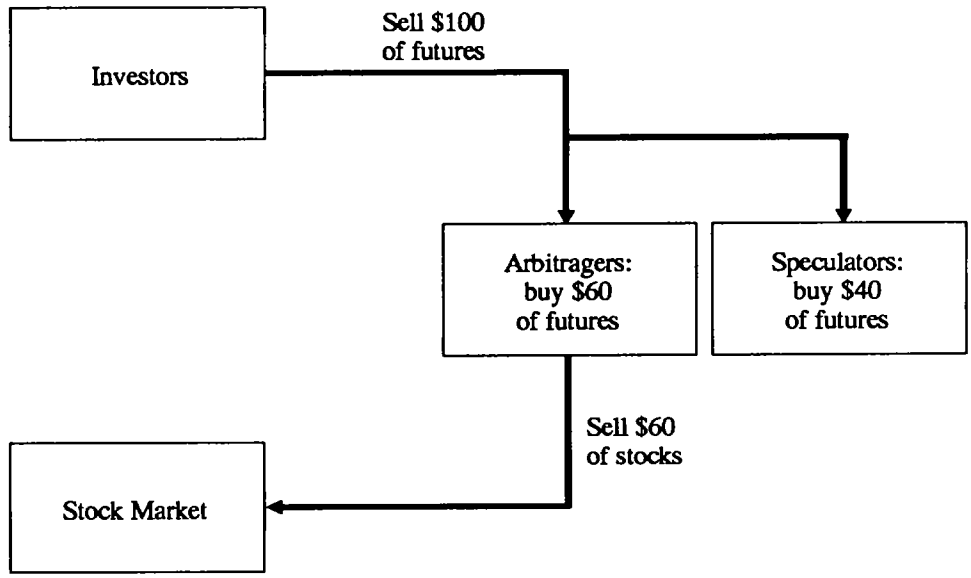
An investor sells stock index futures to hedge a portfolio of stocks because he earns profits from the futures sale when stock prices fall.[9] To see why, suppose stock prices fall, causing an investor to lose $10 on his stock portfolio. Because stock prices fell, futures prices would also fall. The investor would earn a profit on the futures that he sold because he would offset his futures position by buying futures for less than he paid. For example, if the investor sold futures for $320 and futures prices fell to $310, the investor could buy futures for $310 and make $10.[10] The $10 profit on the futures would offset the $10 loss on the stocks.[11]

Index arbitragers. Index arbitragers use stock index futures to make a profit from temporary differences between stock prices and stock index futures prices. In theory, the price of the S&P 500 futures contract should roughly equal the S&P 500 index. In practice, however, discrepancies often develop for short periods of time that make either the futures contract or the actual stocks in the S&P 500 cheap relative to the other. When these gaps occur, arbitragers buy the cheaper one and sell the more expensive one, locking in the difference for a profit. For example, suppose investors sell S&P 500 futures to protect themselves from a falling stock market, driving the futures price below the S&P 500 index.[12] Arbitragers would lock in a profit by buying futures and simultaneously selling stocks.

Speculators. Speculators use futures to profit from expected changes in stock prices because futures prices and stock prices are closely related. When speculators expect the market to rise, they buy stock index futures. If the market does rise, they make a profit because they can offset their position by selling futures for more than they paid. Conversely, when speculators expect the market to fall, they sell stock index futures. If the market does fall, they make a profit because they can offset their position by buying futures for less than they sold futures. Of course, if speculators guess wrong, they suffer a loss.

When panic selling causes stock prices to fall, some speculators will buy stock index futures. Panic selling causes stock prices to fall below the values consistent with fundamental economic conditions. In other words, stock prices are too low. If stock prices are too low, they should rise in the future. Speculators who realize stock prices are too low buy futures because, if futures prices do rise, they can earn a profit by selling futures for more than they paid.[13]

Figure 1
Selling Pressure: Futures Trading Not Restricted



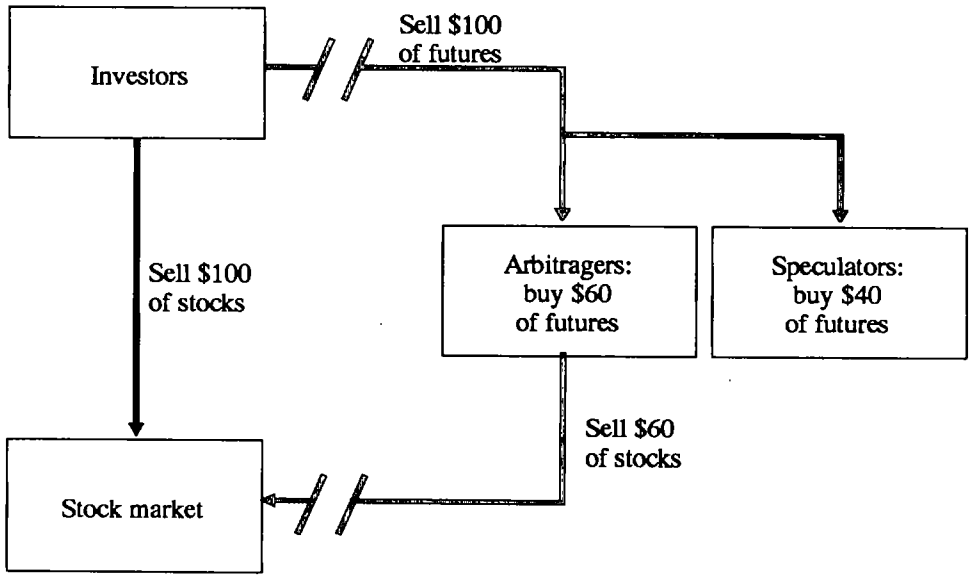
Transfer and absorption of selling pressure. Index arbitragers transfer selling pressure from the futures market to the stock market, while speculators absorb selling pressure. The box at the top of Figure 1 represents an investor who hedges his stocks against falling stock prices by selling $100 of stock index futures. The sale of futures causes futures prices to fall below stock prices. Because futures prices are lower than stock prices, arbitragers would buy futures and sell stocks. For example, suppose arbitragers buy $60 of futures and, therefore, sell $60 of stocks. Speculators who believe stock prices are going to rise would then buy the remaining $40 of futures. In this example, speculators absorb 40 percent of the futures sale. In other words, only 60 percent of the futures sale is transferred to the stock market.

The effect of the futures sale on stock prices depends on how much of the sale speculators absorb. Suppose, for example, stock prices fall $10 when speculators absorb 40 percent of the sale. If speculators absorb more than 40 percent, stock prices will fall less than $10. But if speculators absorb less than 40 percent, stock prices will fall more than $10.

How uncoordinated circuit breakers increase a fall in stock prices

Circuit breakers can increase the size of price declines in the stock market if they are more confining in the futures market than in the stock market. When investors sell futures, only part of the selling pressure is transferred to the stock market because speculators absorb some of the

Figure 2
Selling Pressure: Futures Trading Restricted



selling pressure. When circuit breakers confine futures trading, however, all of the selling pressure flows to the stock market because speculators do not absorb any of the selling pressure. As a result, stock prices fall more than they would if futures trading were not confined.

Selling pressure in the stock market increases when circuit breakers are more confining in the futures market (Figure 2). As in Figure 1, the box at the top of Figure 2 represents an investor who wants to hedge his portfolio against falling stock prices by selling $100 of futures. But because futures trading is confined, the investor cannot sell futures. The investor can achieve the same goal, however, by switching to the stock market and selling $100 of stocks.[14] Thus, when futures trading is confined, the selling pressure increases from $60 to $100.

Selling pressure increases when futures trading is confined because speculators do not absorb any of the selling pressure. When futures trading is not confined, speculators absorb $40 of the selling pressure. When futures trading is confined, however, speculators do not switch to the stock market to buy stocks because it is too costly.[15] As a result, when futures trading is confined, the decline in stock prices increases.

Better coordination of circuit breakers in the stock and futures markets would reduce the decline in stock prices because the selling pressure would not increase. Coordinated circuit breakers would impose the same trading restrictions in the stock and futures markets, preventing investors from switching from the closed to the open market. For example, if trading is halted in both the stock and futures

markets, investors who wanted to sell futures could not switch to the stock market and sell stocks. Instead, they would have to wait for both markets to reopen. If the trading halt did not alter anyone's views by the time the markets reopened, investors, speculators, and index arbitragers would behave just as if trading had never been interrupted. As a result, stock prices would fall just as if there had been no circuit breakers. In other words, coordinated circuit breakers would cause stock prices to fall less than uncoordinated circuit breakers. Moreover, if the original price decline was due to panic selling and traders realized there was no real reason to sell, stock prices would fall even less.[16]

IV. Conclusion

The New York Stock Exchange and Chicago Mercantile Exchange adopted circuit breakers for stocks and stock index futures to stop panic-induced price declines. Although the two exchanges tried to coordinate their circuit breakers, the circuit breakers have not proved to be fully coordinated. Overall, circuit breakers appear to be more confining in the futures market than in the stock market because futures market circuit breakers tend to trip more often and are more restrictive. As a result, rather than reducing the decline of stock prices in times of panic selling, the circuit breakers adopted by the exchanges might actually increase the size of a decline.

This article has argued that better coordination of circuit breakers could enhance their overall effectiveness. Better coordination could be achieved by tightening circuit breakers in the stock market. Alternatively, the futures market could relax its circuit breakers. In any event, both markets must work together to improve the degree of coordination.

Appendix

Circuit Breakers on the New York Stock Exchange and the Chicago Mercantile Exchange's S&P 500 Stock Index Futures Contract

This appendix describes the current and proposed circuit breakers for the Chicago Mercantile Exchange's (CME) S&P 500 stock index futures contract and the New York Stock Exchange (NYSE).

Current circuit breakers

On October 20, 1988, the following coordinated circuit breakers were put into effect for the CME's S&P 500 stock index futures contract and the NYSE.

S&P 500 stock index futures:

1. Five-point opening limit: The S&P 500 futures price can open no more than five points above or below the previous day's closing price. If the opening futures price falls (rises) five points but trades at a higher (lower) price within ten minutes, the limit is removed. If after ten minutes the price is still stuck at the five-point limit, trading is halted for two minutes.
2. 12-point intermediate limit: If the S&P 500 futures price falls 12 points below the previous day's closing price, the price cannot fall further for 30 minutes or until 2:30 p.m. Chicago time, whichever comes first.
3. 30-point circuit breaker:
   a. If the S&P 500 futures price falls 30 points below the previous day's closing price and the Dow Jones Industrial Average falls less than 250 points, the price cannot fall further for one hour.
   b. If the S&P 500 futures price falls 30 points below the previous day's closing price and the Dow falls 250 points, trading is halted for one hour. After one hour, trading can resume when 50 percent of the capitalization of the S&P 500 index has resumed trading in the stock markets.
4. 50-point daily price limit: The S&P 500 futures price cannot change more than 50 points above or below the previous day's closing price. In addition, if the S&P 500 futures price falls 50 points below the previous day's closing price and the Dow falls 400 points, trading is halted for two hours. After two hours, trading can resume when 50 percent of the capitalization of the S&P 500 index has resumed trading in the stock markets, but the futures price cannot fall further.

New York Stock Exchange:

1. 12-point decline in the S&P 500 futures price (sidecar): If the S&P 500 futures price falls 12 points below the previous day's closing price, the CME will notify the NYSE. At that time:
   a. Program trading orders—simultaneous orders for 15 or more different stocks—for S&P 500 stocks that are entered through the NYSE's Designated Order Turnaround (DOT) computer system are sent to an undisclosed computer file (sidecar) for five minutes. After five minutes,

the file will be opened and the orders will be eligible for execution.

b. During or at the end of the five-minute period, trading in any S&P 500 stock—not just stocks included in program orders—is halted if:
   (i) a stock last sold for less than $20 and a trade would cause its price to fall more than one point,
   (ii) a stock last sold for $20 or more and less than $100 and a trade would cause its price to fall more than two points, or
   (iii) a stock last sold for $100 or more and a trade would cause its price to fall more than three points.

c. If trading is halted in any of the 50 largest capitalized S&P 500 stocks trading on the NYSE or any Major Market Index stocks and there is an order imbalance of 50,000 shares or more, including orders entered through DOT or by hand, the size of the imbalance must be made public. A trading halt is not required on the basis of 50,000-share imbalance alone.

d. The sidecar rule can be used only once in a day and will not be put into effect during the last 35 minutes of a trading day.

2. 250-point fall in the Dow: The market will close for one hour if the Dow falls 250 points from the previous day's closing price.

3. 400-point fall in the Dow: The market will close for two hours if the Dow falls 400 points from the previous day's closing price.

Proposed circuit breakers

To date, circuit breakers have tripped on three occasions: October 13, 1989, October 24, 1989, and January 12, 1990. On all three occasions, circuit breakers were tripped in the futures and stock markets by a 12-point decline in the S&P 500 futures price. On October 13, 1989, the 30-point circuit breaker also tripped in the futures market. In response to the two October episodes, the CME and NYSE proposed changes for the circuit breakers. The proposed changes had not yet been approved when circuit breakers tripped on January 12, 1990.

S&P 500 stock index futures:

1. Five-point opening limit: The opening limit is still five points above or below the previous day's closing price. However, the limit applies for a full ten minutes, even if trades occur at higher (lower) prices when the market opens five points down (up). If prices stay at the limit throughout the ten-minute period, trading is halted for two minutes.

2. 12-point intermediate limit: No change.

3. 20-point circuit breaker: This is an entirely new limit that basically replaces the old 30-point circuit breaker, except that it is not affected by the Dow. If the S&P 500 futures price falls 20 points below the previous day's closing price, the price cannot fall further for one hour. In addition, if the limit is hit after 1:30 p.m. Chicago time, the limit applies for the remainder of the day.

4. 30-point daily price limit: The S&P 500 futures price cannot change more than 30 points above or below the previous day's closing price. In addition, if the S&P 500 futures price falls 30 points below the previous day's closing price and the Dow falls 250 points, trading is halted for one hour. If the S&P 500 futures

price falls 30 points below the previous day's closing price and the Dow falls 400 points, trading is halted for two hours. After the one-hour or two-hour period, trading can resume when 50 percent of the capitalization of the S&P 500 index has resumed trading in the stock markets, but the futures price cannot fall further.

5. 50-point daily price limit: This limit is eliminated.

New York Stock Exchange:

1. 12-point decline in the S&P 500 futures price (sidecar): If the S&P 500 futures price falls 12 points below the previous day's closing price, the CME will notify the NYSE. At that time:
   a. Program trading orders for S&P 500 stocks that are entered through DOT are sent to an undisclosed computer file (sidecar) for 30 minutes, instead of five minutes. After 30 minutes, the file will be opened and the orders will be eligible for execution.
   b. During or at the end of the 30-minute period, trading in any sidecar stock—as opposed to the old rule which applied to any S&P 500 stock—is halted if:
      (i) a stock last sold for less than $20 and a trade would cause its price to fall more than one point,
      (ii) a stock last sold for $20 or more and less than $100 and a trade would cause its price to fall more than two points, or
      (iii) a stock last sold for $100 or more and a trade would cause its price to fall more than three points.
   c. If trading is halted in any of the 50 largest capitalized S&P 500 stocks trading on the NYSE or any Major Market Index stocks and there is an order imbalance of 50,000 shares or more, the size of the imbalance must be made public. A trading halt is not required on the basis of a 50,000-share imbalance alone.
2. 50-point decline in the Dow (sidecar): If the Dow falls 50 points below the previous day's closing price, the sidecar procedures that are followed after a 12-point decline in the S&P 500 futures price will be followed except that the sidecar period will last only 15 minutes instead of 30 minutes.
3. 250-point fall in the Dow: No change.
4. 400-point fall in the Dow: No change.

Endnotes

1 Actually, the Brady Commission recommended coordinated circuit breakers for the stock, stock index futures, and options markets because, to have any chance of success, circuit breakers must be coordinated across all markets that trade stocks and products based on stocks (Brady 1988). Although this article concentrates on the stock and futures markets, the arguments apply to all markets that trade products based on stocks.

2 Experts disagree, however, about whether coordinated circuit breakers can stop price declines caused by panic selling. In addition, some argue that even if circuit breakers can stop panic-induced price declines, the costs of circuit breakers might outweigh the benefits (Edwards 1988). This article does not address these questions.

3 Specialists can delay the opening of a stock with the NYSE's approval under certain circumstances (New York Stock Exchange 1989).

4 An order can be sent to the NYSE's trading floor either through the exchange's Designated Order Turnaround (DOT) computer system or it can be carried by hand. Program trading orders carried by hand are not delayed.

5 Specifically, the NYSE's (1989) *Floor Official Manual* states that trading must be halted if: (1) a stock last sold for less than $20 and a trade would cause its price to fall more than one point, (2) a stock last sold for $20 or more and less than $100 and a trade would cause its price to fall more than two points, and (3) a stock last sold for $100 or more and a trade would cause its price to fall more than three points.

6 Unfortunately, the data in Chart 1 cannot be used to determine whether circuit breakers were effective on October 13, 1989, for two reasons. First, although stock and futures prices fell throughout the day, the data provide no information about whether prices would have fallen more or less in the absence of circuit breakers. Second, if the decline in prices was due to economic fundamentals rather than panic selling, the circuit breakers are not supposed to be effective.

7 Stock index futures are used in both static and dynamic hedging strategies. In a static hedging strategy, investors try to guarantee their return on an investment by reducing both downside and upside risk. That is, investors buy or sell a hedging asset such that losses on the portfolio are offset by profits on the hedging asset, and profits on the portfolio are offset by losses on the hedging asset. In a dynamic hedging strategy, investors try to set a lower bound on their return on an investment by reducing downside risk but not upside risk. That is, investors actively buy or sell a hedging asset such that losses on the portfolio are offset by profits on the hedging asset, but profits on the portfolio are not offset by losses on the hedging asset. For a more detailed description of different hedging strategies, see Figlewski 1986.

8 Investors also use futures to hedge because the transactions costs of selling futures, such as brokers fees, are very small.

9 Investors can sell stock index futures even though they do not own any because a futures contract is simply an agreement to sell stocks at a later date. Furthermore, since delivery is not allowed in stock index futures contracts, the investor simply buys stock index futures at a later date to offset the initial sale.

10 While changes in stock index futures prices and portfolio values are closely related, in general, they are not equal. The changes will be equal in the special case where the portfolio is made up of the stocks in the index because the price of a stock index futures contract is approximately equal to the sum of the prices of the underlying stocks. But for other portfolios, the relationship between changes in prices need not be one-for-one. For example, futures prices might consistently change twice as much as the value of a portfolio.

11 Of course, if stock prices rise $10, the investor would lose $10 on the futures. The $10 loss on the futures would offset the $10 profit on the stocks.

12 Actually, the equilibrium S&P 500 futures prices is slightly higher than the S&P 500 index if the risk-free interest rate is larger than the dividend rate—dividends per dollar of stock. Thus, index arbitragers might buy futures and sell stocks even if the S&P 500 futures price is greater than the S&P 500 index.

13 If stock prices are falling because of economic fundamentals, however, speculators would probably expect stock prices to fall in the future so that they would sell futures. These sales would push down stock and futures prices to their new equilibrium values faster than otherwise.

14 Because the investor sells $100 of stocks when futures trading is restricted, the example in Figure 2 implicitly assumes that the hedging strategy requires the investor to sell $1 of futures for every $1 of stock in the portfolio. That is, the hedge ratio is assumed to equal one. In general, the qualitative results are not affected if the hedge ratio does not equal one.

15 The cost of switching to the stock market is high because the futures trading restrictions make a speculator's existing position riskier. For example, suppose a speculator buys

futures during a panic selling period. Normally, if he changes his views about future stock prices, he can offset his position simply by selling futures. But when futures circuit breakers are tripped, the speculator's position becomes much riskier because he cannot sell futures. As a result, speculators would probably not want to take on additional risks and switch to the stock market when futures trading is restricted.

16 Some critics of circuit breakers would argue that temporary trading restrictions, even when coordinated, impose unnecessary costs on traders.

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