# CURRENT ISSUES

## IN ECONOMICS AND FINANCE

# The Effects of Price Limits on Trading Volume:
# A Study of the Cotton Futures Market

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*Will trading volume shift from a market with price limits to a closely related market without them? An examination of the U.S. cotton market reveals that trading volume does in fact move from a class of security that is subject to trading limits (cotton futures) to another that is not (options on cotton futures). The results add to the debate on trading limits by calling into question the limits' overall effectiveness.*

The effectiveness of trading limits—exchange-mandated restrictions on trading during times of market stress—is widely debated. Although different trading limits have existed in various markets for decades and have been scrutinized over the past ten years, no consensus has emerged regarding their ultimate usefulness. Opponents of trading limits contend that they infringe on the efficient, free-market system of price setting, while advocates counter that trading limits impose reasonable restrictions when markets are under extreme strain.

In this edition of *Current Issues*, we evaluate the effectiveness of a common type of trading limits— price limits—by investigating their effect on exchange-traded *volume*, an approach that earlier literature has not addressed. Our analysis focuses on cotton trading volume on the New York Cotton Exchange (NYCE), where cotton futures trading is subject to price limits but options on cotton futures trading is not.[1] The NYCE's structure allows us to study a market's reaction to price limits directly by examining the shift in volume from a market with trading limits to a closely related market without them.  If price limits do in fact restrict trading, then we should see a reduction in overall trading volume when the limits are in effect.[2]

Our results suggest that, on average, aggregate trading volume is essentially the same on days when price limits on futures contracts are binding (that is, when the futures price goes "in limit") as on days when the limits are not binding. The *composition* of trading, however, does change when a futures price goes in limit, because market participants transfer trading volume from the restricted futures market to the unrestricted options on futures market. In terms of total trading volume, the transition of trading from futures-based to options-based strategies appears seamless. Significantly, although our analysis is confined to the U.S. cotton market, we believe that our main conclusion—that trading volume will move from a market with trading limits to a substitute market without them—can reasonably be extended to other markets.

### Trading Limits

Trading limits can take a variety of forms, the most common being:

- *price limits*, which confine the price at which an asset can trade on any given day to a range determined by the previous day's closing price;

- *trading halts*, which prevent all trading in a market (for a set period of time) under unusual conditions, such as massive one-sided order flow;

- *circuit breakers*, which prohibit the simultaneous trading of an asset and a derivative of the asset, such as an option or futures contract; and

- *position limits*, which constrain the number of derivatives contracts that any one market participant can control at any time.

The imposition of trading limits remains a controversial topic from both a theoretical and a practical standpoint. Opponents of trading limits argue, in general, that unrestricted trading of an asset is more efficient than regulated trading. In particular, they contend that trading limits prevent mutually advantageous trades that would occur voluntarily, and that they create costs by preventing market participants from liquidating existing positions or establishing new hedging positions (Commodity Futures Trading Commission 1988; Kodres and O'Brien 1994). In addition, some opponents argue that trading limits impede the "price discovery" process because the price of the restricted asset is not observable to market participants when the price limit is binding (Lee, Ready, and Seguin 1994). Trading limits can also create what many market participants call the "magnet effect" (Hieronymus 1971; Cantor 1989; Fama 1989), which causes trading volume and price variability to increase as market participants anticipate an impending trading limit and advance the execution of their trades.

Proponents of trading limits counter these criticisms by arguing that there is a public good in maintaining an orderly market and that individual market participants do not take this factor into account when trading. For example, some advocates note that trading limits can discourage unreasonable prices that result from excessive speculation because the limits provide a cooling-off period that gives traders time to absorb new information (Khoury and Jones 1983; Ma, Rao, and Sears 1989). Other proponents contend that trading limits can serve as a partial substitute for margin requirements because a price limit "potentially limits the information available to the losing party about the extent of his losses at the time he is required to make the daily settlement" (Brennan 1986). In addition, proponents argue, trading limits may lessen credit risks and curtail detrimental trading strategies by explicitly recognizing that markets have a limited capacity to absorb enormous one-sided order flow (Brady Commission 1988).

Despite their differences, the arguments over the effects of trading limits tend to share an implicit assumption: namely, that there is no closely related market to which one can easily turn when trading limits are in effect, or in other words, that trading limits do, in fact, limit trading. If such a closely related market did exist, neither the proponents' contention that trading

limits allow time for information to be absorbed by the market nor the opponents' claim that trading is less efficient would necessarily be compelling reasons for an exchange to impose or forgo trading limits.

We challenge the assumption behind such arguments by providing evidence that trading limits can be easily circumvented when close market substitutes are available. In the case of the U.S. cotton market, trading volume moves from a class of security that is subject to trading limits (futures) to a class that is not (options on futures).

## The Cotton Market in the United States

Various outlets exist for trading cotton in the United States. These outlets include the spot, futures, and options on futures markets.

**Spot Market.** The spot market for U.S. cotton—trading for the physical transfer of cotton—operates without any formal guidelines on location, time, or size of trading unit, and is subject only to informal requirements for reporting transactions. Most spot market trading in the United States is concentrated in the South and Southwest. Spot prices for cotton are not publicly disseminated through a central quoting mechanism, but are collected and reported at the end of each day by the U.S. Department of Agriculture.[3]

**Futures Market.** Cotton futures are traded exclusively on the NYCE.[4] The cotton futures market provides cotton market participants with a standardized product that serves both their hedging and speculative needs. (Box 1 briefly describes the mechanics of cotton futures trading.) The futures market serves as the primary source of price discovery for the U.S. cotton (both spot and futures) markets on an intraday basis. In fact, the spot market price for cotton is most often quoted as a spread above or below the current futures price. Interestingly, when the futures market goes into limit—that is, when the price limits are binding—liquidity in the spot market diminishes dramatically because the spot price can no longer be easily calculated using the equilibrium futures price.

Futures contracts on the NYCE are subject to daily price limits. During the period examined, September 1995, all cotton futures prices on the NYCE (except for contracts with seventeen or fewer days remaining before expiration) were subject to a two-cent limit move above or below the previous day's closing futures price (referred to as the daily settlement price).[5] For example, if one day's daily settlement price was eighty cents per pound of cotton, all transactions on the exchange on the following day had to take place between seventy-eight and eighty-two cents. This limit expanded to three cents when three or more contracts closed at the limit price for three consecutive trading days.

**Options on Cotton Futures Market.** An options contract represents the right to buy or sell one NYCE futures contract. Like futures contracts, options on cotton futures are traded on the NYCE, in designated areas called trading pits. The options on futures trading pit is adjacent to the futures trading pit, and NYCE members eligible to trade both contracts can easily buy and sell contracts in both markets.

Unlike cotton futures, however, options on cotton futures are not subject to daily price limits. (Box 1 also provides a description of the mechanics of cotton options trading.)

### The Effects of Price Limits on Trading Volume

We study the effects of price limits on trading volume as a function of the fraction of the trading day in limit. The fraction of the trading day in limit is defined as the number of minutes in a trading day in which the futures contract is constrained by its limit price, divided by the total number of minutes in a trading day (250 minutes for cotton futures). For example, if the futures price was at its limit price for 100 minutes of the trading day, the fraction of the trading day in limit would be 0.4 (100 divided by 250). If price limits are effective, we would expect the average cotton trading volume to decrease as the fraction of the day in limit increased. Conversely, if the average number of futures contracts did not decrease (or even increased) as the fraction of the trading day in limit increased, we would conclude that the price limits are not effective at limiting trading. To test the relationship between price limits and trading volume, we conduct a regression analysis of exchange-traded volume and the fraction of the trading day in limit.

Our sample period, the twenty trading days in September 1995, was chosen for its extremely large number of limit moves.[6] On more than half of the days, the cotton price was in limit for some fraction of the day, an occurrence that is very rare because price limits are designed to be triggered only under unusual circumstances. (In fact, for some markets, years can pass without a single limit-move day.) Therefore, although twenty observations may be a small sample for some studies, it is a reasonable quantity in this context.[7]

**Futures Volume.** We find that the total number of futures contracts traded declines significantly as the fraction of the trading day in limit increases (Chart 1). The negative and significant coefficient on the regression variable representing the fraction of the day in limit (Chart 1, inset) implies that the price limits have a

Chart 1
**Futures Volume Relative to Fraction of Trading Day in Limit**

Contracts traded (thousands)



$$\text{Futures volume}_t = 7671 - 5114 * \text{fraction of day in limit}_t$$
$$(758) \quad (1591)$$
$$R^2 = 0.364$$

Fraction of trading day in limit

Sources: New York Cotton Exchange; DRI/McGraw-Hill; authors' calculations.

Notes: The chart presents the total number of cotton futures contracts traded per day in September 1995 (for the December 1995 contract) as a function of the fraction of the trading day in which the contract was in limit. The inset contains the results of the regression relating these two variables, with standard errors in parentheses. The regression line has been added.

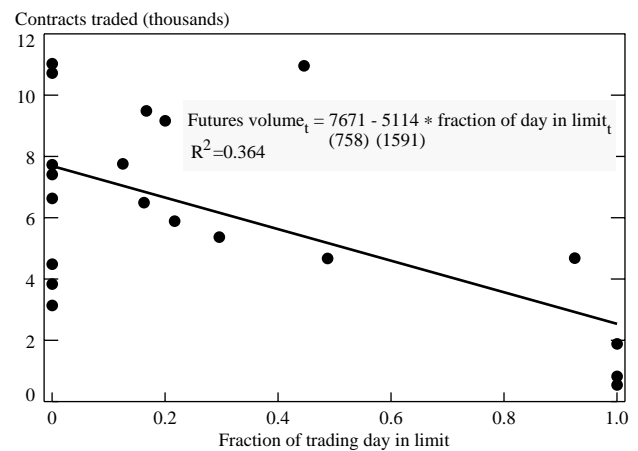---

### Box 1: Cotton Futures and Options Contracts

A cotton futures contract is a standardized legal contract specifying that one party deliver to the other party 50,000 pounds (approximately 100 bales) of a specific grade of cotton at an agreed-upon price (the contract price) at a particular date in the future (the delivery date). For example, if a December 1995 futures contract had a contract price of eighty cents, one party would be obligated to deliver 50,000 pounds of cotton to the other in December 1995 in exchange for $40,000 (50,000 pounds times eighty cents per pound).

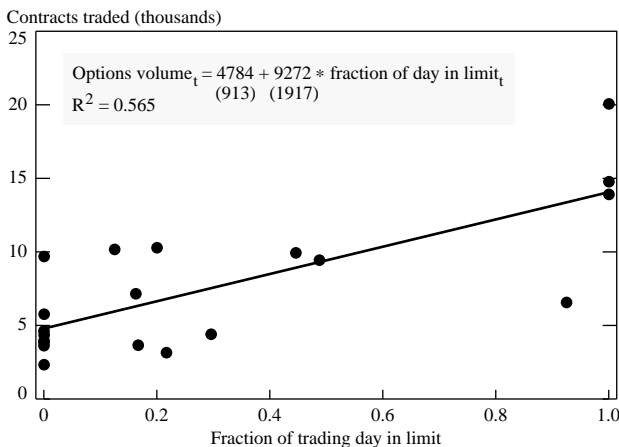An option on futures contract can take one of two forms. A *call option* gives one party the right, but not the obligation, to *purchase* a futures contract with a specified contract price (the strike price) from the other party between the current date and a predetermined date in the future (the expiration date of the option). For example, if one party purchases a December 1995 cotton call option contract with a strike price of eighty, the purchasing party has the right, at any time before expiration, to demand from the seller delivery of a futures contract with a contract price of eighty cents. A *put option* gives the option owner the right, but not the obligation, to *sell* a futures contract with a specified contract price to another party between the current date and the expiration date of the option.

negative and significant impact on the trading volume of futures contracts on the NYCE. The regression suggests that, on average, 7,671 contracts trade on a day when the futures price is not in limit at all (*fraction of day in limit* = 0), but only 2,557 contracts trade on a day when the futures price is in limit all day (*fraction of day in limit* = 1).[8] Therefore, we conclude that price limits are effective in limiting the volume of futures contracts traded.

**Options on Futures Volume.** The large drop in the futures volume fully accords with our expectations. More noteworthy, however, is our finding that the number of options on futures contracts traded increases significantly as the fraction of the trading day in limit increases (Chart 2). The positive and significant coefficient on the variable representing the fraction of the day in limit in the Chart 2 regression implies that price limits lead to a significant increase in options volume. The regression suggests that, on average, 4,784 contracts trade on a day when the futures price limit is not binding at all (*fraction of day in limit* = 0), but 14,056 contracts trade on a day when the futures price limit is binding all day (*fraction of day in limit* = 1).[9] This result leads us to conclude that the trading volume of options on futures increases significantly when the price limits on futures contracts are binding.

**Futures-Equivalent Volume.** The evidence from the cotton market indicates that when the futures price limit is binding for a larger fraction of the trading day, volume shifts from the futures market to the options on futures market. This finding prompts an important

question: How *complete* is the substitution from futures trading to options on futures trading?

To answer this question, we aggregate cotton futures and options volume into a single measure, the "futures-equivalent volume" (Box 2). This futures-equivalent volume is the sum of the futures volume and the options volume, with the options volume weighted to reflect the fact that options are less price sensitive than futures. When we regress the fraction of the trading day in limit on the total futures-equivalent volume traded, we find that price limits do not have a significant impact (Chart 3, inset). On average, 10,064 futures-equivalent contracts trade on a day when the futures price limit is not binding

Chart 2
**Options Volume Relative to Fraction of Trading Day in Limit**



Contracts traded (thousands)

Options volume$_t$ = 4784 + 9272 * fraction of day in limit$_t$
            (913)   (1917)
$R^2$ = 0.565

Fraction of trading day in limit

Sources: New York Cotton Exchange; DRI/McGraw-Hill; authors' calculations.

Notes: The chart presents the total number of cotton options contracts traded per day in September 1995 (for the December 1995 contract) as a function of the fraction of the trading day in which the futures contract was in limit. The inset contains the results of the regression relating these two variables, with standard errors in parentheses. The regression line has been added.

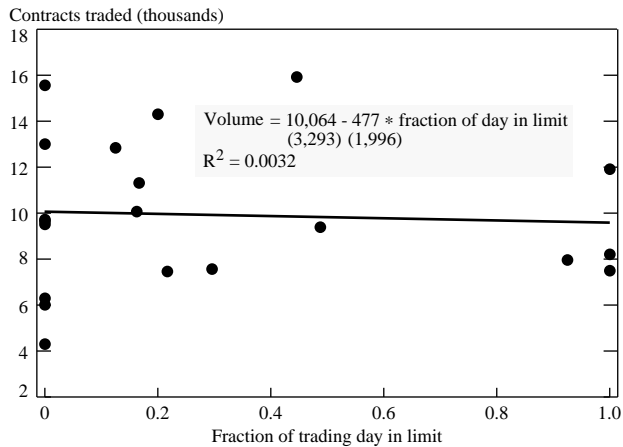> **Box 2: Futures-Equivalent Trading Volume**
> Options can be combined to create an exposure that mimics the exposure of a futures contract. One such combination of options—a purchased call option and a sold put option with the same expiration and the same strike price—is known as a synthetic futures contract because its cash flows are designed to replicate exactly the cash flows of a futures contract with the same expiration. Call spreads, bull spreads, or other options-based trading strategies can also be used to mimic the exposure of a cotton futures contract. Such replication enables market participants to substitute an options-based strategy for a futures-based strategy when the futures are in limit.
>
> Since substitution is possible, we create a measure of aggregate cotton trading volume in order to study the effect of price limits on trading volume across related markets. This measure, which we call the "futures-equivalent volume," is the sum of the futures volume and the options volume, where the options are weighted by the absolute value of their own *deltas*.[a] This method accounts for the fact that options are less price sensitive than futures by adjusting the number of options contracts downward by the absolute values of their deltas.
>
> It is important to use the entire volume of options (weighted by their deltas) because it is not clear which options-based trading strategy a market participant will use when price limits are in effect in the futures market. For example, he or she may choose to use a synthetic futures contract, which is an exact substitute for a futures contract, or switch to other options-based strategies.
>
> [a] The delta is the change in price that an options contract will experience if the price of the underlying futures contract increases by one. The absolute value of the delta of an options contract will be between zero and one. A futures contract (as well as a synthetic futures contract) has a delta of one.

**Chart 3**

**Futures-Equivalent Volume Relative to Fraction of Trading Day in Limit**

Contracts traded (thousands)

$$\text{Volume} = 10{,}064 - 477 * \text{fraction of day in limit}$$
$$(3{,}293) \quad (1{,}996)$$
$$R^2 = 0.0032$$

Fraction of trading day in limit

Sources: New York Cotton Exchange; DRI/McGraw-Hill; authors' calculations.

Notes: The chart presents the number of futures-equivalent cotton contracts traded per day in September 1995 (for the December 1995 contract) as a function of the fraction of the day in which the futures contract was in limit. The inset contains the results of the regression relating these two variables, with standard errors in parentheses. The regression line has been added.

at all (*fraction of day in limit* = 0), and 9,587 futures-equivalent contracts trade on a day when the futures price limit is binding all day (*fraction of day in limit* = 1). Consequently, the average aggregate trading volume in cotton appears unaffected by the fraction of the trading day in which the futures price limit is binding. Therefore, the substitution is complete to the extent that the average futures-equivalent volume traded on limit days is not significantly different from the average futures-equivalent volume traded on days that were not in limit.[10]

## Conclusion

Our examination of the impact of price limits on changes in NYCE cotton trading volume reveals that as the fraction of the trading day in which a futures contract is in limit increases, futures trading declines and options on futures trading rises. However, aggregate futures-equivalent volume remains unchanged. The latter finding leads us to conclude that market participants shift their trading tactics—that is, they switch from outright futures to options on futures. Although it is impossible to determine what the total futures trading volume would be on volatile days in the absence of price limits, our evidence does imply that market participants can easily find ways to circumvent the trading restrictions.

These results raise questions about the motivation behind the design of trading limits. According to our analysis, restricting one class of security while allowing another to trade freely only serves to shift trading around and may not halt overall trading volume in a particular market during a volatile period. In addition, trading limits do not affect all market participants equally. For example, a small number of market participants adhere to self-imposed rules that prohibit trading in the options market because of that market's perceived riskiness. Consequently, these market participants have fewer opportunities to hedge their exposure during limit periods and may resort to trading in other markets whose price movements are less perfectly correlated to the risks they are hedging.

Although our analysis is confined to the cotton market, where options on futures serve as very close substitutes for futures, our results may hold true in other markets. Many exchanges have trading restrictions on various spot and derivatives markets similar to those imposed by the NYCE on cotton futures. Participants in these markets may react to the imposition of trading limits by shifting trading volume to a related market without restrictions, if one is available. Moreover, additional strategies to circumvent exchange-mandated trading limits may entail the transfer of volume from an organized exchange to an over-the-counter market, particularly given the recent advances in technology and the growing importance of the over-the-counter market for derivatives. In summary, restrictions on trading limits are unlikely to be effective unless they are coordinated across market venues.

## Endnotes

1. This feature is found in many agricultural, metal, and energy futures contracts.

2. The ultimate *goal* of trading limits may be to dampen volatility in prices. The *mechanism* through which this goal is achieved generally involves a cessation of trading at some point.

3. A more thorough description of the spot market for U.S. cotton can be found in Anderson, Shafer, and Haberer (1996).

4. There are currently no other competing cotton futures exchanges in the world. Cotton yarn futures trade on the Nagoya Textile Exchange and the Osaka Textile Exchange in Japan; however, they are not viable hedging instruments because of differences in trading hours and grades of deliverable cotton. By contrast, in commodity markets such as gold, oil, or soybeans, trading can shift to another location, such as the United Kingdom, when a U.S. futures exchange imposes price limits (Cantor 1989).

5. This limit increased to three cents, effective January 1996.

6. The futures and options price data and options volume data were obtained from the *Time and Sales* and *Broker Reconciliation* reports, which the NYCE provided. The futures volume data were obtained from DRI/McGraw-Hill.

7. Trading during September 1995 was representative of the 1994-95 crop cycle in terms of volatility and number of trading sessions in which price limits were in effect. Trading during this cycle was unusually active because of strong foreign demand for U.S. cotton as a result of poor crops in other cotton-producing nations.

8. The volume on a day in which the futures prices were in limit all day comprises two types of trades. Market participants may be compelled to trade futures at the limit price—even if doing so implies trading at a disadvantageous price relative to an equivalent options-based strategy—because they are prohibited from trading options (Box 2). Spread trades, which are the simultaneous purchase and sale of two futures contracts with different expirations, represent the other component of volume.

9. Further analysis shows that the volume of different types of options-based strategies—individual options, synthetic futures, and all other options-based strategies—is positively correlated with the fraction of the trading day in limit (Evans and Mahoney 1996).

10. Our main findings are robust to the inclusion of additional explanatory variables in the regressions. Specifically, we included an estimate of intraday volatility, the distance from the price limit to the average synthetic futures price (to capture the strength of the incentive to switch from futures to options), and the time elapsed since the last nonlimit period (to capture any possible pent-up demand for futures trading after a limit period). For details, see Evans and Mahoney (1996).

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