The Effect of Daily Stock Price Limits on the Investment Risk: Evidence from the Egyptian Stock Market

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Abstract

The study aims to investigate the relationship between daily price limits and stock volatility, trading volume, delayed adjustment of stock prices, and its fair value. To achieve this goal, we used the data of the listed firms in EGX30. We analyzed the data using descriptive analysis then we applied General linear model, ARCH and GARCH models. Based on our analysis results show a positive relationship between upper daily limit and stock volatility, a positive relationship between daily price limits (upper limit- lower limit) and trading volume, a positive relationship between upper daily limit and the return between the closing price and the opening price on the same day, a positive relationship between lower daily limit and the return between the closing price and the opening price in the next day, a negative relationship between upper daily limit and the return between the closing price and the opening price in the next day, and a positive relationship between daily stock price limits and the fair value.

Keywords: Volatility spillover, Delayed price discovery, Trading interference, Fair value, Daily limits

1. Introduction

Daily price limits are mostly used in the emerging financial market to avoid sharp and undesired fluctuations in daily stock prices. Limiting daily price fluctuations to a certain percentage is used to smooth stock price movements in the market place. Boundaries of daily price limits differ between countries for example; it is 10% in Shanghai, 5% in Australia, 7% in France, 4-8% in Greece, 15% in Korea, 30% in Malaysia and 7% in Taiwan.

In Egypt, a daily price limit of 5% is used for such purpose. The aim of using the mechanism of daily price limits is to avoid the circuit breaker, as information reaches the irrational investor. Daily price limits give irrational investors the time span needed to make rational investment decision Chen (2014). Also the daily limits save much time for investors during the trading session and protects small investors from the undesired speculations. Thus, daily price limits may increase the level of confidence of small investors in the market mechanism Chen (2005).

However, using daily price limits has its pros and cons. On the one hand, proponents of applying the daily price limits refer to the fact that this system can prevent the price collapse. They claim if applied in 1987, it might prevent the market crash of October 1987. Also, the system offers an opportunity to the irrational investor to slow down the re-evaluation processes and rationalizes his investment decisions. Moreover, proponents of daily price limits, state that such limits decrease the degree of price volatility in a way that minimizes the over-reactions of investors in the market. Additionally, such limits neither have an affect nor represent any intervention in the trading activities.

On the other hand, critics of the daily price limits are so many. They claim that daily price limits cause spillover of the risk related to the stock over a longer period of time rather than one day for example (Volatility Spillover Hypothesis), delays the discovery of the equilibrium price that is reached whether through one trading day or through a number of days, according to what is permitted by the applied system of daily price limits (Delayed Price Discovery Hypothesis), and it represents an interference in trading activities, hindering the market mechanisms from taking the financial market to better efficiency levels (trading interference hypothesis).

It appears that no published studies have been conducted purely in the Egyptian context, addressing the implications of daily price limits system. That is why this study is vitally important and unique, and why we were motivated to undertake it. Therefore, this study aims to explore the impact of daily price limits system on stock volatility, trading volume, delayed adjustment of stock prices, and its fair value.

The rest of the paper is organized as follows: section 2, provides a review of the relevant literature, section 3, data and methodology, section 4, results of the data analysis, section 5, represents the conclusion and further research.

2. Literature Review

This section presents a survey of the relevant literature in daily price limits. We benefit from the previous research effort in shaping our research problem and in the development of the research hypotheses. We organized the literature review to reflect the main stream in daily price limits research, namely, price limits and stock volatility, price limits and trading volume, price limits and equilibrium price, price limits and the fair value.

2.1 Daily Price Limits and Stock Volatility

Kim (1997) examined the relation between the implementation of daily price limits, and its impact on the maximum limit of price variation, trading volume, daily stock return. He used Tokyo stock market data covering the period from 1989 to 1992 and used the event study methodology. Kim (1997) concluded that daily price limits decrease the volatility of stock returns and do not conflict with the trading volume.

However, Lehmann (1989) examined the relationship between the daily price limits and stock volatility. The same results were obtained from the Chinese and New York stock markets, based on the event study. Lehmann (1989) concluded that the inconsistency between supply and demand during the trading session is what imposes the arrival of the prices at their limits (maximum limit- minimum limit). He also concluded that the price limits do not cause decreasing volatility, but it is a reason for extending the spread of risk to a longer term as this system prevents the whole variation in prices to happen in one day of trading– prevents instant price correction- leads to inconsistency at a longer period of time.

Phylaktis et al., (1999) found evidence that daily price limits have a limited role in decreasing stock return volatility. He concluded the following results: (1) stock return volatility that reaches price limits does not revert quickly to the normal price level as compared to stocks that have not reached price limits. (2) There is only one case in which price limits affect stock return volatility and increasing it, the case of Greece where price limits are used to refer to the price manipulation, thus increasing volatility in stock return.

Kim’s (2001) study agreed with those of Kim (1997) and Phylaktis et al., (1999), in which he compared between 6 systems of daily limits to know which has more effect on return volatility. They used data of maximum price limit- minimum price limit- stock return. Based on event study, Levene test, and F-Value test, Kim (2001) concluded that the stock market, in general, is not less volatile when there is a clear system for price limits. Voronkova and Henke’s study (2005) agreed with Kim’s (2001). They examined the effect of price limits on risk volatility using data from Warsaw market. They concluded that price limits result in a great volatility in stock returns. Thus, price limits have little to do minimizing overreaction or disturbance of prices that occur in the market.

Bildik and Gulay (2006) studied the effect of price limits on the stock market, by testing the volatility spillover hypotheses in a long period and the delayed price discovery hypotheses. The variables of the study were (closing price- opening price- stock returns- trading volume- the minimum and maximum price limit). Using data from the Istanbul market, Turkey, covering the period from (1998-2002) and by using multiple linear regression methods. They concluded that the price limits have a strong and positive effect on the stock market.

Studies of Kim (1995), Park (2000), Lee et al., (2002), Elekdag and Bildik (2004), Zoubi and Nobanee (2007), Mei (2009) Yang (2010) contradict results of the previous studies. In another study, Kim (1995) examined the relation between price limits and the volatility of return. He used daily returns- price limits, size, closing price, and trading days as the variable of his research. Using data from Korea stock exchange covering the period from (1980-1989) He used comparative financial analysis and multiple linear regression. He concluded that the price limits is a mechanism of circuit breaking that aids in decreasing stock return volatility.

Park (2000) used multiple linear regression methods; GARCH and ARCH model. He concluded that price limits decrease stock return volatility. This increase is the result of the following: (1) prices increase in average on the day following the maximum price limits (2) price limits affects price volatility but not for all companies in which price limits are applied. They also concluded that price limits result in the benefit of decreasing return volatility and increasing trading volume. Elekdag and Bildik (2004) stated that there is no clear evidence that supports the effects of price limits on stock return volatility. He showed that stock return volatility decreases spite of the increase in price limits through the daily trading sessions.

On the other hand, Chen et al., (2005) showed that the price limits decrease stock returns volatility. He justified volatility decrease by the followings: (1) the effect of daily limits is symmetric with the stocks that reach the maximum and minimum limits but differ in the bullish and bearish markets (2) during the bullish period, price limits decrease stock return volatility for low price movements, not high price ones. (3) In the bearish period, the price limits decrease stock return volatility for high price movements, not low price ones. Results of Zoubi and Nobanee (2007) study showed that price limits decrease stock return volatility, for price limits may result in volatility spillover over a longer period which makes prices move in a negative and slow motion toward equilibrium levels. Mei (2009) tackled the relationship between price limits and stock return volatility. Using data from Taiwan stock exchange over the period of (1994- 2002) and using event study, He examined the relationships between daily limits, daily returns, and closing prices. He concluded that price limits cause sudden variability in price which in turn results in the volatility spillover over a longer period.

Both Yang (2010) and Lee et al., (2002), using data from the USA, Canada, Hong Kong and Singapore, from 1972-2007, and they used auto-correlation method and sensitivity analysis to examine the relationships between, maximum limit, minimum limit, trading volume, profit distributions, price volatility, and returns. They reached the same conclusion concerning the effect of price limits on the stock market. That is daily price limits may positively or negatively affect the stock market.

2.2 Daily Price Limits and Trading Volume

Joan and James (1997) examined the relationship between daily price limits and price movement and trading volume. They used data of highest price limit- lowest price limit- trading volume from USA market covering a period from 1995 to1997. They used multiple linear regressions for analysis and concluded that existence of daily price limits does interfere in the trading process. Thus, price limits affect the trading volume. Furthermore, Steenbeek and Berkman (1998) stated that daily price limits result in interference in the trading activities. Thus it affects the trading volume because of the followings: (1) there are factors that affect the decisions of trading, therefore; if the actual price is close to price limits then the investors tend to increase trading and this results in increasing the trading volume. (2) But if there is a Satellite market, the investors turn to this market to avoid reaching price limits and this result in the decrease in the trading volume.

Wang (1998) and Steenbeek and Berkman (1998) conducted similar studies to examine the effect of daily price limits on the trading volume. They used data extracted from Taiwan stock exchange for the period 1998- 1995. They used auto-correlation, OLS and GARCH to examine the relationships between trading volume and stock return, closing price, maximum price limit, minimum price limit, and current prices. They concluded that the daily price limits resulted in interference in the trading activities as the increase in trading volume decreases daily auto-correlation of approximately half of the stocks listed the market. Also they found that the price limits have a positive effect on the trading volume in case of reaching the maximum limits.

Additionally, Chen (2002) examined the effect of daily price limits on the trading volume using data covering a period from 1980-1994. He examined the relationships between applying daily price limits and trading volume, firm value, and price variations. He used multiple linear regression and T-test. His results showed that daily price limits lead to interference in trading activities as the price limits decrease the trading volume in the future. Merkoulova and Yulia (2003) supported Chen (2002) results and stated that daily price limits result in interference in the trading activities because price limits prevent prices from movement in a certain direction. Thus, investors will not be able to trade at the equilibrium price. Consequently, this will lead to decrease liquidity that affects future markets.

Also, Fernandes and Rocha (2004) used ARMA-EGARCH and auto-correlation to examine the relationships between daily price limits and trading activities. They reached the following conclusions: (1) price limits improve the estimated transaction costs, and (2) trading volume increases on the day that follows reaching the price limit. Chen et al., (2005) in their study of the trading volume in China about the effect of daily price limits on trading activities. They used event study on data cover the period from 1996-2003. They concluded that rate of trading activities increase after prices reached the limit and decreases or remain stable for subsidiary stock groups. Guly and Bildik (2006) used data from Istanbul stock exchange they reached a conclusion that trading volume increases in session following hitting upper price limits, and decreases when stock price fails to reach price limits. LinHsieh and Chang (2008) used comparative financial analysis to study Taiwan stock exchange during the period from 1989-1999. They found that trading occurs repetitively when stocks reach the maximum, and the change in trading volume happens after reaching the maximum limit.

Further, Zeng et al., (2009) in their study of China stock exchange in 2002, using the auto-correlation and ARCH-GARCH found that price limits lead to the repetition of trading at an accelerated rate. In the normal conditions the trading volume is at the lowest possible rate, but bid ask spread high and this reflected on the risk confronting the investors when the stock prices fall to the lowest price limits. Also, Bahattin and David (2010) used data from the USA market from 2003-2004 and used multiple linear regression for analysis. They found through their study of the phenomenon of interference in trading volume that the price limits lead to decrease in the trading volume in the future. Moreover; the trading volume is positively related to variation in future prices.

More recently, Yang and Hsuanyeh (2013) noticed through their study of the USA market during the period from 1972- 2008 that trading volume increases on Day 0 and decreases on Day Hit and Day 0.9, while on Day 1 the average of variation in the trading volume is negative and the intrinsic value is often high on Day 5 and Day 2. The rate of variability is positive on Day 0, while the trading volume and the price variability might highly increase on the following day of Day 0 if the trading volume highly decreases in comparison with the absolute value of variability in the previous days.

In his comprehensive study, Chan (2014) agreed with all the previous studies and concluded that the trading volume increases for shares which have price limits have in comparison with the no limits shares, and that the rational investor becomes optimistic and buys the shares even after reaching the highest limit of the price.

2.3 Daily Price Limits and Equilibrium Price

Many studies indicate that the daily price limits lead to delay of the equilibrium price. For examples, a study of Kim (1997), Huang et al., (2001), Merkoulova et al., (2003), Chang (2008) and Farag (2013). Other studies point out that price limits does not affect in such delay, examples as Chen et al., (2005), Li et al., (2014). Kim (1997) tested the effect of price limits on the delayed equilibrium price in Tokyo stock exchange in the period from 1989-1992. He examined the relationships between the maximum price limit, minimum price limit, opening price, closing price, and overnight returns. He used event study and Z-value test. He concludes that the price limits hinder prices from reaching equilibrium price, and overnight returns may be positive or negative for the stocks that reach the maximum or the minimum limit and thus price limits restrict the efficiency of price discovery. The study of Huang et al., (2001) agrees with Kim’s study (1997). He examined the effect of price limits on the delay of equilibrium price. Using data from Taiwan stock exchange from 1990-1996 and the multiple linear regression was used. He concluded that price limits delay the discovery of equilibrium price which reflects on the intrinsic value of stocks.

The study of Merkoulova et al., (2003) agreed with studies of Kim (1997) and Huang et al., (2001). He examined the relationship between the price limits and equilibrium price in USA market in the period from 1972- 1974 and from 1968 to1998. They showed that price limits delay the discovery of equilibrium price instead of facilitating it. Also, it has been revealed that price limits have a negative effect on future markets represented in the delay of reaching equilibrium price. The study of Chang (2008) agreed with the studies of Kim (1997), Huang et al., (2001) and Merkoulova et al., (2003). His study of Taiwan stock exchange from 1989-1999 by using comparative financial analysis, reached a conclusion that the price limits decrease the efficiency of discovering equilibrium price because:

• For the maximum limits, the hypothesis that price limits put the maximum permissible limit for the daily movement of stock prices and this result fails to reflect the effect of information about the stocks that reaches the daily limits on the trading days and that move slowly to the new equilibrium price. Recent studies indicated that the process of delayed price discovery is considered difficult under the implementation of daily price limits.

• For the minimum limit, it's found that the minimum price limits affect the price discovery and the average of price continuity, while price reflection does not change for the minimum partial group. Although the price continuity rate of the minimum limits for the partial group is low, for the maximum limits the price continuity rate is still higher than the price reflection.

More recently, the study of Farag (2013) agreed with the studies of Kim (1997), Huang et al., (2001), Merkoulova et al., (2003) and Chang (2008). Farag (2013) concluded that price limits hinder the stock prices from reaching the levels of equilibrium prices, because of:

• Closing prices do not reflect enough information in the market during the trading session.

• Price limits delay the trading mechanism.

• Price limits affect the market’s efficiency, and this explains the structural changes in volatility and the phenomenon of the day and week.

However, the studies of Li et al., (2014) disagreed with the previous studies. They examined the effect of price limits on the delay of equilibrium price. They used event study to examine the relationships between maximum price limit, minimum price limit, the abnormal returns, the closing price, and the opening price. They used data from publicly traded stocks in China, Hong Kong, and New York market during the period from 1993 to 2006. They concluded that there is no delay in discovery of equilibrium price in China market for the maximum price limit or the minimum price, as:

• When the degree of price continuity for the following day for the Chinese stocks has been compared with the other markets, it's found that there is an effect of price limits on the delay of equilibrium price.

• Also, it's found that in New York and Hong Kong, investors of the institutions play a greater role than those of the stock markets in China and are more rational.

• It is expected that the abnormal returns are to be much less than the returns found in China A for the maximum price limit and are high for the minimum price limit.

The study of Chen et al., (2005) agreed with the study of Li et al., (2014). In which the former concluded that there is no delay in discovering equilibrium price in China market whether for the maximum or minimum price limit, as:

• The price limits delay the discovery of the equilibrium price for the maximum price limits but not the minimum limits of the price movement.

• The hypothesis of discovering the delay of equilibrium price stipulates that there are positive and negative returns in overnight for the stocks that reach the maximum and minimum price limits.

• Price limits delay the price discovery when there is a high and extraordinary percentage of a price continuation.

2.4 Price Limits and Fair Value

Most of the studies concerning the relationships between daily price limits and the fair value of the stock support the implementation of daily price limit. Examples: Lee and Kim (1997), Huang (1998), Hung et al., (2001), Chen et al., (2005), Bildik and Gulay (2006), Chang and Hsieh (2008), Yang (2010) and HanCao (2014).

Lee and Kim (1997) studied the relationship between price limits and the deviation of returns from their fair value. They used data from a sample consists of 1172 trading days in Korea stock exchange. The price limits were divided into two groups the maximum price limits and the minimum price limits and each group contains 50 stocks in the period from1990 to 1993. They used Restricted Pass regression analysis and Two-pass regression analysis to deduce that the daily limits affect the firm value. They reached the following results:

• The price limits compare between the distribution of observed returns and realized returns.

• There are differences and heterogeneity in the distribution of observed and realized returns as the price limits delay price modification for the variation in information and thus it affects the market’s efficiency so it becomes inefficient market.

• The price limit concludes the presence of serial correlation between the observed returns and realized returns.

The study of Huang (1998) of Taiwan stock exchange, He used a sample of 1000 publicly traded companies in the stock market covering the period from 1971to1993 and used event study, comparative financial analysis and t-test. He found that the weak performing stocks of weak has a positive risk towards abnormal returns and vice versa; strong performing stocks of has a negative risk towards the abnormal returns.

Huang et al., (2001) studied the behavior of price concerning the daily movements of the stock, in the period of (1990-1996). He used event study and concluded that the noise traders, in general, cannot specify the fair value of the stock. Noise traders do not have enough information about the change in the fair value of the stock during the exchange period. So, if the fair value of the stock exceeds the price limits, the exchange will be suspended, and it will proceed in later periods until it reaches the fair value of the stock.

Chen et al., (2005a) studied the performance of the daily price limit in China. He concluded that the stocks of a low book to market ratio reaches the maximum price limits repetitively. Thus, there is a positive relationship between the stock return and the book to market value ratio. Also the study suggested that the most important common factors of risk are firm size and book to the market ratio.

Bildik and Gulay (2006) concluded that daily price limits have a strong effect on the stock market. Where the stock prices change during the trading sessions and differ from session to another and thus it is difficult for investors to specify the fair value of the stock. The price limits control this by putting a maximum and a minimum price limit but sometimes the number of buyers of stocks increases in one time, and at another time it decreases. Chang and Hsieh (2008) specify in their study the reasons why daily price limits affect the fair value of the stock as follows:

• If the price limits are effective, then the investor would be able to avoid the irrational trading behavior and this enables investors to make a rational valuation to specify the fair value of the stock, and thus there is a relationship between the price limits and fair value.

• If the price limits are not-effective, then this can create a conflict between investors towards specifying the fair value of the stock.

• When stock prices move to the maximum or minimum limit of the price, some investors change their understanding of the fair price of the stock. They become more optimistic or pessimistic.

Yang (2010) provided another explanation of why daily price limits affect the firm value as follows:

• According to the hypotheses of overreaction, investors are liable to overreact towards the new information. Thus, the price limits may deviate from their actual values, and thus the price limits provide investors a calming period in which they re-evaluate stocks.

• The proponents of imposing price limits assume that the investor is irrational. Thus, they use wrong beliefs, and in spite of this the investors learn how to interact with the market environment, and they may turn into rational investors if they receive the true value of the stock. In contrast, the challengers of daily price limits assume that the investor is rational, i.e., the investor receives the fair value of the stock.

Recently, HanCao, (2014) found that the price limits have different effects on stock prices about either maximum or minimum price limits. Also the application of daily price limits results in achieving higher returns for investors who own stocks that have a minimum price limit. However, they fail to achieve high returns in case of stocks that reach the maximum price limit. Thus it is difficult for the investor to specify the fair price of the stock.

3. Data and Methodology

The research population consists of all companies listed on the Egyptian Stock Exchange. According to the Egyptian stock exchange website, the number of listed companies is about 221 firms. We use data of the most actively traded stocks in the market. Thus we use the EGX30 index which includes the most actively 30 publicly traded companies. We exclude financial firms (banks), so a sample of 28 companies was considered. We collected data of these companies for the period from Dec 2005 to Dec 2015 in which data was available. We apply an event study methodology and use General Linear Model, ARCH-GARCH model, and Z test for data analysis. Based on the literature review, we can formulate the following measurable hypothesis:

H1: There is a statistically significant relationship of between the daily price limits and stock return volatility.

$$VTJ = \alpha + \beta 0 \text{ daily stock hit} + \beta 1 \text{ daily stock less} + \text{Error} \tag{1}$$

H2: there is no statistically significant relationship between the daily price limits and the trading interference.

$$CTV = \alpha + \beta 0 \text{ daily stock hit} + \beta 1 \text{ daily stock less} + \text{Error} \tag{2}$$

H3: there is a statistically significant relationship of between the daily price limits and delayed discover of the equilibrium price.

$$Equ = \alpha + \beta 0 \text{ daily stock hit} + \beta 1 \text{ daily stock less} + \text{Error} \tag{3}$$

H4: there is a statistically significant relationship of between the daily price limits and fair value (closing price).

$$MSV = \alpha + \beta 0 \text{ daily stock hit} + \beta 1 \text{ daily stock less} + \text{Error} \tag{4}$$

Table 1. Definition and calculation of variables

Variable	*Definition*	*Calculation*
Dependent Variables		
Price volatility	The daily stock return	(closing price for day $_{t-1}$ – closing price for day $_{t}$) / closing price for day $_{t-1}$
Trading volume	The percentage of variability in trading volume	Ln (trading volume $_{t}$ / trading volume $_{t-1}$) ×100
Equilibrium price	The return between the closing price and opening price on the same day	Ln (closing price / opening price)
	The return between the opening price and closing price on the following day	Ln (opening price $_{t+1}$ / closing price)
Fair value	Fair value of the stock	Closing price
Independent Variables		
Daily price limit	The variation rate in stock prices	(closing price – opening price) / Opening price × 100

Where:

Daily price limits: the variation rate in stock prices is calculated through the event day. Thus, According to the rate of variation, the data is divided into two groups:

• The first group: includes stocks that have not reached the daily price limit whether by increasing or decreasing (i.e. stock less)

• The Second group: those stocks that reach the daily limit or those in which variability reaches the daily limit whether regarding increasing or decreasing (i.e., shock hit)

Price volatility: Here the average stock return is achieved for both the day that proceeds and the day that follows reaching the maximum and minimum price limits.

Day 0 = the day on which prices reach the maximum or minimum price limit

Day -1= the previous day

Day 1= the next day

To take into consideration the price volatility through transactions that happen per day, so according to Kim et al., (2011) and Grossman (1988), we can measure volatility as follows:

Volatility i,t = ln (rh i,t / rl i,t)

rh i,t : refers to the high price in stock i in time t

rl i,t : refers to the low price in stock i in time t

Trading volume: here the percentage of variability in trading volume is calculated before and after the event day for stocks that reach the maximum limit and stocks that reach the minimum limit. According to (Mei et al., 2009; Tan et al., 2008), we find that the average of daily trading volume is measured by getting the average of the number of stocks that are traded for stocks of each group on each day.

The delay of discovering the equilibrium price: Here, there are two types of stock returns calculated for each group:

• The first type: includes returns of both opening and closing price for the same day (P_EQ1).

• Second type: includes return generated from differences between both closing and opening price on the following day (P_EQ2).

The fair value of the stocks: here the researcher tries to measure fair stock value via stock closing prices.

4. Results of the Analysis

4.1 Descriptive Statistics

The following table represents the descriptive statistics for all dependent and independent variables that have been used in our analysis:

Table 2. Descriptive Statistics of Study Variables

Variables	*LM1max*	*LM2min*	*CLOSING*	*LN_TRADI*	*RETURN*	*P_EQ1*	*P_EQ2*
Mean	12.07595	11.68575	11.88986	15.57024	0.143343	0.999759	1.026029
Maximum	230.4200	221.9300	226.0700	21.58056	2000.000	1.523596	131.7500
Minimum	0.020000	0.020000	0.020000	1.945910	-92.73000	0.640000	0.005767
Std. Dev.	22.49797	21.98221	22.28230	2.007294	9.157251	0.025517	0.617786
Skewness	4.736661	4.781959	4.764116	-1.251618	176.3396	0.436313	159.2963
Kurtosis	31.03314	31.55775	31.35237	5.626886	37968.50	14.30195	33388.75
Jarque-Bera	2192249.	2270897.	2239928.	32965.63	3.61E+12	321715.2	2.79E+12
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	60 089	60 089	60 089	60 089	60 089	60 089	60 087

Table (2) shows that the mean of LM1max = 12%, LM2min = 12%, Closing = 5.5%, trading volume=15.6 %, return=14%, P_EQ1=0.9%, and P_EQ2=1.02%. As for the standard deviation of variables, LM1max =22 %, LM2min =22Closing =22 %, trading volume=2%, return=9%, P_EQ1=2.5%, and P_EQ2=62%. Furthermore, the result of normality test (Jarque-Bera Test) shows that our data is not normally distributed.

4.2 General Linear Models

In this step, we shall use General Linear Model (GLM) to understand the behavior of trading activities and price movements under daily price limits system. Tables (3) to table (8) show the results of GLM.

Table 3. Number of times for minimum price limit

Stocks	*Number Of Times*	*Percentage %*
The stocks reached the minimum price limit	29 870	48.7
The stocks did not reach the minimum price limit	30 872	51.3

Table (3) shows that the number of times stocks hit the minimum daily price limits are 48.7%. So, daily price limits constrained stock prices from following a down ward trend. Thus, we can say, daily price limits- with reservation- do protect the investors of sharp decrease in stock prices.

Table 4. Number of times for maximum price limit

Stocks	*Number Of Times*	*Percentage%*
The stocks reached the maximum price limit	18 365	30.6
The stocks did not reach the maximum price limit	41 687	69.4

The previous result is supported by table (4) indicates that the number of times stocks reached the maximum price limit is 30.6%. This means a difference of 18.1% in shares that tend to go down over shares that tend to go up and hit the maximum daily price. This result show that investors in the Egyptian stock exchange need to be protected from sharp price decrease and daily price limits provided the needed help in that issue.

When we investigated the impact of price limits on stock volatility, trading volume, equilibrium price and closing price for companies that did not reach the minimum price limit or companies that had or had not reach the maximum price limit we obtained the following results. Table (5) shows standard deviations and return averages for each of the two groups of stocks.

Table 5. Volatility and return average for stock groups

Stocks	*Number Of Times*	*Return Average*	*Standard Deviation*
The stocks reached the minimum price limit	297 270	0.0425	0.3690
The stocks did not reach the minimum price limit	30 872	0.0043	0.2064
The stocks reached the maximum price limit	18 365	0.0524	0.3860
The stocks did not reach the maximum price limit	41 687	0.0099	0.2478

Table (5) indicates that both the return average and the standard deviation of the stocks that reached the minimum price limits are less than the return average for the stocks that had not reached the minimum price limit. The return average for the stocks that reach the maximum price limit is greater than the return average for the stocks that did not reach the maximum price limit, as well as the standard deviation. This may add support to our previous conclusions that stocks that have down word sloping prices are riskier and represent the majority of traded stocks in the Egyptian market. These stocks have a lower average return and a lower risk, 4.25% return compared with 5.24%, and 36.9% standard deviation compared with 38.6%. However, consistency of risk and return in each group may drive a conclusion that daily price limits help in increasing market efficiency.

Table 6. Volatility and trading volume average for stock groups

Stocks	*Number of Times*	*Trading Volume Average*	*Standard Deviation*
The stocks reached the minimum price limit	297 270	15.9102	1.8634
The stocks did not reach the minimum price limit	30 872	15.2473	2.0824
The stocks reached the maximum price limit	18 365	15.9424	1.8797
The stocks did not reach the maximum price limit	41 687	15.4066	2.0381

Table (6) shows that the average trading volume of stocks that reached the minimum price limit is greater than the average trading volume of stocks that did not reach the minimum price limit. We find the standard deviation for trading volume of the stocks that did not reach the minimum price limit greater than the standard deviation of trading volume of the stocks that reached the minimum price limit. Also the average trading volume of the stocks that did not reach the maximum price limit is greater than the average trading volume of the stocks that did not reach the minimum price limit. Also, the standard deviation of the trading volume of the stocks that did not reach the maximum price limit is greater than the standard deviation of the trading volume of the stocks that reached the maximum price limit. This refers to the appreciation of the Egyptian investors of the low-risk stocks when trading in the stock exchange.

Table 7. Return average between opening and closing for stock groups

Stocks	*Number of times*	*Return average between opening & closing*	*Return average between closing & opening*	*Standard deviation Between opening & closing*	*Standard deviation Between closing & opening*
Stocks reached the minimum price limit	297 270	1.0004	1.0152	0.0308	0.2722
Stocks did not reach the minimum price limit	30 872	0.9991	1.0363	0.0191	0.8212
Stocks reached the maximum price limit	18 365	1.0009	1.0037	0.3398	0.2270
Stocks did not reach the maximum price limit	41 687	0.9993	1.0359	0.0207	0.7260

Table (7) shows that the return average between opening and closing for the stocks that reach the minimum price limit is greater than the average return between opening and closing for the stocks that have not reached the minimum price limit, in addition to the standard deviation. Whereas, we find that the average return between opening and closing for the stocks that have not reached the minimum price limit is greater than average return for the stocks that reached the minimum price limit, as well as for the standard deviation. We also find that average return between opening and closing for the stocks that reach the maximum price limit is greater than average return for the stocks that have not reached the maximum price limit, as well as the standard deviation. Whereas, we find that average return between opening and closing for the stocks that have not reached the maximum price limit is greater than average return for the stocks that reached the maximum price limit, as well as for the standard deviation of the return of the stocks between opening and closing which is about (0.22695) for stocks that reached the maximum price limit.

Table 8. Closing price average for stock groups

Stocks	*Number of Times*	*Closing Price Average*	*Standard Deviation*
Stocks reached the minimum price limit	297 270	17.0459	25.3991
Stocks did not reach the minimum price limit	30 872	6.9898	17.4952
Stocks reached the maximum price limit	18 365	21.9576	29.4347
Stocks did not reach the maximum price limit	41 687	7.4566	16.4127

In table (8) the average closing price of the stocks that reached the minimum price limit is higher than the average closing price of the stocks that have not reached the minimum price limit. Also, the standard deviation of the stocks that reached the minimum price limit is higher than stocks that did not reach the minimum price limit. In addition, the average closing price of the stocks that reached the maximum price limit is higher than the average closing price of the stocks that did not reach the minimum price limit and the standard deviation of the stocks that reached the maximum price limit is higher than the standard deviation of the stocks that did not reach the maximum price limit.

4.3 Testing the Research Hypotheses

We used GARCH model to study the relation between the price limits and stock return volatility, trading volume, equilibrium price and closing price to know the extent of the effect of the independent variable on the dependent variable and the range of contrast in errors, and how the independent variable explains the dependent variable through R-squared, along with examining the range of error contrast.

H1: There is a statistically significant relationship of between the daily price limits and stock return volatility.

Table 9. the relationship between price limits and the stock return volatility

Variable	*Coefficient*	*Std. Error*	*z-Statistic*	*Prob.*
LM1_MIN	-0.043171	0.023957	-1.802044	0.0715
LM2_MAX	0.078680	0.023847	3.299318	0.0010
D(RETURN(-1))	-0.416569	0.004004	-104.0292	0.0000
C	-0.015488	0.013764	-1.125282	0.2605
	Variance Equation			
C	0.573520	0.020410	28.09926	0.0000
RESID(-1)^2	0.311952	0.006985	44.65755	0.0000
GARCH(-1)	0.694438	0.004646	149.4589	0.0000
T-DIST. DOF	4.718793	0.066555	70.90098	0.0000
R-squared	0.239990	Mean dependent var		-3.33E-05
Adjusted R-squared	0.239952	S.D. dependent var		12.87324
S.E. of regression	11.22299	Akaike info criterion		4.925808
Sum squared resid	7567779.	Schwarz criterion		4.927007
Log likelihood	-147980.5	Hannan-Quinn criter.		4.926181
Durbin-Watson stat	2.442024			
Heteroskedasticity Test: ARCH				
F-statistic	3.94E-05	Prob. F(1,60084)		0.9950
Obs*R-squared	3.94E-05	Prob. Chi-Square(1)		0.9950

Results in table (9) show that:

• According to the adjusted coefficient of determination (R2), daily price limits explains (23.9%) of the total variation in stock return volatility.

• Based on Z-test, there is a positive significant effect between the maximum price limit and stock return volatility at a significant level less than (0.05). This indicates the increase of the volatility level of the return of the stocks that prices that reached the maximum limit. Thus, daily price limits may contribute in increasing stock risk. Thus, we reject the null hypothesis and accept the alternative hypothesis that there is a statistically significant relationship between the daily price limits and stock return volatility.

• Homogeneity and stability of conditional variance of random errors for model GARCH (1) were found when the random error follow the normal distribution, where the value ARCH-LM reached (0.9950) which is not significant at a significant level greater than (0.05).

H2: there is no statistically significant relationship between the daily price limits and the trading interference.

Table 10. the relationship between price limits and the trading volume

Variable	*Coefficient*	*Std. Error*	*z-Statistic*	*Prob.*
GARCH	0.044452	0.012787	3.476278	0.0005
LM1_MIN	0.124295	0.008794	14.13358	0.0000
LM2_MAX	0.153244	0.009423	16.26225	0.0000
LN_TRADI(-1)	0.529356	0.004945	107.0422	0.0000
LN_TRADI(-2)	0.462485	0.004937	93.66817	0.0000
	Variance Equation			
C	0.011279	0.000918	12.28689	0.0000
RESID(-1)^2	0.077723	0.003641	21.34570	0.0000
GARCH(-1)	0.901843	0.004288	210.3284	0.0000
T-DIST. DOF	6.965724	0.217423	32.03761	0.0000
R-squared	0.736345	Mean dependent var		16.39831
Adjusted R-squared	0.736310	S.D. dependent var		1.468738
S.E. of regression	0.754208	Akaike info criterion		2.014101
Sum squared resid	17060.91	Schwarz criterion		2.016594
Log likelihood	-30200.51	Hannan-Quinn criter.		2.014901
Durbin-Watson stat	2.198663			
Heteroskedasticity Test: ARCH				
F-statistic	3.318318	Prob. F(1,29995)		0.0685
Obs*R-squared	3.318172	Prob. Chi-Square(1)		0.0685

Results in table (10) show that:

• According to the adjusted coefficient of determination (R2) daily price limits explain (73.6%) of the total variation in trading volume. The rest of the percentage is due to random error in the formula or may be for not listing other variables which were supposed to be listed within the model.

• Based on Z-test, there is a positive significant effect between the (minimum-maximum) price limits and trading volume at a significant level less than (0.05). Thus the trading volume increases whenever price limits are reached. For the other groups, whose prices have not reached their limits, the decrease in trading volume or stability in trading volume is expected in following days. Thus we refuse the null hypothesis and accept the alternative hypothesis which says that there is a statistically significant relationship between the daily price limits and trading interference.

• Homogeneity and stability of conditional variance of random errors for model GARCH (1) was found when the random error follow the normal distribution, where the value ARCH-LM reached (3.318) which is not significant at a significant level greater than (0.05)

H3: there is a statistically significant relationship of between the daily price limits and delayed discover of the equilibrium price.

Table 11. the relationship between price limits and delayed discover of the equilibrium price on the same day

Variable	*Coefficient*	*Std. Error*	*z-Statistic*	*Prob.*
LM1_MIN	0.000229	0.000181	1.263918	0.2063
LM2_MAX	0.001281	0.000181	7.058056	0.0000
P_EQ1(-1)	0.107747	0.004043	26.64830	0.0000
P_EQ1(-2)	0.008481	0.004085	2.075912	0.0379
P_EQ1(-3)	0.029650	0.004013	7.387908	0.0000
C	0.853535	0.006292	135.6568	0.0000
	Variance Equation			
C	1.86E-05	9.35E-07	19.92877	0.0000
RESID(-1)^2	0.191628	0.005875	32.61680	0.0000
GARCH(-1)	0.821998	0.003776	217.7147	0.0000
T-DIST. DOF	3.570486	0.062261	57.34711	0.0000
R-squared	0.018433	Mean dependent var		0.999759
Adjusted R-squared	0.018351	S.D. dependent var		0.025517
S.E. of regression	0.025282	Akaike info criterion		-4.892884
Sum squared resid	38.40213	Schwarz criterion		-4.891386
Log likelihood	147006.9	Hannan-Quinn criter.		-4.892419
Durbin-Watson stat	1.976496			
Heteroskedasticity Test: ARCH				
F-statistic	0.078509	Prob. F(1,60083)		0.7793
Obs*R-squared	0.078512	Prob. Chi-Square(1)		0.7793

Table (11) shows the followings:

• According to the adjusted coefficient of determination (R2), daily price limits (maximum price limit- minimum price limit) explain (18%) of the total variation in the dependent variable: delayed discovery of the equilibrium price (measured by the difference between opening and closing prices on the same day). The rest of the percentage is due to random error in the formula or may be for not listing other variables which were supposed to be listed within the model.

• Based on Z-test, there is a positive significant relationship between the maximum price limit and the late detection of the equilibrium price on the same day at a significant level less than (0.05). Thus, we expected the continuation of the price movement in the same direction for the group of stocks that reached the upper limit of the price (+, +) in an attempt to reach the equilibrium price. Hence, it can be said that the application of the daily price limit system delays access to the equilibrium price. Thus, we refuse the null hypothesis and accept the alternative hypothesis that says that there is statistically significant relationship between the daily price limits and the delayed discover of the equilibrium price.

• Homogeneity and stability of conditional variance of random errors for model GARCH (1) were found when the random error underwent a natural distribution, where the value ARCH-LM reached (0.078509) which is not significant at a significant level greater than (0.05).

Table 12. the relationship between price limits and delayed discover of the equilibrium price on the next day

Variable	*Coefficient*	*Std. Error*	*z-Statistic*	*Prob.*
LM1_MIN	6.86E-05	1.71E-06	40.18999	0.0000
LM2_MAX	-0.000159	2.84E-06	-56.21916	0.0000
P_EQ2(-1)	0.009010	1.40E-07	64276.74	0.0000
P_EQ2(-2)	0.990991	4.37E-06	226686.7	0.0000
	Variance Equation			
RESID(-1)^2	0.066088	0.000336	196.5700	0.0000
GARCH(-1)	0.933912	0.000336	2777.778	0.0000
T-DIST. DOF	2.518696	0.008179	307.9653	0.0000
R-squared	0.945688	Mean dependent var		1.045923
Adjusted R-squared	0.945682	S.D. dependent var		0.419857
S.E. of regression	0.097853	Akaike info criterion		-7.068222
Sum squared resid	287.1964	Schwarz criterion		-7.066560
Log likelihood	106022.3	Hannan-Quinn criter.		-7.067689
Durbin-Watson stat	2.585869			
Heteroskedasticity Test: ARCH				
F-statistic	0.000773	Prob. F(1,29995)		0.9778
Obs*R-squared	0.000773	Prob. Chi-Square(1)		0.9778

Table (12) shows the adjusted coefficient of determination (R2) shows that price limits (maximum price limit-minimum price limit) explain (94.5%) of the total the delayed discovery of the equilibrium price (measured by the difference between opening and closing prices on the next day). The rest of the percentage is due to random error in the formula or may be for not listing other variables which were supposed to be listed within the model.

• By using (Z-test), we find that there is a positive significant effect between the minimum price limits and the delayed discovery of the equilibrium price. While there is a negative significant effect between the maximum price limits and the delayed discover of the equilibrium price at a significant level less than (0.05). Thus, we refuse the null hypothesis and accept the alternative hypothesis that says that there is statistically significant relationship between the daily price limits and the late detection of the equilibrium price.

• Homogeneity and stability of conditional variance of random errors for model GARCH 1 were found when the random error underwent a natural distribution, where the value ARCH-LM reached (7.067689) which is not significant at a significant level greater than (0.05).

H4: there is a statistically significant relationship of between the daily price limits and fair value (closing price).

Table 13. the relationship between price limits and closing price

Variable	*Coefficient*	*Std. Error*	*z-Statistic*	*Prob.*
LM1_MIN	0.003800	0.000546	6.954073	0.0000
LM2_MAX	0.005606	0.001027	5.458195	0.0000
D(CLOSING(-1))	-0.435296	0.004333	-100.4630	0.0000
C	-8.53E-06	1.59E-06	-5.369772	0.0000
	Variance Equation			
C	3.76E-11	3.94E-11	0.955774	0.3392
RESID(-1)^2	0.452015	0.005968	75.74370	0.0000
GARCH(-1)	0.685340	0.002163	316.8803	0.0000
T-DIST. DOF	4.950875	0.043941	112.6720	0.0000
R-squared	0.425078	Mean dependent var		5.59E-05
Adjusted R-squared	0.425049	S.D. dependent var		1.974527
S.E. of regression	1.497195	Akaike info criterion		-0.817550
Sum squared resid	134681.6	Schwarz criterion		-0.816352
Log likelihood	24570.07	Hannan-Quinn criter.		-0.817178
Durbin-Watson stat	2.340973			
Heteroskedasticity Test: ARCH				
F-statistic	1.90E-05	Prob. F(1,60084)		0.9965
Obs*R-squared	1.90E-05	Prob. Chi-Square(1)		0.9965

• According to the adjusted coefficient of determination (R2) daily price limits (maximum price limit- minimum price limit) explain (42.5%) of the total variation of the stock fair value (measured by stock closing prices). The rest of the percentage is due to random error in the formula or may be for not listing other variables which were supposed to be listed within the model.

• By using (Z-test), we find that there is a positive significant effect between the minimum and maximum price limit and closing price at a significant level less than (0.05). Thus, we refuse the null hypothesis and accept the alternative hypothesis that says that there is a statistically significant relationship of between the daily price limits and closing price.

Homogeneity and stability of conditional variance of random errors for model GARCH 1 were found when the random error underwent a natural distribution, where the value ARCH-LM reached (1.60084) which is not significant at a significant level greater than (0.05).

5. Conclusion

Based on our review of the literature, there are conflicting views between researchers on the effect of daily price limits in the stock markets. To examine this effect in the Egyptian stock market, we, divided traded stocks into two groups (that reached the limit on the day of the event maximum, and minimum and that did not reach the limit on the day of the event (maximum and minimum). By examining the volatility of stocks, trading volume, late detection of the equilibrium price and fair value (closing price), the following results have been reached:

In case of stocks that reached the limit, daily price limit postpones it to return to their normal level of volatility compared with the stocks that did not reach the limit. This leads to creating the volatility spillover phenomenon.

Traded activities increase on the day following the event day (i.e., the day of reaching the limit), and it decreases on the day after the event for the stocks that did not reach the limit, which agrees with the hypothesis of interference in trading activities.

1. Daily price limits may contribute in increasing stock risk.
2. Daily price limits affects on trading activities.
3. Daily price limits delay the discovery of the equilibrium price

4. Daily price limits increase the variation of the stock fair value

Based on our findings implementation of daily price limits in Egypt has four important contributions. First, increase volatility significantly after reaching the limits because it prevents large price changes and immediate corrections. This result is consistent with that of (Lehmannn, 1989; Phylaktis et al., 1999; Kim, 2001; Henke & Voronkova, 2005; Bildik & Gulay, 2006).

Second, implementation of daily limits does interfere in trading operations. This result is accepted also by (Joan & James, 1997; Steenbeek & Berkman, 1998; Wang, 1998; Chen, 2002; Merkoulova & Yulia, 2003; Fernandes & Rocham 2004; Chen et al., 2005; Gulay & Bildikm 2006; Lin & Chang, 2008; Zeng et al., 2009; Bahattin & David, 2010; Yang & Hsuanyeh, 2013; Chen, 2014).

Thirdly, implementation of daily limits does delay the discovery of equilibrium price; our results show that price limits prevent prices from reaching their equilibrium level. This result is consistent with that of, (Kim 1997; Huang et al., 2001; Merkoulova et al., 2003; Chang, 2008; Farag, 2013) agree with this view.

Finally, implementation of daily limits does affect the fair value; we find that the noise traders, in general, cannot specify the fair value of the stock. One explanation for such finding is the inability of the noise traders to have enough information about the change in the fair value of the stock during the exchange period This result is also accepted by (Lee & Kim, 1997; Huang, 1998; Hung et al., 2001; Chen et al., 2005; Bildik & Gulay, 2006; Chang & Hsieh, 2008; Yang, 2010; HanCao, 2014; Dabbou & Silem, 2014).

For further research we suggest a research in:

- The effect of daily stock price limits on the market efficiency.

- Study the implementation of the daily stock price theory in the future markets.

-A comparative study of the daily limit system in emerging markets.

-Study the effect of implementation of the daily stock price on the initial issue operations.

-Risk and return analysis of the daily stock price limit.

-Study the efficiency of price limits on the determinants of stocks.

-What does the circuit breaker in attracting financial markets?

-The effect of daily price limits on the asymmetric information.

- The effect of daily price limits on the on the stock split.

- The effect of daily price limits on the anomalies phenomena.

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