Still in Search for Answers: A Critical Survey on the Circuit Breaker Regulation

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Abstract

Following the 1987 stock market crash, there has been much discussion in policy circles about the use of circuit breakers in financial markets. Proponents argue that circuit breakers reduce overreactions, while skeptics suggest that it harms the price discovery process. As yet, investors know very little about the effects of such breakers on price dynamics, and the few relevant empirical studies that do exist produced very ambiguous results. This paper critically surveys studies conducted on circuit breakers and offers possible reasons for the inconclusiveness of the findings in existing literature.

Key words: Circuit Breakers; Price Limits; Stock Market Volatility.
JEL Classifications: G14, G15, G18

1. Introduction

Circuit breakers, with all their multi-dimensional complexities, have started to interest investment researchers within the last decade or so. Unfortunately, there is no agreement on whether circuit breakers are effective tools or not. Also, to date, most of the existing literature does not aid in resolving this issue.

"Our ignorance is unfortunate because circuit breakers can have very significant effects upon markets" (Harris 1998; p. 1). Whether these effects are positive or negative[1] is debatable. Regulators clearly need to know more about these effects if they are to make optimal decisions about whether or not to apply circuit breakers to their stock exchanges, and if they do apply them, they need to know which ones are most effective.

Though circuit breakers can take many forms, in this paper, my primary focus is on price limits that are triggered by an allowable daily trading band for individual share price fluctuation. Daily price limits set a maximum percentage or value that a security or derivative contract can rise or fall during a set trading session.

Even though research on price limits is mostly empirical, as Kim (2000) points out, the literature on trading halts[2] is more theoretical and can provide some insight into price limits on individual stocks. Therefore, although the focus of this paper is not directly on trading halts, I shall nevertheless outline most of this literature to provide a flavor of past research in an area that most consider essential for the study of price limits.

This paper critically surveys the literature on two types of circuit breakers: trade halts and price limits. Section 2 starts with a quick review of basic concepts necessary to understand the content of this study. Section 3 summarizes alternative research approaches to trading halts and identifies the difficulties associated with research in this area. Section 4 reviews in detail the studies conducted on price limits and discusses arguments for and against them. Finally, section 5 concludes the main findings, provides a summarized comparison between the two literatures earlier mentioned and lays out further extensions that can add value to the field.

2. Basic Concepts

As Harris claims: "All circuit breakers limit trading activity in some way. ***Trading halts*** stop trading when prices have moved, or will imminently move, by some pre-specified amount.

[1] Empirically, some researchers have concluded that circuit breakers reduce volatility (Ma, Rao, and Sears (1989a, 1989b)), others find that volatility increases (Kuhn, Kuserk, and Locke (1990), Lee, Ready, Seguin (1994)). Still others find that the trading restrictions have little effect in the long run (Lauterbach and Ben-Zion (1993), Santoni and Liu (1993), Overdahl and McMillan (1998)).

[2] Another type of circuit breaker mechanism that is triggered by extreme market movements.

Trading resumes after some time interval. ***Price Limits*** require all trade prices to be within a certain range. If traders are unwilling to negotiate prices within the limited range, trading will stop. ***Transaction taxes*** restrict trading by taxing it. ***Margin requirements*** and ***position limits*** restrict the size of positions that traders can accumulate. Finally, ***collars***[1] restrict access to computerized order submission systems" (Harris 1998; p. 2).

There is no consensus on whether circuit breakers are effective tools or not. Table 1 displays the latest debated issues on the effectiveness of circuit breakers. Proponents believe that circuit breakers provide investors with a "cooling-off" period that attempts to reduce the fear and panic that might occur when there are sharp market declines. By contrast opponents, believe that circuit breakers might disturb market activity, as they would lead to liquidity drains and the diminishing of market depth.

Table 1

Debate on the Effectiveness of Circuit Breakers

Two schools of thought on the effectiveness of circuit breakers	
Those who support circuit breakers argue that circuit breakers	**Critics of circuit breakers argue that circuit breakers:**
provide investors with "cooling off" period to calm fears or provide time to digest news when there are steep de lines in the markets;	prevent investors from engaging in equity transactions that reflect their assessments of economic events. Investors might therefore be trapped in their positions;
reduce market volatility and protect investors from excessive market volatility;	accelerate price movements towards the pre-announced limits ("the magnet effect") as market participants alter their strategies and trade in anticipation of a market halt;
provide time to restore the equilibrium between buyers and sellers; and	induce panic and uncertainty if the markets shut down suddenly and scare away buying power necessary to turn a selling panic around;
provide the opportunity for increased information flow.	are unfair to market participants with positions that benefit from the volatility;
	deprive market participants of opportunities to raise liquidity to meet other obligations and lead to a chain of defaults.

Source: SFC Quarterly Bulletin Autumn 2001.

Furthermore, regulators hoping that its mechanisms would decrease volatility adopted circuit breaker restrictions. To evaluate whether this happens or not, and to consider whether they are desirable, the concept of volatility will require further elaboration. According to Harris, "economists identify and differentiate between two types of volatility: **fundamental volatility** and **transitory volatility**. Fundamental volatility relates to uncertainty about underlying security values, whereas, the trading process causes transitory volatility" (p. 2).

[1] In July 1990, the NYSE implemented two collars through amendments to its rule 80A. The first collar prohibits traders from submitting market orders through the Super Dot order routing system when doing index arbitrage program trades if the Dow has moved by more than 50 points from its previous day's close. Instead, index arbitrage traders must submit limit orders or tick sensitive orders. With a tick sensitive order, a trader can only buy on a down or zero-down tick, and can only sell on an up or zero-up tick. This collar stays active until the market has returned to within 25 points of its previous day's close. The second collar of rule 80A is the sidecar. The sidecar is activated in the first five minutes after the S&P 500 futures contract drops more than 12 points (around 96 Dow points) from the previous close. When made active, the Super Dot order routing system diverts all program trading market orders for S&P 500 stocks into a file. At the end of the five minutes, the exchange pairs buy and sell orders and submit any remaining order imbalance to the floor. If the floor cannot handle the imbalance in an orderly fashion, the exchange halts trading in the stock and disseminates information about the order imbalance to the public. The sidecar can be activated only once a day (Goldstein, Evans & Mahoney, 2000).

3. Trading Halts[1]

Trading halts were advocated by the members of the Brady Commission who argued that these mechanisms "cushion the impact of market movements, which would otherwise damage market infrastructures" (Presidential Task Force on Market Mechanisms 1988; p. 66). American stock exchanges instituted trading halts in the year following the 1987 market crash in an effort to protect investors and markets in the event of a future extreme market adjustment.

Though trading halt rules have now been in effect for a decade, the breakers have been triggered fairly infrequently. The trading halts rules originally called for trading interruptions of one and two hours when the Dow Jones Industrial Average (DJIA) fell 250 and 400 points. Because of increases in the level of the market, the point breakers were widened in 1997 and then tied to percentage changes in the DJIA in 1998. Table 2 details the history of circuit breakers in U.S. security markets. These halts were triggered for the first time on October 27, 1997 when the DJIA fell 350 points by 2:35 p.m. In the 25 minutes following the reopening at exactly 3:05 p.m., the Dow fell an additional 200 points to trigger a second halt, which closed the market for the day.

Table 2

Circuit Breaker History

This table provides details on U.S. circuit breaker rules since they were first put in place in response to the market crash of October 1987. The original circuit breakers were triggered when the DJIA moved by a given number of points. More recently, actual point levels are fixed quarterly based on the average closing level of the Dow industrials in the previous month.

First circuit breaker implemented in October 1988	
250 point drop in DJIA	Trading halt for one hour.
400 point drop in DJIA	Trading halt for two hours if additional 150 point drop after trading resumes.
Circuit breakers widened in January 1997	
350 points drop in DJIA	Trading halt for half an hour.
550 points drop in DJIA	Trading halt for one hour if additional 200 point drop after trading resumes.
Current circuit breaker rule adopted in February 1998	
10% drop	Halt trading for one hour if before 2:00 p.m.
	Halt trading for 30 minutes if between 2:00 and 2:30 p.m.
	No halt in trading if after 2:30 p.m.
20% drop	Halt trading for 2 hours if before 1:00 p.m.
	Halt trading for 1 hour if between 1:00 and 2:00 p.m.
	Close the market for the day if after 2:00 p.m.
30% drop	Close the market for the day.

Source: Ackert, Church, and Jayaraman (2000).

Insights into the expected economic impact of a trading halt rule have been provided, mostly, by theoretical studies. Greenwald and Stein (1991) provide support for the Brady Commission's argument that trading halts provide a calming influence in times of market distress. In their model, value-motivated investors withhold orders in response to large volume shocks because transactional risks are high (i.e., traders are unsure of the final execution price they will receive). In the Greenwald and Stein (1991) model, the number of value-motivated investors who respond to a volume shock of uninformed investors is random and exogenous. They attribute the random response in part to uncertainty about the number of investors who are monitoring the market. This

[1] There are two kinds of trading halts: market-wide mandated halts (NYSE Rule 80B) and halts on individual stocks (NYSE Rule 80A). When talking about trade halts in this paper, we assume the first kind unless otherwise specified. Trade halts are commonly identified with the general term: circuit breakers.

uncertainty contributes to the transactional uncertainty that causes these investors to withdraw from the market when uninformed traders cause prices to change quickly. Although they conclude that trading halts can help these value-motivated investors better read the market, and thereby improve market quality, they do not model the effect of a trading halt on the distribution of the number of value-motivated traders who initially respond to volume shocks.

Subrahmanyam (1994) provides a theoretical model that offers a different position on the usefulness of trading halts. If investors fear that a halt will occur before they can submit their orders, they may submit them earlier in order to increase the probability that they execute. Thus, a circuit breaker rule will intensify price movements and increase volatility, which is the opposite effect regulators seek. Subramanyam's basic static model assumes that three types of traders trade one risky security. The first type: a competitive market maker, who absorbs the net demand of the other traders and then sets the price. The second: a risk-neutral trader who possesses private information about the fundamental value of the risky security and the third is the informationless trader whose share demands are exogenous. He further assumes that market makers are risk averse and possess negative exponential utility[1]. Furthermore, Subrahmanyam extends his model to intertemporal and multimarket contexts and still finds the same results.

Again, empirical studies on market-wide trading halts are scant, in part, because it is impossible to reliably estimate the net effect of a trading halt on the market. One can attribute various reasons to such a phenomena. Stock prices and associated volatility may change for a variety of reasons, including the distribution of informed and uninformed traders, macroeconomic factors, and investor sentiment. Moreover, empirical methods may or may not permit the researcher to ascertain what would have happened in the absence of trading circuit breakers.

Furthermore, in practice, it is very hard to accurately decompose volatility into its transitory and fundamental components[2]. As a consequence, fundamental volatility factors will affect the estimated transitory volatility component whenever the decomposition is not perfect thus greatly complicating all the statistical inferences.

Finally, given the fact that these empirical studies are geared towards studying financial markets in general and circuit breakers in particular, time series (sample period) problems usually arise. Researchers usually try to avoid time series problems by examining large samples. In order to draw reasonable conclusions about circuit breakers, researchers should clearly define what they mean by large samples. According to Ackert, Church and Jayaraman (2000) "a sample can be large in three ways. It may include many rule adoptions, it may include many securities that get affected by a single regulation, or it may include many time periods affected by a single rule" (p. 4).

Harris further adds "the strongest study would be the classical event study… economists like to analyze a sample of many circuit breaker adoptions. If these adoptions occurred at different times, a before and after contrast study should result in insightful conclusions" (p. 13). Unfortunately, very few trading halts have occurred. As a result of these empirical research difficulties, researchers have tried to conduct different kinds of studies that might provide us with more insights on the effectiveness of circuit breakers.

Ackert, Church and Jayaraman (2000) found that using an experimental method can control for the various problems such as specifying the level of uncertainty, the distribution of information across traders, and the fundamental determinants of asset value. They add that the use of an experimental method makes it easier to examine behavior under alternative market structures[3] (e.g., in the presence and absence of trading halts).

In their study they use an experimental method to analyze the impact of trading halts on price dynamics, trading volume, and profit-making ability. They conduct nine experimental asset

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[1] Subrahmanyam justifies modeling market makers as being risk averse by argueing that since risk aversion is a "cost" of providing services, the market maker who actually operates would be the least cost agent (i.e., least risk averse). He adds that circuit breakers function under extreme price movements, which are also likely to correspond to conditions with extreme trading volume. Under such conditions, market makers are very likely to act as risk averse agents.

[2] Harris (1998) provides an example of how hard it is to decompose volatility.

[3] Ackert, Church and Jayaraman (2000) argue that such an examination cannot be conducted in naturally occurring markets and provide reference to McDaniel and Hand (1996) for further discussion of an experimental approach.

markets to compare behavior across three regulatory regimes: market closure, temporary halt, and no interruption. In the sessions with market closures, no transactions are permitted for the remainder of a trading period if the circuit breaker is triggered. With temporary halts, market activity is interrupted when a price movement triggers the breaker. Finally, in the sessions with no interruptions, market participants are free to transact at any price during the trading period. They conduct three market sessions with each institutional structure and in each market they vary the level of uncertainty and information asymmetry among traders.

The main conclusions are that the deviations from the expected price are not different in the presence of temporary halts and permanent market closures. Moreover, the primary driver of deviations from fundamental value is the level of information asymmetry in the market. They also find that in periods with greater information asymmetry the deviation is twice as large as that in other periods. Their analysis of trading volume indicates that circuit breakers affect trading activity in a significant way. When they control for the time the market is open for trading, activity is greater in the market closure regime than in the temporary and no halt regimes. The possibility of market closure accelerates trading activity. Finally, they find that trading halts do not affect trading profits in a significant way indicating that traders are unable to exploit informational advantages.

Although these laboratory results are intriguing, they must be treated with caution. Traders in these experiments trade primarily to rebalance their portfolios rather than to exploit private information. Furthermore, since extreme volatility in the real world is due largely to uncertainty about common values rather than to uncertainty about distribution of quantity among traders who value assets differently, these results may have limited relevance.

Lee, Ready and Seguin (1994), Santoni and Liu (1993), Overdahl and McMillan (1997), Goldstein, Evans and Mahoney (2000) have found an alternative way to study the effectiveness of trading halts. Rather than focusing on market halts similar to the ones mandated by NYSE rule 80B (market-wide halts) they research NYSE rule 80A[1]. Again the obvious reason here is that rule 80B has only been triggered on one occasion, which makes examining such types of regulation very hard.

Lee, Ready and Seguin (1994) examined NYSE trading halts on individual stocks[2] to determine what effect they have on subsequent trading volumes and volatilities. To control for the fact that these events are usually associated with large price changes, they match trading halts with events they call "Pseudo Halts"[3]. The results show that the reopening trade that ends the halt does not have significantly higher volume than the cumulative volume over the price-matched pseudo halt period. However, they find that volume and volatility for the trading day following the halt are significantly larger than corresponding measures following the matched psuedo halt. They conclude that halts stabilize prices in the market.

Economists, however, have criticized Lee, Ready and Seguin's findings. As Harris eloquently explains: "the halts may be associated with more significant information than the pseudo halts…The most that these events call tell us about circuit breakers is that halts clearly do not overwhelmingly stabilize the market" (p. 17).

Santoni and Lui (1993) test for changes in volatility surrounding the adoption of trade halts using an Autoregressive Conditional Heteroscedasticity (ARCH) model[4]. Using data through May 1991, they find no significant effects. Harris (1998) concludes that the use of the ARCH process is

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[1] First implemented on August 1, 1990, NYSE rule 80A was established to reduce excess market volatility by adding frictions to the linkage between the cash and the futures markets. Implicitly, it is intended to prevent "the tail from waging the dog" by preventing index arbitrage traders from further pushing individual stock prices in either rising or declining markets. Rule 80A used to go into effect whenever the DJIA moves either up or down by 50 points or more from its previous day's close. When in effect, rule 80A restricts index arbitrage traders from making destabilizing trades. In other words, the rule requires that once the DJIA has advanced (declined) by 50 points or more, all index arbitrage orders to buy (sell) any S&P component stock must be entered as a "buy minus" ("sell plus") order. This restricts those using an index arbitrage strategy from buying NYSE stocks in a rising market or selling NYSE stocks in a falling market. The rule stays in effect for the remainder of the day unless the DJIA returns to within 25 points of the previous day's close, at which point rule 80A is lifted. On February 11, 1999, the U.S. Securities and Exchange Commission (SEC) allowed the NYSE to change rule 80A so that it is triggered upon a 2% change in the DJIA. All the studies discussed here pre-dates this change.

[2] The most common reasons for this halt are order imbalances, news pending, and news dissemenation.

[3] Similar price episodes in the same stock for which there was no halt.

[4] The ARCH model was introduced by Engle (1982).

not needed and probably does not contribute much to the results. The ARCH model allows the authors to illustrate how variances change at high frequencies through time. Since the effect of trade halts on volatility should be a long-term effect, it will act at very low frequency.

Overdahl and McMillan (1997) study the effect of rule 80A on trading in the cash and futures markets. The authors find that index-arbitrage trading volume significantly declines during the 68 observations in their sample when rule 80A is triggered (consistent with early work published by the NYSE (1991)), but prices in the cash and futures markets nonetheless remained linked.

Finally, Goldstein, Evans and Mahoney (2000), using minute-by-minute data from 1988 to 1997 examine the effectiveness of rule 80A in reducing stock market volatility. Using a variety of parametric and non-parametric specifications to examine if volatility is dampened during those times NYSE rule 80A is in effect. They first examine the intra-day patterns of stock market volatility, and then examine the effects of rule 80A during both up and down movements. Overall, after controlling for other volatility determinants, they find that rule 80A has a small but statistically significant effect in reducing stock market volatility. Furthermore, the effect is asymmetric in that volatility is reduced more in a rising market than in a declining one.

4. Price Limits[1]

Unlike circuit breakers, price limits are not a trading halt per se, since they do not create a timeout from the trading process. Trading can continue immediately if buyers and sellers agree to a price within the limit bounds. Once again, price limits set a maximum percentage or value that a security or derivative contract could rise or fall during a trading day. Many financial asset markets have daily price limits on individual markets. U.S. future markets are perhaps the best-known example[2], but price limits are mostly common in non-U.S. equity markets, including Austria, Belgium, Egypt, France, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, Spain, Switzerland, Taiwan, and Thailand. Because of its less disruptive nature, price limits are instituted in more markets than other circuit breakers. Table 3 lists the major stock markets that have price limits in place, ranging from 5% to 60%.

Table 3

Stock Markets with Price Limits

Stock Markets	Price Limit
Austria	± 15%
Belgium	± 5-10%
Egypt	± 5%
Finland	± 15%
France	± 15%
Luxembourg	± 5%
Portugal	± 15%
China	± 10%
Japan	± 10-60%
Korea	± 15%
Malaysia	- 30% (downside limit only)
Taiwan	± 7%
Thailand	± 30%
Turkey	± 10%

[1] There are two types of price limits: tick size and trading session price limit. The tick size rule specifies the minimum allowable price change from one trade to the other and the tick size varies with the security price. The trading session price limit rule determines the maximum allowable percentage change in the price of a security during a session.

[2] Price limits are common features of commodity futures contracts traded in the U.S. since 1925. Over time, they have been adopted on financial futures contracts as well (SFC Quarterly Bulletin Autumn 2001).

Sources: various exchange websites.

These stock markets offer little explicit justification for price limits. For example, The Taiwan Stock Exchange says it imposes price limits "…in order to maintain a stable stock market[1]…" The Tokyo Stock Exchange (TSE) justifies its price limit system by stating that "it prevents day-to-day wild swings in stock prices," and that it also provides a "time-out" period[2]. These appealing reasons doubled by the thought that studying price limits might convey more about trading halts has generated interest among researchers interested in the subject matter[3].

Despite, the appeal of studying price limits, research confirming any benefit is lacking. Empirical price limit studies on U.S. futures and non-U.S. equities investigate two main questions: do price limits reduce volatility, and do they alleviate investor overreaction?

Ma, Rao, and Sears (1989a and 1989b) examine limit moves in Treasury bonds, silver, corn and soybean future contracts using event study methods. They find evidence of price reversals after limits are reached, indicating overreaction and subsequent correction. They also find that volatility decreases following the limit move. In their own words, this evidence suggests that price limits provide a "cooling-off period" for the market.

In referring to the studies of Ma *et al.* (1989a and 1989b), Lehman (1989) and Miller (1989) both question the gained insights from studying volatility after limit days since post limit prices will undoubtedly experience less volatility. In other words, "the results are probably due more to mean reversion than to the limit move" (p. 3).

Lauterbach and Ben-Zion (1993) studied the Tel Aviv Stock Exchange (TASE) trading during the week of October 19, 1987, to determine what effect the price limits had on trading. The TASE then used a single price auction to trade all stocks. The rules then, in effect, required that clearing price be within ten percent of the previous close, otherwise, trade in the stock would halt (that is, it would not trade at all). Unlike other markets, today's excess demand and supply schedules based on yesterday's closing price are publicly known before the single price auction. If there is a limit price move, these schedules are also known at the price limits. Lauterbach and Ben-Zion use this information to determine the extent to which the previous day's order imbalance disappeared on the day following a trading halt. The results indicate that the halt eliminated some, but not all, of the imbalance.

According to Harris, the TASE results are subject to alternative interpretation. The reduction in the order imbalance could have resulted from reversal in valuations. "If the price change following a large price change is random (as opposed to being a reversal due to the large price change or the trading halt), then the TASE evidence is not particularly reliable. It is the result of a one-shot event study" (p. 18).

Price limit critics, on the other hand, contend that there are at least three problems with price limits: volatility spillover, delayed price discovery, and trading interference.

Kim and Rhee (1997) empirically test the three above-mentioned hypotheses by employing a new design to examine price limit performance. Kim and Rhee's new design stems from Lehmann (1989) and Miller (1989) which both criticize Ma *et al.* (1989a) by claiming that their findings are inevitable and trivial evidence for price limits and that volatility is biased (inclined) to decrease on days after high volatility. In direct response to these contentions Kim and Rhee compare the behavior of stocks that reach a price limit to stocks that almost reach their daily limit. By examining the post limit day behavior between both stock categories, they are able to conduct an analysis superior to studies that merely compare post limit days to limit days of stocks that hit limits. Since the former group of stocks experience restraints in their price movement while the latter group of stocks do not, any significant difference in the post limit day behavior can be associated with the price limit.

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[1] Taiwan Stock Exchange Fact Book (1996).
[2] TSE Website (http://www.tse.or.jp)
[3] Chen (1993) studies the Thai Stock Exchange, Kim and Rhee (1997) study the Tokyo Stock exhange and Mecagni and Shawki (1999) – the Egyptian Stock Exchange.

Kim and Rhee apply their novel technique to the Tokyo Stock Exchange (TSE) [1] and find compelling evidence to question the effectiveness of price limits. For stocks that experience limit hits, they document the following results: volatility does not return to normal levels as quickly as the stocks that did not reach the limits (volatility spillover hypothesis); price continuations occur more frequently than for stocks that did not reach the limits (delayed price discovery hypothesis); and trading activity increases on the day after the limit day, while all other stock sub-groups experience drastic trading activity declines (trading interference hypothesis).

Their work, though, is subject to criticism in two ways: first, the sample sizes are small, and second the TSE price limits are set with a very wide band that the limits are rarely reached (see Table 3).

Chen (1993) looks at the imposition of price limits in the Thai Stock Exchange and empirically compares volatility before and after the change using GARCH methods to model the time structure in volatility. He finds that conditional volatility increases significantly in the sub-period after the imposition of the price limit mechanism. Similarly, Mecagni and Shawky (1999) using a GARCH-M (p,q) model examine whether the introduction of price limits to the Egyptian stock exchange affected the trading habits (mean-variance portfolio postulate) of investors. The results show that price limits have significantly disrupted the risk-return relationship. These two studies experience criticism due to the fact that the reliability of GARCH specifications has yet to be proven. Moreover, they are essentially one-shot event studies[2].

Kim (2000) studies price limits and their effects on stock market volatility in a very different and interesting way. To conduct his study, he looks at the Taiwan Stock Exchange (TSE) and conveys that it offers much promise for insightful empirical investigation especially because, since 1962, they have had eleven different price limit ranges. Since time-series data were available from 1975 to 1996, the study period only overlooked six out of the eleven different price limit ranges.

Table 4

Average Variance of Daily Returns under Different (TSE) Price Limit Regimes[3]

Variance measures are multiplied by 100. An *F*-value from the Levene's test for homogeneity of variance is reported at the bottom of the table. When conducting pairwise variance comparisons, the symbols < and > are used to denote whether the variance from one regime is smaller than, or larger than, the variance from an adjacent regime. For the pairwise comparisons, statistical significance is determined using *F*-statistic (reported below < > symbols) on the ration of the two variances.

	IV		V		VI
Time Period	10/27/87-11/13/88		11/14/88-10/10/89		10/11/89-12/31/96
Price Limit Range	3%		5%		7%
Stock Return Variance	0.4129	>	0.3218	>	0.0996
		$F = 1.29^{*}$		$F = 3.22^{*}$	
No. Observations	10,991		21,634		483,767
Test for Equality of Variance	$F = 252.7^{*}$				

*Denotes statistical significance at the 5% level.

In Kim's empirical approach, he measured the variance of daily stock returns for each of the six price limit regimes that existed within the span of the time period he has selected. Pair-wise comparisons were conducted between adjacent regimes to see if the regime under more restrictive price limits had lower volatility. This actually makes sense because market regulators are most likely to make revisions to their price limit mechanism as a response to current market conditions. However, because price limits constrain daily returns, calculating the simple variance of daily returns will suffer an estimation bias. Therefore, when he encounters a price-limit-hit day, he calculates a proxy for

[1] The TSE is the second largest stock exchange in the world in terms of market capitalization and its price limit system has remained unchanged since 1973.
[2] See Kim (2000) for event studies criticism.
[3] Portion of Table 1 in Kim (2000).

the 'true' return in the following manner: the closing price for that day is assumed to be the closing price on the next subsequent day, which did not have a limit move. In other words, the returns are accumulated until a subsequent non-hit day occurs, and he treats that as a single return observation. Moreover, Kim assumes that these proxy returns can reasonably represent the returns that would have been observed in the absence of price limits. In fact, this approach follows the same method used by Roll (1984) to identify "economic" returns in his study of orange juice future prices.

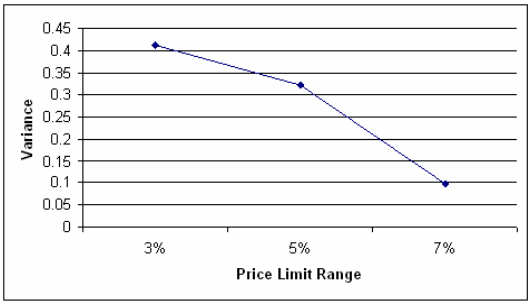

Fig. 1. Average Variance of Daily Returns under Different (TSE) Price Limit Regimes[1]

This figure depicts volatility at different price limit levels. It can be seen that the stock market is less volatile when price limits are less restrictive.

His results found, for the most part, that the stock market is not less volatile when price limits are more restrictive. In fact, it appears that the markets are more volatile under stricter price limits, especially when *adjacent* comparisons are made (See **Table 4** and **Figure 1**). These results contradict the widely held view among regulators that restrictive price limits can moderate volatility.

5. Conclusion

Recent economic and financial turmoil has created a high demand for more regulation of stock markets in the national and international arenas. This high demand, in turn, has lead researchers to conduct more studies on regulatory mechanisms such as circuit breakers in order to understand their effectiveness. Unfortunately, both empirical and theoretical studies have turned out to be ambiguous and offer very little guidance.

The literature on trading halt has had theoretical studies to its advantage; unfortunately, the results are far from concrete. Moreover, due to the fact that market-wide trading halts have been rarely experienced empirical studies have been very hard to sketch. This has motivated researchers to find alternative methods to draw empirical conclusions. These methods have included experimental studies, trade halt on individual stocks studies, and price limit studies. Unfortunately, due to a lack of relevant data and the presence of numerous credible alternative explanations for volatility, these empirical correlation studies do not provide much guidance too.

In order to obtain more reliable results, I believe that regulatory mechanisms such as the different types of circuit breakers should be studied theoretically and empirically independent of each other. Even though the literature on market-wide trading halts can provide some insights, by analogy, into price limits and vice versa. The findings are limited. Trading halts differ institutionally and theoretically from daily price limits. While a share price is capped before it reaches its limit, individual prices prior to trade halts are not capped in the same way. Furthermore, trade halts affect all stocks equally and limits on individual stocks directly affect these respective stocks. Trade halts affect a portfolio's entire equity component from its market, but a price limit hit affects only a small part of a diversified trader's portfolio.

Finally, after reviewing price limits and trade halts, I believe that studying price limits has a higher potential of providing answers regarding the little understood effects of circuit breakers. Need-

[1] Graphed from portion of Table 1 in Kim (2000).

less to say, price limits give us a chance to study its mechanism both theoretically and empirically. No direct theoretical work that I am aware of has modeled how price limits may reduce market manipulation in young developing markets. Furthermore, a lot of political economy questions remain to be modeled and tested, for example: When should markets adopt price limits and what should be the optimal band to use? Theory will help us set the path and it's the empirical strength of the field of price limits that will guide research to the right direction to ultimately find answers.

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