

**UNIVERSITY OF CALIFORNIA**

**Los Angeles**

**Circuit Breakers and Price Discovery**

**Theory and Evidence**

**A dissertation submitted in partial satisfaction of the  
requirements for the degree Doctor of Philosophy  
in Economics**

**by**

**Jong-Won Yoon**

**1994**

To Prof. David Levine

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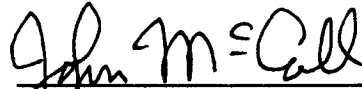
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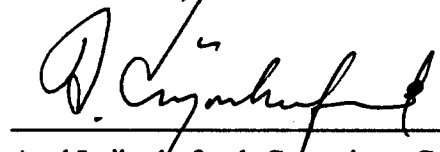
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1994

*I dedicate this dissertation to my parents and to my wife, Soo-Hyang.*

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## **ABSTRACT OF THE DISSERTATION**

**Circuit Breakers and Price Discovery  
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**Professor Axel Leijonhufvud, Co-Chair**

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**This dissertation analyzes how circuit breakers affect stock price behavior. We present an auction-based asset market model in which traders with differential information about an unknown true value of an asset trade an indivisible share in a simple clearinghouse. Based on different trading rules which mimic the actual trading process in a market with and without circuit breakers, we investigate how the existence of circuit breakers makes a difference in the resulting price behavior. Our model suggests that in presence of circuit breakers, asset prices overshoot their equilibrium value that would have been achieved without circuit breakers. We identify this price overshooting as an institution-induced phenomenon, since the existence of circuit breakers themselves becomes a source of panic trading by enticing people to overreact**

to an underlying shock.

In order to examine how circuit breakers have worked in actual stock markets, we investigate Korean stock market data which possess a large number of circuit breaker triggered observations. We test whether the price overshooting hypothesis suggested in the model is empirically valid. The test of price overshooting is based on the idea that stock price behavior would systematically differ if circuit breakers are triggered than if they are not. We find a significant negative (positive) bias after the upper (lower) circuit breaker bound is triggered, supporting the price overshooting hypothesis. We also examine how circuit breakers affect price volatility using a variant of the Autoregressive Conditionally Heteroscedastic (ARCH) model. We find that price volatility becomes greater after circuit breaker-triggered events compared to non-triggered events.

In sum, the existence of circuit breakers, aimed at reducing volatility in compensation for an efficiency loss, does not aid price discovery. Rather, the findings of price overshooting and increased volatility indicate that circuit breakers destabilize prices: exactly opposite of what this regulation intends to accomplish. This evidence suggests the need for more careful formulation in the design and implementation of circuit breaker mechanisms.

# Chapter 1.

## Introduction

Stock markets play a central role in a modern industrial economy, both as a harbinger and a facilitator of economic activities. Moreover, they are the primary engine of a nation's economic growth by providing means by which industries raise capital to finance innovative businesses and to provide employment opportunities. Given the importance of stock markets to the economy and to the public, it is critical that they be maintained in an effectively structured and well functioning manner. However, an event threatening their integrity occurred in October of 1987. Not only did this event bring about a one third price decline across the globe, but also significantly impaired people's confidence in the entire financial system. One of the institutional responses to this extraordinary event was to introduce circuit breaker mechanisms as a device to prevent unusual market breakdowns. This paper attempts to answer the following question: "What would have occurred in October of 1987 if there had been circuit breakers?"

Circuit breaker mechanisms, by themselves, are not new. As Grossman (1990) points out, stock markets experience a daily "circuit breaker" between the close of trading on one day and the opening of trading the following morning. However, the intraday programmed circuit breakers are different from regular market closings in the sense that the latter is perfectly *predictable*. Different stock markets have instituted their own intraday circuit breaker systems. For example, the New York Stock Exchange (NYSE) in the United States introduced trading halts after Black Monday in

1987. In other cases, some Asian countries placed daily price fluctuation limits on how much a stock price can change in a day.<sup>1</sup> Most exchanges which have placed a limit on price movements usually stipulate the following objective: "to prevent rapid price changes and to promote investors' confidence by reducing market volatility." That is, by introducing mechanisms that break the circuit under unusual market stress, traders are allowed a chance to catch their breath and calmly assess their positions, thereby preventing market breakdowns.

Since the October market crash, there have been extensive studies on whether the existence of circuit breakers can achieve the above objective, that is, to aid price discovery and stabilize price movements. However, existing studies report mixed results from both a theoretical and empirical perspective, and the effect of circuit breakers on price movements remains to this day controversial.

This dissertation analyzes whether the existence of circuit breakers does help facilitate the price discovery process. We examine stock price behavior in response to a shock to the asset when price changes are subject to a predetermined fluctuation limit. An asset market model incorporating auction theory is employed to analyze the price formation process in stock markets. Based on different trading rules which describe the actual trading process in a stock market with and without circuit breakers, we investigate how circuit breakers affect traders' bidding decisions and make a difference in the resulting price. We show that, in the presence of circuit breakers, asset prices overshoot the equilibrium value that would have been achieved without circuit breakers. That is, the introduction of circuit breakers for the purpose of reducing excess volatility may actually destabilize price movements.

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<sup>1</sup>Such price limits specify either a maximum amount of daily change which might differ for different price ranges (Korea and Japan), or a maximum proportion of the previous day's closing price (Taiwan and Thailand). We also find such a price limit in futures markets. Daily price fluctuation limits on the Chicago Mercantile Exchange (CME) are an example.

The reasoning underlying price overshooting is explained as follows. In the model, price changes are driven by a fundamental shock to the asset as well as a supply shock. Since prices are not fully revealing due to the supply shock, traders supplement their private information with price information when available. In the presence of circuit breakers, price information is given to traders as a truncated distribution. This leads traders to guess that the underlying shock is so large that the equilibrium price is beyond the circuit breaker bound. Belief adjustment based on the truncated price information causes some traders (called *naive* traders) to overreact to the underlying shock since their reservation price becomes greater when it is conditioned on that information. Since they regard prices as exogenously given, they do not consider the possibility that their aggressive bidding results in a greater price than the equilibrium level. Recognizing the consequence of aggressive bids submitted by some traders, other traders (called *sophisticated* traders) behave conservatively and submit lower bids than their reservation prices. The resulting market clearing price as a function of both traders' bidding strategy is shown to be greater than the price determined in a market without circuit breakers. However, as more rounds of trading continue, prices converge to their equilibrium level.

While an once and for all shock is assumed throughout the analysis, we also discuss the presumed benefit of circuit breakers under the assumption that shocks arrive in the market each period. In this situation, circuit breakers may have a beneficial effect by preventing a sudden price change due to a temporary volume shock. A release of information about order imbalances while circuit breakers are in effect can make traders recognize that the price change is mostly due to a particular realization of a supply shock. Also, if circuit breakers can affect a realization of the supply shock by inducing more value traders to the market, they might contribute to

moderate price volatility. However, price overshooting occurs even under this circumstance if there are some traders whose updated bids are based on the truncated price information. That is, in a situation where it is unknown whether a price decline is due to a fundamental or supply shock, a triggering of circuit breakers may cause traders to overreact and scare them away from the market rather than reassuring them. After all, whether circuit breakers are effective in moderating price volatility will depend on which effect dominates the other.

We rely on the real market data to see how circuit breakers have worked in reality. Korean stock market data are employed considering the advantage that they have in providing a large number of circuit breaker triggered observations. Identification of price overshooting in an empirical context is based on the idea that if price overshooting has occurred, successive stock returns after the circuit breaker-triggered events no longer follow a martingale which would have held otherwise. A significant negative (positive) bias in price movements is detected after the upper (lower) circuit breaker bound was triggered, suggesting that there is a substantial price overshooting. It is also found that price volatility is greater for the circuit breaker-triggered events compared to non-triggered events. This evidence of price overshooting and increased volatility indicates that circuit breakers did not facilitate price discovery. On the contrary, their very existence impairs price discovery and consequently destabilizes price movements.

However, there may be situations where circuit breakers would be beneficial. For example, while we analyze a situation where there is no system overload, the huge order flows beyond the limited capacity of exchanges may create bottlenecks in the order transmission process. Also, markets may have built-in amplifiers of feedback effects of price movements such as margin calls. In such situations, circuit breakers



can help the price discovery process by preventing or retarding possible endogenous amplifying feedback effects. Although this study cannot deny such a rationale of circuit breakers, it suggests the need for more careful formulation in the design and implementation of circuit breaker mechanisms.

The remaining chapters of this dissertation are organized as follows. Chapter 2 briefly reviews the literature regarding the effects of circuit breakers on price behavior. Chapter 3 presents a theoretical framework to analyze the stock price behavior in the presence of circuit breakers. Chapter 4 provides a connection between the theoretical deductions and empirical inferences. It addresses the question of how to identify price overshooting if any, and also differences in price volatility caused by the triggering of circuit breakers. Chapter 5 describes the data set and its variables. Based on the reasoning suggested in Chapter 4, we present the empirical evidence about whether circuit breakers help facilitate price discovery in actual stock markets in Chapter 6. Besides providing descriptive statistics, we also test the price overshooting hypothesis and the volatility implications of circuit breakers. Chapter 7 discusses the existing arguments for circuit breakers and suggest their rationale based on our empirical results. The last chapter concludes this dissertation with several comments and a summary.