MSA-Management science journal
ISSN 2974-3036
Volume: 3, Issue:2, Year: 2024 pp.1-27

Efficient Market Hypothesis Revisited: Evidence from Egypt

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Abstract: The impact of economic events on stock markets and their reflection on returns of financial markets, has been an area of profound importance. Hence, based on importance of the currency devaluation on the economic development of countries, this paper aims to investigate the impact of currency devaluation on the Egyptian stock market in 2016 and 2022 and examine if the Egyptian market is efficient. This was examined using parametric and non-parametric unit root tests for stationarity. Moreover, ARCH(Autoregressive Conditional Heteroskedasticity)and EGARCH(Exponential Generalized Autoregressive Conditional Heteroscedasticity)models were conducted on two indices EGX100 and EGX30.

The results indicate the stationarity of returns regardless of market events. The findings are important to policymakers and investors to evaluate and forecast market movements. The chosen Egyptian context is justified due to insufficient research conducted on the Egyptian market and the controversial findings of existing literature on emerging markets in general and the Egyptian market in specific.

Keywords: *Efficient Market Hypothesis, EGX, Currency Floatation, Devaluation, Behavioral Finance.*

JEL Codes: G14, G40, G41, G53

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Introduction

The objective of this paper is to investigate the efficient market hypothesis (EMH) within the Egyptian market during economic events such as the currency devaluation that occurred in 2016 and 2022 and to determine if the Egyptian market is classified as efficient and within which level of efficiency. Understanding the dynamics of financial markets is crucial for academics, decision-makers, and market participants. Studying markets' efficiency and the EMH, initially proposed by Fama in 1970, has been a central tenet of all financial studies. According to Benthabet & Benthabet (2023) the EMH is the extent to which the prices of financial market assets accurately reflect all the information that is currently accessible. According to Patil & Rastogi (2020), the foundation of the EMH is the idea that market participants are rational and have equal access to asset information. As a result, no investor could take advantage of market information to elevate their return on investment. EMH is further identified as a random walk hypothesis and assumes randomness of stock prices and rejects its predictability given the informational symmetry in an efficient market (Dias, Teixeira, & Machová, 2020).

Yet, behavioural finance assumes the irrationality of investors and the existence of some behavioural biases that contradict and prevent the EMH from existing and lead to markets being inefficient. The cause of these behavioural biases of investors is hindering the development of markets and causing irrational decisions to be taken that could lead to market dysfunctionality on the short- and long-term horizons.

The importance of understanding the level of market efficiency in an emerging market such as Egypt is that policymakers must consider and anticipate the level to which investors would react to certain economic or political events and anticipate the level to which investors' behavioural biases could interfere with investors' decisions.

Therefore, this paper aims to add to the literature on how the Egyptian stock market was impacted by the Egyptian pound's currency flotation on November 3rd 2016, and on March 21st, 2022 and if the Egyptian stock market fits into any level of market efficiency. Hence, this research contributes to the existing literature by examining the EMH in an emerging market such as Egypt during two economic events. Moreover, the significance of this research is in determining the level of efficiency in the market that could explain market movements during the reoccurring currency devaluation and other currency flotation events which cause turbulence in the Egyptian market. Adding to the field of study, this study employs different parametric and non-parametric unit root tests, and different autoregressive models to examine the level of efficiency of the

Egyptian market. This is done on the relatively long periods before and post-devaluation events (2 years before and 2 years after each currency devaluation event) to account for all market movements.

The rest of the paper is organized into five sections: the first section is the introduction in which it introduces the topic and the aim of the paper, the second section is the literature review that includes the EMH and its levels of efficiency within different and similar contexts, as well as behavioural biases and their relation in explaining market movements during economic events. The third section focuses on the research design and the data and sample used to examine the EMH in Egypt. Section 4 discusses the results and analysis of the findings. The fifth section concludes the research and future suggestions.

Literature Review and Hypothesis Development

The EMH and its validity are the fundamental paradigm on which current financial markets studies have been founded. Based on the degree of information availability, EMH is divided into three major categories; the strong form efficiency, in which the prices of assets in the market accurately reflect all historical, present-day, and future knowledge about these assets (Tiwari & Jena, 2023). Semi-strong forms of efficiency are those stock markets where prices only reflect the most recent and prior information on the stock (Chu & Zhang, 2019). When all the previous data present in the market is reflected in the stock price, this is known as weak form efficiency. Nevertheless, evidence from some developed countries revealed the persistence of the semi-form efficient hypothesis (Kumar, 2020), yet in emerging markets several studies rejected the random walk hypothesis in all its forms (Ananzeh, 2021).

The concept of timely information flow in the market and the immediate or prolonged reflection of this on the stock market is what distinguishes the three levels of efficiency and is commonly referred to as Informational efficiency. (Patil & Rastogi, 2020) argue that while some studies view informational efficiency in markets to improve stock market performance and foster overall economic growth, in actual practice, neither informational efficiency nor the assumed level of a reason among investors exists in financial markets. Accordingly, the field of behavioural finance has received extensive attention in the literature to identify the root of investors' market irrationality.

Mondal & Yadav (2022) assessed the EMH using socially responsible indices in emerging markets and presented evidence that markets such as South Africa, Singapore, and South Korea all exhibit random walk hypothesis, while India and Egypt exhibit non-randomness in daily and weekly returns and randomness for other durations.

Contrary to this conclusion, a study employing the rolling root test conducted on the French stock market rejected the weak form efficiency of the French market and supported the adaptive market hypothesis of the market's successive periods of efficiency and inefficiency (Boya, 2019).

Additionally, the weak form of EMH is rejected in the context of a European study (Miloş & Haţiegan, 2020), despite recent changes in the European stock market and further suggestions for testing the semi-strong form of EMH is to be considered given the context of European stock market. Moreover, a panel study for 33 countries in developed countries in the period of 1992-2018 using panel root tests provides strong evidence for the weak-form efficiency of stock markets. These results were later refuted by another study done in five central and east European countries using run tests that revealed chaotic and nonlinearity in indices returns which questions the validity of EMH in these countries (Albulescu, Tiwari, & Kyophilavong, 2021).

In the emerging market of China, a study on the 4 main indices post the 2015 market crash revealed the inefficiency of the Chinese market and the lagged impact of the crisis on stock prices (Han, Wang, & Xu, 2019). Additionally, studies on Latin American stock markets revealed that the efficiency of their stock market improved drastically after the global financial crisis (Zhu, Bai, & Vieito, 2019), and that weak-form efficiency is evident in this market (Granero, Balladares, & Requena, 2020).

Concerning the global pandemic of COVID-19, the random walk hypothesis was disproved in a study that examined the effects of the COVID-19 pandemic in seven industrialized nations between 2019 and 2020 using the variance root test (Dias, Heliodoro, Alexandre, & Silva, 2020). This complements a study conducted in COVID-19 on the US, Spain, UK, Italy, France, and Germany that employed variance root tests and automatic portmanteau testing to demonstrate that the stock market was predictable and hence rejecting the EMH during covid-19 crisis in these countries (Ozkan, 2021).

Due to periods of unpredictability and non-random patterns in stock return over the years, the Nigerian stock market's efficiency in the context of emerging markets was evident (Umoru, Udobi-Owoloja, & Nzekwe, 2020). The outcomes are in line with those of the Malaysian stock market in another study by (Marsani & Shabri, 2022), and the Bombay Stock Exchange after dividends announcement (Goyal & Gupta, 2019).

In Bangladesh, the weak form hypothesis was tested on the Dhaka Stock Exchange (DSE) indices returns and provided evidence of rejecting the random walk hypothesis and weak form efficiency according to Sadat(2019) and Zaman (2019). The impact of calendar effects on the stock market and the timing of some calendar days, have been proven to impact stock market returns profoundly. Based on this in Indonesia, a weak form hypothesis was found to be evident while testing the main index of LQ 45 and the impact of calendar anomalies on it (Malini, 2019).

Given the instability of the Arab countries especially during the political uprisings, research on the effects of political shocks on some stock markets revealed evidence of the efficient market, and results were more reliable under the adaptive market hypothesis. The random walk theory was disproved in all of its manifestations in the following countries: Jordan, Egypt, Saudi Arabia, the UAE, Bahrain, and Oman (Ananzeh, 2021). When the nations of the MENA area were examined using several stock indices, mixed results frequently emerged; nonetheless, overall results showed a lack of market efficiency (Derbali, 2019).

Further studies were conducted on Saudi Arabia given its recent economic development and its economic growth, after employing several root test and autocorrelation tests on the Tadawul All Share Index (TASI), it was evident that the Saudi Arabia stock market does not follow the weak form EMH (Khoj & Akeel, 2020). However, it was suggested that given the vast growth of Saudi Arabia economically it would be more consensus to test the semi-strong form in further studies. These results are in line with the results from testing out the weak form hypothesis of the Bahrain stock market using run test and autocorrelation test for return on 2011-2015. Results indicate that returns of the main indices in the Bahrain stock market do not follow the random walk hypothesis and have some non-randomness in the stock volatility (Kumar, Soni, & Hawaldar, 2020).

Moreover, applying different methodologies such as the wavelet root tests in 29 African financial markets indicated that based on past stock performance, future returns on stocks can be predictable which rejects the random walk hypothesis in the context of the African countries (Ikechukwu & Evans, 2020). This is in line with findings from a study on four Arab indices including Egypt that used GARCH and OLS regression and showed evidence that calendar anomalies and the January effect increase the returns on stocks, and investors in the Arab region could make use of this January effect in their investment strategy which opposes the EMH (YANG & NEMLİOĞLU, 2023).

The findings were in the light of testing different forms of the EMH in developing, developed and MENA regions. However, as highlighted previously, the EMH itself has different criticisms on the applicability of its main assumption, the rationality of investors. To test whether a market is efficient or not it has to be determined first the degree of rationality of its investors participating in the market. According to Bilir (2018) behavioural finance is concerned with the degree of rationality of investors in a market and the factors that impact their biased decisions. Hence, it is evident that behavioural finance explains the different irrational behaviour of investors based on their character biases.

Behavioural finance, according to Jain (2020) is the fusion of finance and psychology. It is assumed in the behavioural discipline that investors, while generally rational, have behavioural and heuristic biases that affect their decision-making process and may lead to irrationality (Dai, 2021) . Whether the bias results from a mistake in information processing, a mistake in belief, or an emotional mistake, behavioural finance acts as a core criticism of the EMH and rejects its main propositions. The market's information asymmetry and investors' irrationality are thus highlighted as two key factors that affect market efficiency.

The degree of rationality of investors, although contributed entirely to individualistic character bias, however, was found to be influenced by several factors. According to Baker, Kumar & Goyal (2019) financial literacy acts as a main defence against investor bias. An increase in financial awareness and financial literacy in markets offsets the character bias of investors and aids them in overcoming their initial irrational decisions (Sabir, Bin Mohammad, & Shahar, 2019). Hence, it is evident that countries and markets that are characterized by a high degree of financial awareness and financial literacy of their participants have somewhat degree of efficiency in their capital and financial market.

Accounting for the behavioural bias of investors and the assumption of EMH, gave rise to a theory of adaptive market hypothesis which was proposed by Lo (2004). This theory assumes the nonstationary of EMH as it assumes times where the efficient hypothesis is evident in the market and times where it is not applicable. The main assumption of the adaptive market hypothesis is based on the dynamics of markets, which is influenced by the degree of financial stability markets possess (Khuntia & Pattanayak, 2018). Precisely in emerging markets which are characterized by instability of their political and economic conditions, the adaptive markets hypothesis effect is more profound.

Albahli, Nazir & Nawaz (2023) argue that although the adaptive market hypothesis appears to be the integration of behavioural finance with EMH, it does not yet explain the reason behind the fluctuations and volatility of market efficiency. Moreover, EMH illustrates the degree to which a market belongs and based on this categorization; market improvements are proposed. Unlike the adaptive hypothesis which highlights only whether any form of efficiency exists at certain times or not (Obalade & Muzindutsi, 2018). Hence, based on this argument EMH prevails yet to be the most testable hypothesis in financial markets.

In the context of Egypt, a study was conducted to test the weak form efficiency of the market given the announcement of dividends or stock splits. The results showed the positive impact of dividends announced and stock split on stock prices, however, the inefficiency of the Egyptian market was found due to insiders' information and the ability of investors to gain abnormal profits (Indrayono, 2022). Magui, Elsiefy & Bahaa (2023) added that due to the inefficiency of the Egyptian stock markets, it was found that utilizing certain technical analysis strategies yielded abnormal returns for investors. For a country such as Egypt which is characterized by a period of political instability, a study was conducted to examine the impact of changing political regimes on the stock market. It was found that the political stability resulted in abnormal returns after its occurrence however volatility was not impacted hence rejecting the random walk hypothesis (Samdani, Ullah, & Nabi, 2021).

An economic event such as currency devaluation is expected to have a significant influence on the nation's entire economy especially if it is an emerging market (Gogue, Wonyra, & Baita, 2020). According to research by Zarei, Ariff & Bhatti (2019) fluctuating exchange rates and switching from a pegged to a floating currency exchange regime are expected to encourage economic budget deficits and have favourable effects on economic performance. Applying this to the emerging market of Egypt, a study explained that the recent Russian-Ukrainian war urged investors to pull their investments from markets such as the Egyptian stock market (Werr & Awadalla, 2022).

According to El Baradei (2019) currency devaluation is the decrease in value of home currency against and relative to foreign currency. The devaluation is identified as one of the most drastic economic events that upon occurrence, alters the economy of countries. In addition, currency devaluation impacts the GDP of economies and acts as an agent towards altering the strategy of the economy overall. Factors influencing the devaluation are numerous as trade deficit as well as some strategies of countries to account for public debt and to encourage foreign investors to seek investors in the country (Hassaan & Salah, 2023).

Currency devaluation in the Egyptian market in 2016 has reshaped the economy and caused turbulence in the market. The occurrence of currency devaluation was due to changing the exchange regime in Egypt into a floating regime instead of pegged (Zarei, Ariff, & Bhatti, 2019). The change is assumed to cause economic boost and development in the short as well as in the long term. Nevertheless, the impact of such devaluation on capital and financial markets in Egypt has not been thoroughly studied which is considered a gap in the existing literature.

Reflecting on recent theories and studies that attempted to link the EMH and macroeconomic events to currency devaluation, a study conducted by Asif & Frommel (2022) on 18 emerging and 10 developed countries' foreign exchange markets efficiency, results indicated the presence of long-memory in theses markets which rejects the EMH. The long memory theorizes that returns of the market are explained by the furthest point in the past relying on the reoccurring patterns in markets which contradicts the EMH. Moreover, another research attempted to link the foreign exchange regime of Tanzania and the stock market efficiency, indicating that the stock market efficiency displays both cases of efficiency and inefficiency according to the different foreign exchange regimes. Where during currency depreciation, market inefficiency prevails and during a normal currency state, market efficiency is evident (Epaphra & Kazungu, 2021).

Based on the discussed literature this paper intends to study the weak-form EMH within the Egyptian setting in light of the inconsistent outcomes of the EMH across nations and periods. Policymakers and investors can evaluate market movements and forecast market movements based on an examination of the market's efficiency. When markets are inefficient, it causes issues with information asymmetry and investor mistrust, both of which have a negative effect on the market as a whole (Iyke, 2019).

Moreover, given the importance of currency devaluation and its occurrence in the Egyptian market and the lack of studies conducted on these events in relation to its impact on the stock market in Egypt, hence this research is conducted to attempt to fill the gap in the existing literature of examining the EMH for the Egyptian market during different currency devaluation events. The research aims to fill this gap by proposing the following hypotheses:

H0: returns have a unit root
H1: returns are stationary

The null hypothesis suggests that the Egyptian market returns follow the random walk hypothesis and hence have a degree of market efficiency. These hypotheses are aligned with the research objective to examine the degree of Egyptian market efficiency over periods post and before the devaluation events.

Methodology

This study will be tackling both currency devaluation events that occurred on November 3rd, 2016, and March 21st 2022 on the stock market and test the random walk hypothesis through an event study. The devaluation events impact on stock market returns will be tested on both indices EGX100 and EGX30, based on the research done by ((Ikechukwu & Evans, 2020); (Magui, Elsiefy, & Bahaa, 2023); (Ananzeh, 2021)) which found that EGX100 is the most used proxy for the Egyptian stock market as it is inclusive of EGX30 and EGX70; and it includes furthermore almost all firms with largest market cap and most traded stocks. Nevertheless, EGX30 will be used as a robustness check for the results of EGX100, as this method has been conducted previously by (Samdani, Ullah, & Nabi, 2021).

Event study methodology was introduced by Ball and Brown (1968). (Sun & Abraham, 2021) view that it aims to examine certain calendar date events on the stock market and examine the period pre and the occurrence of such events to compare their impact and significance.

Conducting event study methodology can be done generally following two main approaches; the first is to determine the pre and post-period time intervals and then the date of the event and afterwards abnormal returns following immediately the event occurrence will be calculated (Albulescu, Tiwari, & Kyophilavong, 2021). Hence, the volatility of the market is to be examined over the short-, medium- and long-term using the rolling window regression approach and the chosen event window is to be determined according to the study. The second approach to event study is to create a dummy variable of the event regress using the dummy variable of the event and examine the volatility of returns given the impact of the dummy variable (Event) (Kamal, 2016). Following the work of (Umoru, Udobi-Owoloja, & Nzekwe, 2020), the second approach will be used in examining the weak form of EMH in the emerging market of Egypt.

Various statistical methods have been used to test the EMH and its validity in different markets (as discussed in the literature). Common methods used are run tests, variance root tests, GARCH models, multifractality methods, and wavelet unit root tests. However, following the work of (Umoru, Udobi-Owoloja, & Nzekwe, 2020) and (YANG & NEMLİOĞLU, 2023) unit root test and EGARCH/ARCH models will be used to test the EMH in Egypt as an emerging market. This method is considered the most suitable to capture the stationarity of the stock market returns (Umoru, Udobi-Owoloja, & Nzekwe, 2020). Furthermore, two unit root tests will be conducted: the first Is a parametric unit root test of ADF (Augmented Dickey fuller unit root test) and the second is a non-parametric test to be conducted as a robustness check for the results of the ADF which is Philips-perron test.

The unit root tests are conducted to test whether the returns are stationary or non-stationary based on the null hypothesis that there is non-stationarity in the data which means that the returns correspond to market movements, that is tested if the H0 is significant to the p-value of 0.05 (Mondal, Singh, & Yadav, 2022).

H0: returns have a unit root.

H1: returns are stationary.

Moreover, since the data being studied is returns of the stock market index, hence the returns are calculated as a log of the stock market closing prices according to Ananzeh (2021) in the following equation:

$$ln = \frac{pt}{pt-1} \text{ (equation 0)}$$

Where pt is the new closing price and pt-1 is the previous closing price. The returns of the stock index, its calculated as:

$$r = \Delta pt + \beta + \varepsilon \text{ (equation 1)}$$

Where a change in pt is calculated a $beta\ represents$ the variance or drift parameter epsilon error term.

According to Yang & Nemlioglu (2023) testing of EMH with unit root tests is not significant enough to examine the variances in returns, which is done by using Autoregressive Conditional Heteroskedasticity (ARCH) and the exponential Generalized ARCH (EGARCH) models. These models aim to examine the conditional and unconditional variances that occur in stock market returns to highlight whether a certain event influences such variances or not (Ananzeh, 2021).

As per Derbali (2019) and Yang & Nemlioglu (2023) the conditional mean and conditional variance equations of the following kind served as the basis for the analysis:

$$\sigma^2 t = \gamma + \Sigma\theta\varepsilon^2 + \Sigma\delta\sigma^2 \text{ (Equation 2)}$$

The conditional variance in equation (2) was calculated based on historical data and was represented as a function of a vector of exogenous factors. It demonstrated how the investor could forecast the variance for this period by forming a weighted average of a long-term average (the constant term), the anticipated variance from the previous period (i.e., the GARCH term), and knowledge about the volatility in returns noticed in the previous period (i.e., the ARCH term). For the ARCH and GARCH terms, the lags p and q, respectively, were chosen. Moreover, following the work of (Kamal, 2016), the event being examined should be introduced as a dummy variable in the variance equation as follows:

$$\mathrm{r} = \alpha + \beta \mathrm{devaluation} + \varphi \mathrm{Currency\_devalaution\_dummy} + \varepsilon$$
(Equation 3)

In equation 3 the currency devaluation is integrated as a dummy variable where its value is zero before the event and 1 starting from the date of the event and onwards.

Data and Sample Used

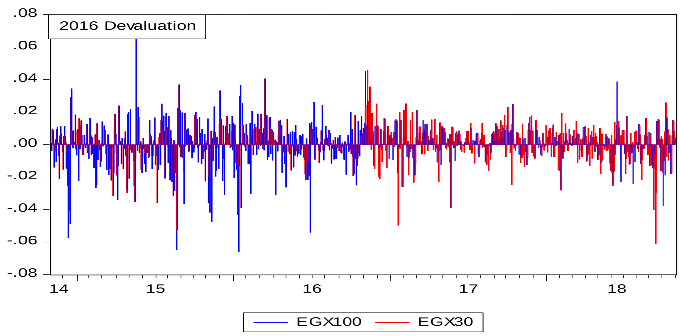
The data used is the closing prices for EGX100, while the chosen period will be unbalanced according to the currency devaluation events. The first currency devaluation occurring in Egypt for economic reform was from November 3rd of 2016 and thus 2 years before and after the event were retrieved from 3/11/2014-3/11/2018. The second currency devaluation event occurred on the 21st of March 2022 post the Russian-Ukrainian war which impacted Egypt economically, however for this event period of 1 year and 8 months before and after the currency devaluation event is retrieved due to the data availability following the work of (Ananzeh, 2021).

The chosen time period was selected according to Kamal (2016) and El-Masry & Badr (2020), which proposed that the most appropriate time period to be used is 2 years, pre and post-the event to be examined (the event date is November 3rd 2016 and 21st of march 2022). This is to ensure that the long- and short-term impact of the event is captured and considered. All data is retrieved from the Refinitiv database from the financial lab at the British university in Egypt.

Discussion and Results

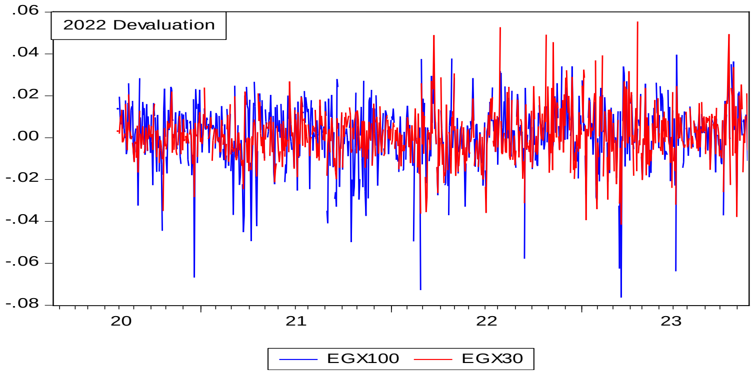
Upon retrieving EGX100 and EGX30 closing prices and logging the returns of the index (equation 0). The returns for the whole sample period are shown in the following graphs:

Figure 1. 2016 Devaluation Event Impact on EGX100 and EGX30



Source: Authors' Analysis for whole data sample (2014-2018) 2 years before and after the 2016 devaluation event

Figure 2. 2022 Devaluation Event Impact on EGX100 and EGX30



Source: Authors' Analysis whole data sample (2020-2023) 1 year and 8 months before and after the 2022 devaluation event

From the graphs above, it is observed that for EGX100 and EGX30, the returns throughout the sample period are stationary. However, accounting for the variances that occurred in these indices is vital to understanding what caused such fluctuation in the returns and the impact of market events on this volatility. Meanwhile, the descriptive statistic for both indices during both events is shown as follows in table 1:

Table 1. EGX100 and EGX30 Indices Descriptive Statistics

	2016 Event		**2022 Event**	
	EGX100	**EGX30**	**EGX100**	**EGX30**
Mean	0.000149	0.000279	0.001522	0.00112
Median	0.001119	0.00067	0.0032	0.0006
Maximum	0.075186	0.064886	0.0396	0.0555
Minimum	-0.0659	-0.05764	-0.0764	-0.0415
Std. Dev.	0.013332	0.013574	0.014882	0.012301
Skewness	-0.71707	-0.14773	-1.05369	0.314242
Kurtosis	6.841523	6.069894	6.276818	5.109599
Jarque-Bera	684.4732	386.4063	511.0124	163.1285
Probability	0.0000	0.0000	0.0000	0.0000
Sum	0.145319	0.272292	1.2296	0.9051
Sum Sq. Dev.	0.173484	0.179455	0.178724	0.122114
Observations	977	977	808	808

Source: Authors' Analysis for the two samples data (2014-2018) and (2020-2023)

From the descriptive statistics, it is observed that for both indices the significance of the Jarque-Bera test (compared to a p-value of 0.05)

MSA-Management science journal
ISSN 2974-3036
Volume: 3, Issue:2, Year: 2024 pp.1-27

indicated the normality of returns for both indices. Moreover, the negative values of skewness and high values of kurtosis and its higher values than '3'; indicate the negative values that exist in returns as well as the leptokurtic nature of the returns. Afterwards, ADF unit root analysis will be conducted to fit the nature of the macroeconomic analysis of the currency devaluation variable on stock market returns.

Table 2. ADF-unit Root Test

EGX100 Before 2016 Devaluation					**EGX100 After 2016 Devaluation**				
Null Hypothesis: EGX 100 has a unit root									
Exogenous: Constant, Linear Trend									
Leg Length: 0 (Automatic - based on SIC, maxlag=17)									
			t-Statistic	Prob.*				t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-24.7965	0.0000	Augmented Dickey-Fuller test statistic			-17.0649	0.0000
Test critical values:	1% level		-3.96748		Test critical values:	1% level		-3.97713	
	5% level		-3.41443			5% level		-3.41913	
	10% level		-3.12934			10% level		-3.13213	
EGX100 Before 2022 Devaluation					**EGX100 After 2022 Devaluation**				
			t-Statistic	Prob.*				t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-16.9052	0.0000	Augmented Dickey-Fuller test statistic			-17.0932	0.0000
Test critical values:	1% level		-3.44632		Test critical values:	1% level		-3.4464	
	5% level		-2.86848			5% level		-2.86851	
	10% level		-2.57053			10% level		-2.57055	

Source: Authors' Analysis for EGX100 before and after the 2016 and 2022 devaluation events

Table 3. Philips-Perron Test

EGX100 Before 2016 Devaluation					**EGX100 After 2016 Devaluation**				
Null Hypothesis: Egx100 has a unit root									
Exogenous: Constant, Linear Trend									
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel									
			Adj. t-Stat	Prob.*				Adj. t-Stat	Prob.*
Phillips-Perron test statistic			-24.8219	0.0000	Phillips-Perron test statistic			-16.932	0.0000
Test critical values:	1% level		-3.96748		Test critical values:	1% level		-3.97713	
	5% level		-3.41443			5% level		-3.41913	
	10% level		-3.12934			10% level		-3.13213	

EGX100 Before 2022 Devaluation				EGX100 After 2022 Devaluation			
		Adj. t-Stat	Prob.*			Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-16.9269	0.0000	Phillips-Perron test statistic		-17.2594	0.0000
Test critical values:	1% level	-3.44632		Test critical values:	1% level	-3.4464	
	5% level	-2.86848			5% level	-2.86851	
	10% level	-2.57053			10% level	-2.57055	

Source: Authors' Analysis for EGX100 before and after the 2016 and 2022 devaluation events

In addition to this, the parametric ADF unit root test and the non-parametric Philips-Perron test were conducted for both indices (For EGX30 results in Appendix 1) however for the periods of (3/11/2014-3/11/2016) and (29/7/2021-21/3/2022) and for the periods of (4/11/2016-3/11/2018) and (22/3/2022-21/11/2023) to account for the two sub periods before and after the currency devaluation events.

It was found that based on the P-value for both tests and for both sub-samples, the p-value is significant and hence, the null hypothesis is rejected. Thus, the alternative hypothesis is accepted that data is stationary regardless of market events and fluctuations. This indicated the ability of investors to utilize this stationarity and have abnormal returns in both currency devaluation events.

These findings are in line with other literature that argued that the Egyptian market does not confront the weak market hypothesis (Ananzeh, 2021), moreover, other research precisely concerned with the EMH in Egyptian during currency devaluation highlighted that the even in severe economic events the Egyptian market does not follow random walk hypothesis.

However, according to other literature, the Egyptian market displays characteristics of weak form efficiency and hence somewhat follows the random walk hypothesis (El-Masry & Badr, 2020).

For the second level of analysis of the mean-variance, conditional and non-conditional. The ARCH test is conducted and the results are as follows:

Table 4. ARCH Test

MSA-Management science journal
ISSN 2974-3036
Volume: 3, Issue:2, Year: 2024 pp.1-27

EGX100 in 2016 Devaluation				EGX100 in 2022 Devaluation			
Heteroskedasticity Test: ARCH							
F-statistic	12.68418	Prob. F(1,973)	0.0004	F-statistic	25.65043	Prob. F(1,804)	0.0000
Obs*R-squared	12.5467	Prob. Chi-Square(1)	0.0004	Obs*R-squared	24.91923	Prob. Chi-Square(1)	0.0000
EGX30 in 2016 Devaluation				**EGX30 in 2022 Devaluation**			
F-statistic	24.26714	Prob. F(1,971)	0.0000	F-statistic	7.481496	Prob. F(1,804)	0.0006
Obs*R-squared	23.72421	Prob. Chi-Square(1)	0.0000	Obs*R-squared	14.74362	Prob. Chi-Square(1)	0.0006

Source: Authors' Analysis for EGX30 and EGX100 before and after the 2016 and 2022 devaluation events

Using the whole sample periods the ARCH test for both indices is found to have significance of both the F-tests and Chi-square. According to this, the significance of the P-values allows us to reject the null hypothesis that previous volatility of stock returns does not influence the investors' expectations. Hence, this indicates that the ARCH model suggests that the previous volatility on returns of both indices has influenced and impacted the current and future returns as well.

For the results of the EGARCH of EGX100 (Appendix 2), the conditional variance was found to be significant and of a positive value of (7.99) for the 2016 event and (11.5) value in the 2022 event showing the variance in returns before and after the currency devaluation. Moreover, the negative and insignificance of the dummy variable of the currency devaluation, shows that EGX100 variance was not impacted by the event of currency devaluation in the market. For the results of the EGARCH of EGX30 (Appendix 3), the conditional variance was found to be significant and of the negative value of (-10.14) in the 2016 event and (-5.4) in the 2022 event, showing the variance in returns before and after the currency devaluation events. Moreover, the dummy variable of the currency devaluation is relatively significant and has a negative value. This shows that EGX30 variance was relatively and on a smaller scale, impacted by the occurrence of the currency devaluation in the market.

Reflecting on the research hypotheses and objective, it can be derived that the null hypothesis is rejected where the Egyptian stock market returns are stationary and do not follow the random walk hypothesis. Moreover, fulfilling the main objective of the research which is to examine the level of market efficiency during macroeconomic events such as devaluation, results show the insignificance of these macroeconomic events on the stock market returns for EGX100. However, contradictory results are shown when tested on EGX30 as some significance of these events on the returns is displayed.

Implications

The policy reflecting on the results of this paper, and the implications of this research are in the light of mechanisms of inefficient markets and their reaction towards market events. Based on the results, the inefficiency of the Egyptian market implies that investors can develop investment strategies based on market anomalies, insider trading and using behavioural biases to yield above-average returns that would rather not be obtained in a weak form efficient market. Hence, this research sheds light on how major market events should alter market returns however due to the inefficiency of the market the returns do not correspond to such events. Moreover, the implication of this research is that it recommends policies to enhance the efficiency of the market and encourage investors to overcome their behavioural biases.

Conclusion

The importance of EMH in emerging markets is evident due to its impact on the development and growth of financial and capital markets in these regions, and the impact it has on the economic growth and welfare of society. According to this and according to the occurrence of the currency devaluation in the Egyptian market in 2016 and 2022, and the lack of research on the Egyptian market as efficient or inefficient. Hence, the main purpose of this paper is to examine the EMH and its validity in the Egyptian market on its main market index of EGX100. The index of EGX30 was used as a robustness check for the results.

Based on the previous literature, it was found that one of the optimal methods to test the EMH is the unit root test and EGARCH, ARCH models for variance. Hence, the ADF unit root test was conducted, and it showed the stationarity for both indices returns, furthermore non-parametric unit root test of Philips-perron was conducted and yielded the same results. Meanwhile, the ARCH models for both indices rejected the null hypothesis and found that previous market volatility impacts the current and future returns hence it rejects the EMH and random walk hypothesis.

Moreover, the EGARCH model for EGX100 showed the insignificance of the dummy variable of the currency devaluation and showed the indifference it had to the variance of the returns. However, for EGX30 it was found that the dummy variable has significance and negative value. Thus, based on the mixed results found on both indices it is found that the weak-form hypothesis and the null hypothesis of this paper are rejected for the Egyptian market. Based on these findings it can be concluded that the Egyptian stock market does not follow the random walk hypothesis which indicates the lack of weak form efficiency in the market hence, market movements can be anticipated, and investors can generate excess returns from these movements.

The policy implications that may be implemented in light of the findings regarding the lack of applicability of the random walk hypothesis within the Egyptian stock market are to guarantee that the regulatory framework of the Egyptian stock exchange plays a role in controlling market movements. Furthermore, the awareness of potential unprecedented gains and, conversely, losses resulting from predicted market movements among investors in an inefficient market like the Egyptian market is where financial literacy is put into practice.

Furthermore, it is advised that the financial regulatory organisations overseeing the Egyptian market play a part in reducing insider trading, exaggerated stock values, and herd mentality by putting in place financial regulations that promote market discipline and regain investors' confidence. This could be done by increasing awareness campaigns and policies to promote investing in the Egyptian market and establishing a regulatory unit to regulate the information and news disseminated in the market.

The limitation of this study is in the selected sample period although it aimed to capture the immediate, short-term term and long-term impact on stock market returns. However, the sample period has been characterized by several other market events that might have had an impact on the results and their significance. Moreover, another limitation of this study is the lagged impact of currency devaluation on certain firms and hence, the inability of the study to classify the stock returns according to industry or sectors. In addition to that, one of the limitations of this study is accounting for the political regimes and events that may alter the findings of this research and impact the main indices of the Egyptian market.

Future recommendations for further studies on the topic of EMH are to test the emerging market of Egypt for the adaptive market hypothesis. As shown in the literature the adaptive market hypothesis is more evident in the context of emerging markets as it accounts for the irrationality of investors given the lack of financial literacy in these markets. Moreover, it is recommended for the sake of further analysis to conduct a comparative study with other countries that were impacted by the same event under study and to utilize new methodologies as neural networks for more precise findings.

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Appendix:

Appendix 1. EGX30 ADF Test

EGX30 Before 2016 Devaluation			**EGX30 After 2016 Devaluation**		
Null Hypothesis: EGX 30 has a unit root					
Exogenous: Constant, Linear Trend					
Lag Length: 0 (Automatic - based on SIC, maxlag=17)					
	t-Statistic	Prob.*		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-17.9645	0.0000	Augmented Dickey-Fuller test statistic	-18.3354	0.0000
Test critical values: 1% level	-3.97701		Test critical values: 1% level	-3.97713	
5% level	-3.41908		5% level	-3.41913	
10% level	-3.1321		10% level	-3.13213	
EGX30 Before 2022 Devaluation			**EGX30 After 2022 Devaluation**		
	t-Statistic	Prob.*		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-16.1322	0.0000	Augmented Dickey-Fuller test statistic	-17.8212	0.0000
Test critical values: 1% level	-3.44632		Test critical values: 1% level	-3.4464	
5% level	-2.86848		5% level	-2.86851	
10% level	-2.57053		10% level	-2.57055	

Source: Authors' Analysis for EGX30 before and after the 2016 and 2022 devaluation events

Appendix 1. EGX30 Philips-Perron Test

EGX30 Before 2016 Devaluation					**EGX30 After 2016 Devaluation**				
Null Hypothesis: Egx30 has a unit root									
Exogenous: Constant, Linear Trend									
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel									
			Adj. t-Stat	Prob.*				Adj. t-Stat	Prob.*
Phillips-Perron test statistic			-18.0177	0.0000	Phillips-Perron test statistic			-18.1601	0.0000
Test critical values:	1% level		-3.97701		Test critical values:	1% level		-3.97713	
	5% level		-3.41908			5% level		-3.41913	
	10% level		-3.1321			10% level		-3.13213	
EGX30 Before 2022 Devaluation					**EGX30 After 2022 Devaluation**				
			Adj. t-Stat	Prob.*				Adj. t-Stat	Prob.*
Phillips-Perron test statistic			-16.1242	0.0000	Phillips-Perron test statistic			-17.8515	0.0000
Test critical values:	1% level		-3.44632		Test critical values:	1% level		-3.4464	
	5% level		-2.86848			5% level		-2.86851	
	10% level		-2.57053			10% level		-2.57055	

Source: Authors' Analysis for EGX30 before and after the 2016 and 2022 devaluation events

MSA-Management science journal
ISSN 2974-3036
Volume: 3, Issue:2, Year: 2024 pp.1-27

Appendix 2. *EGX100 EGARCH model*

EGX100 in 2016 Devaluation	*EGX100 in 2022 Devaluation*
Dependent Variable: D(LOG01)	Dependent Variable: D(LOG01)
Method: ML - ARCH (Marquardt) - Student's t distribution	Method: ML - ARCH (Marquardt) - Student's t distribution
Date: 05/29/23 Time: 13:51	Date: 11/21/23 Time: 20:22
Sample (adjusted): 11/05/2014 11/01/2018	Sample (adjusted): 8/04/2020 11/21/2023
Included observations: 976 after adjustments	Included observations: 807 after adjustments
Convergence achieved after 160 iterations	Convergence achieved after 90 iterations
Presample variance: backcast (parameter = 0.7)	Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)	LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)
*ABS(RESID(-2)/@SQRT(GARCH(-2))) + C(7)*ABS(RESID(-3)	*ABS(RESID(-2)/@SQRT(GARCH(-2))) + C(7)*RESID(-1)
/@SQRT(GARCH(-3))) + C(8)*ABS(RESID(-4)/@SQRT(GARCH(-4))) +	/@SQRT(GARCH(-1)) + C(8)*RESID(-2)/@SQRT(GARCH(-2)) + C(9)
C(9)*RESID(-1)/@SQRT(GARCH(-1)) + C(10)*RESID(-2)	*RESID(-3)/@SQRT(GARCH(-3)) + C(10)*RESID(-4)/@SQRT(GARCH(
/@SQRT(GARCH(-2)) + C(11)*RESID(-3)/@SQRT(GARCH(-3)) + C(12)	-4)) + C(11)*RESID(-5)/@SQRT(GARCH(-5)) + C(12)*RESID(-6)
*RESID(-4)/@SQRT(GARCH(-4)) + C(13)*RESID(-5)/@SQRT(GARCH(	/@SQRT(GARCH(-6)) + C(13)*RESID(-7)/@SQRT(GARCH(-7)) + C(14)
-5)) + C(14)*RESID(-6)/@SQRT(GARCH(-6)) + C(15)*RESID(-7)	*RESID(-8)/@SQRT(GARCH(-8)) + C(15)*RESID(-9)/@SQRT(GARCH(
/@SQRT(GARCH(-7)) + C(16)*RESID(-8)/@SQRT(GARCH(-8)) + C(17)	-9)) + C(16)*LOG(GARCH(-1)) + C(17)*LOG(GARCH(-2))
*RESID(-9)/@SQRT(GARCH(-9)) + C(18)*LOG(GARCH(-1))	

Variable	Coefficient	Std. Error	z-Statistic	Prob.	Variable	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	7.997924	0.074138	107.8783	0.00000	@SQRT(GARCH)	11.53918	2.294893	5.028199	
CURRENCY	-0.00016	6.85E-05	-2.36867	0.0179	CURRENCY_DUMMY	-3.81E-05	0.000114	-0.33314	0.739

C	-0.1345	0.009176	-14.6576	0.00000	C	-0.1947	0.044834	-4.34258	0
Variance Equation					Variance Equation				
C(4)	-7.43663	0.124785	-59.5956	0.0000	C(4)	-7.18447	0.574694	-12.5014	0
C(5)	0.009547	0.009624	0.992037	0.3212	C(5)	0.014828	0.008315	1.783242	0.0745
C(6)	0.032369	0.01269	2.550783	0.0107	C(6)	-0.01168	0.008537	-1.3686	0.1711
C(7)	-0.02484	0.013286	-1.86934	0.0616	C(7)	-0.13	0.025031	-5.19369	0.00000
C(8)	-0.02367	0.010286	-2.30138	0.0214	C(8)	-0.03991	0.038377	-1.03988	0.2984
C(9)	-0.18047	0.006426	-28.0836	0.0000	C(9)	0.031785	0.026885	1.182239	0.2371
C(10)	-0.03185	0.007904	-4.02945	0.0001	C(10)	0.01313	0.018153	0.723313	0.4695
C(11)	0.010252	0.008582	1.194553	0.2323	C(11)	-0.01717	0.008323	-2.06324	0.0391
C(12)	-0.00247	0.008789	-0.28149	0.7783	C(12)	-0.00247	0.009702	-0.25462	0.799
C(13)	0.010757	0.008284	1.298504	0.1941	C(13)	0.000954	0.008184	0.116594	0.9072
C(14)	-0.01472	0.008158	-1.80493	0.0711	C(14)	0.012727	0.007311	1.740815	0.0817
C(15)	0.004648	0.007965	0.583557	0.5595	C(15)	-0.00405	0.005819	-0.69557	0.4867
C(16)	-0.0049	0.008252	-0.59385	0.5526	C(16)	0.0319	0.284142	0.112268	0.9106
C(17)	-0.00201	0.006766	-0.29739	0.7662	C(17)	0.088643	0.276564	0.320515	0.7486
C(18)	0.089789	0.001838	48.84461	0.00000					
T-DIST. DOF	2.774139	0.196378	14.1265	0.000	T-DIST. DOF	3.550213	0.404213	8.783025	0.000000
R-squared	0.38011	Mean dependent var		3.49E-06	R-squared	0.413992	Mean dependent var		-1.49E-06
Adjusted R-squared	0.378836	S.D. dependent var		0.016568	Adjusted R-squared	0.412535	S.D. dependent var		0.019278
S.E. of regression	0.013058	Akaike info criterion		-5.9218	S.E. of regression	0.014776	Akaike info criterion		-5.65161
Sum squared resid	0.165912	Schwarz criterion		-5.82673	Sum squared resid	0.175528	Schwarz criterion		-5.54692
Log likelihood	2908.837	Hannan-Quinn criter.		-5.88562	Log likelihood	2298.423	Hannan-Quinn criter.		-5.61141
Durbin-Watson stat	1.999966				Durbin-Watson stat	2.060774			

Source: Authors' Analysis for EGX100 before and after the 2016 and 2022 devaluation events

Appendix 3. *EGX30 EGARCH model*

EGX30 in 2016 Devaluation					***EGX30 in 2022 Devaluation***				
Dependent Variable: D(LOG01)					Dependent Variable: D(LOG01)				
Method: ML - ARCH (Marquardt) - Student's t distribution					Method: ML - ARCH (Marquardt) - Student's t distribution				
Date: 05/29/23 Time: 17:14					Date: 11/21/23 Time: 20:42				
Sample (adjusted): 2 975					Sample (adjusted): 8/04/2020 11/21/2023				
Included observations: 974 after adjustments					Included observations: 807 after adjustments				
Convergence achieved after 152 iterations					Convergence achieved after 128 iterations				
Presample variance: backcast (parameter = 0.7)					Presample variance: backcast (parameter = 0.7)				
LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)					LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)				
*RESID(-1)/@SQRT(GARCH(-1)) + C(7)*RESID(-2)/@SQRT(GARCH(					*RESID(-1)/@SQRT(GARCH(-1)) + C(7)*RESID(-2)/@SQRT(GARCH(				
-2)) + C(8)*RESID(-3)/@SQRT(GARCH(-3)) + C(9)*RESID(-4)					-2)) + C(8)*RESID(-3)/@SQRT(GARCH(-3)) + C(9)*RESID(-4)				
/@SQRT(GARCH(-4)) + C(10)*RESID(-5)/@SQRT(GARCH(-5)) + C(11)					/@SQRT(GARCH(-4)) + C(10)*RESID(-5)/@SQRT(GARCH(-5)) + C(11)				
*RESID(-6)/@SQRT(GARCH(-6)) + C(12)*RESID(-7)/@SQRT(GARCH(					*RESID(-6)/@SQRT(GARCH(-6)) + C(12)*RESID(-7)/@SQRT(GARCH(				
-7)) + C(13)*RESID(-8)/@SQRT(GARCH(-8)) + C(14)*RESID(-9)					-7)) + C(13)*RESID(-8)/@SQRT(GARCH(-8)) + C(14)*RESID(-9)				
/@SQRT(GARCH(-9)) + C(15)*LOG(GARCH(-1))					/@SQRT(GARCH(-9)) + C(15)*LOG(GARCH(-1))				
Variable	Coefficient	Std. Error	z-Statistic	Prob.	Variable	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	-10.18702	0.364961	-27.91265	0.000000	@SQRT(GARCH)	-5.40406	1.358997	-3.976507	0.0001
DUMMY	-0.000195	6.49E-05	-3.011714	0.0026	CURRENCY_DUMMY	-6.55E-05	5.31E-05	-1.233746	0.2173
C	0.145454	0.003012	48.29325	0.0000000	C	0.095586	0.013435	7.114514	0.0000000
Variance Equation					Variance Equation				
C(4)	-10.26959	1.008932	-	0.0000000	C(4)	-7.814291	0.341319	-22.8944	0.0000000

			10.17867						
C(5)	-0.004039	0.002967	-1.361241	0.1734	C(5)	-0.030124	0.01143	-2.635571	0.0084
C(6)	0.133556	0.006674	20.0126	0.0000000	C(6)	0.271091	0.065599	4.132541	0.0000000
C(7)	0.072554	0.019394	3.741068	0.0002	C(7)	0.083927	0.025805	3.252329	0.0011
C(8)	0.010758	0.008506	1.264699	0.206	C(8)	-0.025714	0.013363	-1.924234	0.0543
C(9)	-0.006568	0.00611	-1.074921	0.2824	C(9)	0.014017	0.012503	1.121094	0.2622
C(10)	-0.005682	0.006535	-0.869425	0.3846	C(10)	0.009179	0.012718	0.721748	0.4704
C(11)	0.017507	0.006335	2.763507	0.0057	C(11)	-0.025784	0.01322	-1.950368	0.0511
C(12)	6.49E-05	0.006609	0.009827	0.9922	C(12)	-0.000414	0.012761	-0.032438	0.9741
C(13)	-0.004307	0.006465	-0.666111	0.5053	C(13)	0.018033	0.013086	1.378062	0.1682
C(14)	0.005017	0.005662	0.886093	0.3756	C(14)	-0.001613	0.009811	-0.164384	0.8694
C(15)	-0.20789	0.122795	-1.692994	0.0905	C(15)	0.031057	0.005498	5.648969	0.0000000
T-DIST. DOF	4.560493	0.624892	7.29805	0.0000000	T-DIST. DOF	2.684452	0.370197	7.25141	0.0000000
R-squared	0.36297	Mean dependent var		-1.24E-06	R-squared	0.386879	Mean dependent var		-1.20E-05
Adjusted R-squared	0.361658	S.D. dependent var		0.016882	Adjusted R-squared	0.385353	S.D. dependent var		0.016125
S.E. of regression	0.013488	Akaike info criterion		-5.81408	S.E. of regression	0.012642	Akaike info criterion		-5.916423
Sum squared resid	0.176643	Schwarz criterion		-5.733892	Sum squared resid	0.128493	Schwarz criterion		-5.82337
Log likelihood	2847.457	Hannan-Quinn criter.		-5.783564	Log likelihood	2403.277	Hannan-Quinn criter.		-5.880691
Durbin-Watson stat	2.091401				Durbin-Watson stat	2.1664			

Source: Authors' Analysis for EGX30 before and after the 2016 and 2022 devaluation events