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Empirical Evidence of the Existence of Speculative Bubbles in Stock Prices Traded on The Egyptian Stock Exchange

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Abstract

Purpose - This study aims to investigate whether there exist speculative bubbles in stock prices traded on the Egyptian Stock Exchange. *Design/methodology/approach* - In this study, to identify the presence of speculative bubbles in stock prices, the authors follow the study of Anderson and Brooks (2014) by applying their model for measuring stocks bubble sizes in addition to extract periods of bubbles of stock prices (heterogeneously and homogeneously) using a time series of monthly data for the period from January 2008 to December 2020, the model allows measuring relative bubble sizes of individual stocks using data on stock prices and dividends, the current study uses a sample of 110 stocks traded on the Egyptian exchange which considered the most active in terms of trading volume and liquidity, these active stocks are representative to 14 of different economic sectors of the Egyptian economy. *Findings* - The empirical results indicate during the study period of the dataset for all heterogeneous 110 companies taken together, occurrence of three negative bubbles in their stock prices, further, the dates of these bubbles correspond to specific events happened in the Egyptian economy. In addition to Anderson and Brooks (2014), we extended our analysis making stocks relatively homogenous by grouping them into 14 different sectors in order to study each economic sector separately to reveal which sectors are mainly responsible for arising each bubble, we find that the further analysis can better describe bubbles as few sectors shown more obvious big bubble sizes for each bubble during the study period, only six sectors in 2008-2009, three in 2011-2012, and two in 2016-2017, as they mainly responsible for the initial arising of bubbles in the whole market, while other sectors haven't witnessed any bubbles during the research period. *Originality/value* - This study contributes to previous research in bubble literature, our study is the first that reveals negative bubbles of stock prices in the Egyptian Exchange in addition to reveal which stocks and sectors are responsible for bubbles occurrence in each period, number of companies lacks investments although they considered an opportunity to increase investors' returns, because during the study period stocks' fundamental values are shown higher than market prices, also few sectors are exposed to outflows, although these companies continuously distribute cash dividends, investors extensively selling certain stocks causing sudden outflows which in turn lead to bubbles, so these companies should exert more efforts to inform investors of the true values of their stocks, the central bank of Egypt should encourage investments through taking decisions controlling sustainable currency depreciation to encourage foreign investors to invest their money in the Egyptian exchange.

Keywords: Speculative bubbles, Individual Stocks, Egyptian Exchange, Anderson & Brooks (2014).

Introduction

Since the emergence of financial and capital liberalization policies at the beginning of the nineties of the last century, Egypt with other emerging markets have become integrated with global financial markets which results in arising some financial phenomena that may result in disastrous effects for their whole economy Koudalu and Wu (2022). Since liberalization until now, results of a group of studies identified

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the weak efficiency of the Egyptian Exchange and revealed high probability of crashes, anomalies, noise traders as trading mainly based on speculative purposes (see for example, Abdelzaher (2021), Otaify (2016), Shams (2018), Masry (2015); Ansary and Atua (2012); Girad and Omran (2009), Saad (2009)). According to finance literature, intensive speculative trading as one of the financial phenomena leads to show higher volatility clustering, fat tails, bubbles Inoua and smith (2023), noise traders, financial crises and price anomalies appearing when studying stock prices performance of emerging markets Zhang et al. (2008), Dash and Mahakud (2015), Kuria and Riro (2013), Diaz-Ruiz (2020), Jansen et al. (2022) and Abass et al., (2023). (Abián et al., 2022)

Unsophisticated investors enter markets for speculation purpose as they seek for abnormal returns, lead them choose to allocate fund through non-diversified portfolios causing great influence on price efficiency that may affect the process of stock pricing when arbitrages are limited or costly Hsin and Peng (2023), increasing the severity of speculation on some stocks leads to arising higher deviations between stock prices and their fundamental values, in such a way that stock prices fail to reflect their real values, these deviations are due to the existence of nonfundamental factors, the persistent of this situation eventually leads to the emergence of a frightening phenomenon called speculative bubbles Yildirim et al. (2022). According to bubble literature, fundamental values constructed by using the sum of the present discounted values of expected dividends, since models of present value is considered one of the corner stones of corporate finance, therefore, in order to detect bubbles occurrence, studies used them as a proxy for fundamental factors that could affect stock valuation Basse et al. (2021), the assumption of discounted dividend valuation is applied through models mainly used for valuating stocks of individual companies for the advantage of their obvious forward-looking nature Casta (2022). (Baris, 2022)

On the other hand, majority of studies rely on price indices in detecting bubbles rather than on individual stocks, they used to compare price indices with fundamental values through centering on the relationship between price and dividends. Since Campbell and Shiller, 1988, Fama and French, 1988 indicated that the dividend–price ratio able to predict future stock returns, a great deal of attention from economists (e.g. Park (2010), Polimenis and Neokosmidis (2016), Yu and Huang (2023), Yu et al. (2023)) investigated the question as to whether or not stock returns are predictable through the co-integration relationship between these two variables. That higher levels of cash dividends cause a corresponding rise in stock prices since dividends signal future earnings prospects to investors Yin and Nie (2021).

On contrary, according to results of (e.g. McMillan (2010), Anderson et al. (2010), Jung and Shiller (2005), Costa et al. (2017), Narayan et al. (2013), Anderson and Brooks (2014)), they criticize the use of index data as it declared less supportive to the present value model because using more average values make the impact of any change in dividends or stock prices less explicit as the information content of dividends becomes confused, which turns the measurement of fundamental values to become inaccurate and gives misleading results, so it allows existence of more unfundamental and irrational factors to take place in explaining bubbles occurrence. (Sernaqué et al., 2023)

Moreover, studies disregard index data provide literature and policy makers with additional information as they delve more deeply to understand which stocks participate in creating stock market bubbles and which sectors in the economy most likely exposed to bubbles, also Costa et al. (2017) argued that, the initial occurrence of a bubble primarily arises through speculating on some stocks which extends its effects to impact those who invest in stocks, bubble effects are then transmitted accordingly to the whole market which may result in affecting the economy as a whole, therefore, studies rely on stock prices in detecting bubbles can give more accurate results. As stock prices found to have the distinctive feature of experiencing rapid price dynamics in a short period of time as they are primarily sensitive to private information-based trading as well as public information which result in appearing significant heterogeneity in individual stocks' price dynamics Yin and Zhao, (2015) and Xiao and Zhao (2021).

The above arguments give us a motive to detect bubbles using stock prices of the Egyptian exchange by using model of Anderson and Brooks (2014) as it considered a direct method in investigating bubbles, as it presents a new technique in measuring bubble sizes using data of market prices of individual stocks and dividends as an indicator for fundamental values.

Based on the above, our study attempts to detect bubbles in the Egyptian exchange during the period from January 2008 to December 2020, our study contributes to literature in two ways; *First*, no evidence of the presence of speculative bubbles in the Egyptian Exchange during our study period, however, this period includes five big known crises the Egyptian Economy passed by (The global financial crisis, January 25th revolution 2011, June 30th 2013 revolution, floatation of exchange rate, the COVID-19 pandemic), this time series covers 13 years as the Egyptian economy witnessed many changes in regulations and policies taken by policymakers to reduce the harmful effects resulting from the spread of speculative trading, hence, we suggest that these decisions are expected to affect investor behavior as well as market efficiency along the study period and we expect these decisions may lead to cause variations in our results across time. (Muthuswamy & Nithya, 2023)

Second, we extend literature by applying the model of Anderson and Brooks (2014), as the current study is the first to apply this model -for the best knowledge of the researchers- on an Emerging stock market to reveal its ability to detect bubbles in different environments, as well as analyze bubble formation by using data of individual stocks covering major industrial sectors of the Egyptian economy to know the source of emergence of the bubbles detected.

Since the general objective of the research is to investigate the existence of speculative bubbles on individual stock prices for companies listed in the Egyptian exchange, so the research question can be expressed as follows: Is applying the model of (Anderson and Brooks, 2014) able to give evidence for the existence of speculative bubbles in companies' stock prices that are traded in the Egyptian exchange?

The remainder of this paper is organized through four sections as follows. "Theoretical framework and literature review" section summarizes the theoretical framework and prior literature. "Data and methodology" section explains our data and methodology. "Empirical results" section presents our empirical findings, Finally, "Conclusion" section provides concluding remarks and policy recommendations.

Theoretical Framework and Literature Review

This section is divided into three parts. In the first part, we present a background of speculative bubbles, In the second we briefly explain speculative bubbles, in the last section we show some models used by literature in detecting bubbles.

Theoretical Background

Despite the existence of laws and standards governing trading within stock markets, some phenomena as speculative bubbles lead to destabilize the growth and stability of stock markets and hinder them from performing their economic role, one of the reasons behind the occurrence of bubbles may be represented in the increasing flow of indirect fund (hot money) between countries as a result of pillars and foundations of liberal financial capitalism Roy and Kemme (2020). According to bubble literature, bubbles are one of the phenomena that threaten financial markets and repeated without finding serious solutions by the economies to prevent it from occurring, that's why, phenomenon of bubbles is receiving great attention from governments and researchers alike, studies (e.g. Kindleberger (1996), Miller and Luangaram (1998), Barrell and Davis (2008), Kunieda and Shibata (2016), Hashimoto et al. (2020) indicated that bubbles are the main cause of many historical financial crises.

Keynes (1936), the first economist who discussed the possibility of bubble existence, identified that irrational investors are the sole cause for stock market bubbles, a recent study of Hirota et al. (2022) confirmed that volatility of prices become higher and stock prices tend to deviate from their fundamental values when markets are dominated by speculators and noise traders as they ignore stocks' real values. Their trading decisions mainly based on their expectations about the possibility of sustainable increases in future prices, therefore, bubbles arise because buyers increase their purchases from overvalued stocks as they expect to resell them to more optimistic buyers in the future Jarrow and Lamichhane (2022).

While other authors support the rationality of bubbles (e.g. Abreu and Brunnermeier (2003), Doblas-Madrid (2012), Doblas-Madrid (2016), Jeewon and Jangkoo (2019)) as bubbles can form even if rational investors already know that market prices are deviated from their fundamental values and stocks are overvalued, they argues that bubbles are the reflection of investor rationality since investors are rewarded for the increased risk of a price collapse by ever increasing returns, they keep holding overvalued stocks as price deviations offer the required rate of return, also they indicate that when a bubble arises, sophisticated traders do not always stabilize stock prices, however, they assist in destabilizing them by riding a price bubble hoping to sell to a greater fool to maximize their profits, as they have more skills of timing bubbles and crashes of stocks, thus, high crash probability could result from rational speculative bubbles driven by sophisticated traders not totally from noise traders.

Speculative Bubbles

Speculative bubbles have been explained differently through literature, we conclude from reviewing previous studies that there are three main directions could assist in identifying them, the first emphasized that speculative bubble are the sudden and rapid increase in stock prices, as this trend has been adopted by some researchers, as Kindleberger (1978) who developed the first definition of speculative bubbles, indicating that they are the movements of stock prices to rise for a short period of time, and then a rapid collapse occurs. also, Zhou and Sornette (2006) define them as a situation in which stock prices become more than doubled. The study of Lind (2009), Mayer (2011) agrees that speculative bubbles are the occurrence of a rapid increase in prices followed by a rapid decline, in addition to Brunnermeier and Oehmke (2013) they indicate that bubbles represent a rapid and continuous price increase.

However, the second group shows speculative bubbles as the increasing deviation between the market stock prices and their fundamental values. This trend has been adopted by some researchers, for example Santoni's (1987) defines speculative bubbles as having the special characteristic that they are persistent, systematic and increasing deviations of stock prices from their fundamental values. Garber (2000) defines them as the rising portion of a stock price that cannot be explained by fundamental factors. While Rosser (2000) defines them as the period in which the market price of a stock is not equal to its fundamental value. However, Siegel (2003) presents an operational definition for speculative bubbles where he identifies that the term bubble can only achieved if the realized returns of a stock in the future become greater than two standard deviations from its expected returns. Scherbina (2013) defines them as the deviation of the market price of stocks from their fundamental values because of higher concentration of speculative investments within a particular economic sector, which led to the overpricing of these stocks.

The Third group defines speculative bubbles as the result of involving investor sentiment in trading. This trend has been adopted by some researchers, as the study of Eatwell et al. (1987) that explains speculative bubbles as the rapid and continuous increase in prices of some stocks, as the initial price increases create expectations among investors of the possibility of future price rises, which lead to attracting speculators to the market interested in achieving abnormal profit. Stiglitz (1990) indicates that speculative bubble is the rise in the market price of a stock by greater than its fundamental value due to the belief of some investors that the price will continue to rise and thus they will find other optimistic investors willing to buy their stocks at higher prices.

Moreover, Shiller (2020) defined it, as a situation through which news spread about the occurrence of rises in the prices of some stocks, which stimulates the enthusiasm of large numbers of investors to buy, and the enthusiasm spreads among them as a psychological infection during which some rumors and news of future price rises occur, which attracts large number of investors as buyers, although there are doubts about the fundamental value of stocks, but they continue to buy to imitate the actions of others and achieve their desire to gamble.

Despite the great interest in studying and explaining speculative bubbles, we concluded from the multiplicity of concepts of bubbles the lack of a specific definition agreed upon by researchers capable of explaining the phenomenon of speculative bubbles, due to some weaknesses as most researchers - mentioned above - agreed with the classic definition of Kindleberger (1978), which is the rapid increase in asset prices followed by a sudden and rapid collapse, however according to Lind (2009), the study of Barlevy (2007) argued that this definition is not specific as it cannot accurately able to describe bubbles, as it is also not measurable.

Moreover, most of studies concentrated on making definitions explaining only positive bubbles while ignored the occurrence of the other type of bubbles known as negative bubbles, that considered as the same importance as they lead to huge financial losses to the economy, for example, Gurkaynak (2005) criticizes the idea of negative bubbles and states that they can never be negative, also Brunnermeier (2008) argued that it can't be logic that the investors tend to buy stocks because in the future they expect their prices will become in negative values, on the other hand, studies as Yan et al. (2012) confirmed their existence and described negative bubbles as the reflection image of speculative bubbles, as speculative bubbles result in rapid prices rise, negative bubbles result in rapid prices fall Fry and Cheah (2016), in addition to number of researchers who approved the existence of negative bubbles as they developed models allow for positive and negative bubbles (e.g. van Norden and Schaller (2002), Brooks and Katsaris (2003), Anderson et al. (2010). As a result, we agree with the definition of Santoni's (1987), as he argues that not any increase or decrease in stock prices named a bubble, he defines speculative bubbles as having the special characteristic that they are persistent, systematic and increasing deviations of market prices from their fundamental values.

Models of Speculative Bubbles

Through bubbles literature, many researchers have been interested in studying speculative bubbles through using various models and laboratory studies for trying to detect and forecast their occurrence in many countries all over the world, however, until now, researchers haven't agreed on specific techniques able to investigate the occurrence of bubbles, therefore, many studies were done to reach the most effective one, recently, some studies utilized more than one technique as a trial to detect speculative bubbles as well as different models for measuring fundamental values, summary of some of such different models could be presented through the following table 1.

Table 1. Models used by some recent studies for detecting bubbles.

No.	Study	Methodology
1	Anderson & Sornette (2004)	A new Rational Expectation Model of bubbles
2	Zhou & Sornette (2008)	LPPL formula, Weierstrass-type model, Parametric detrending method, and the (H, q) analysis.
3	Cheung & Friedman (2009)	A Laboratory Study
4	Anderson et al. (2010)	A Regime switching approach, Model of Van Norden and Shaller (1997) and the augmented model of Brooks and Kartasis (2005)
5	Yu & Hassan (2010)	Fractional integration test and duration dependence test
6	Chen & Yan (2011)	Var Log linear asset pricing model in state space model with Marcov- switching
7	Al-Anaswah & Wilfling (2011)	State space model enriched by Markov Switching elements.
8	Liu et al. (2012)	(DSSW) Delong, Shleirer, Summers and Waldmann (1990) model

No.	Study	Methodology
9	Lansing (2012)	A general equilibrium Model
10	Asako & Liu (2013)	A Statistical model with a recursive nature
11	Hong & Sraer (2013)	Price/Trading volume Relationship of credits
12	Liu et al. (2013)	Regime switching regression model
13	Mahmoud et al. (2013)	A Statistical Physics technique of uncertainty (Entropy) by Pincus (1991)
14	Anderson & Brooks (2014)	Van Norden and Shaller (1999) model
15	Nartea and Cheema (2014)	Descriptive statistics, Explosiveness tests and duration dependence tests
16	Bidian (2015)	An Arbitrage-based theory of bubbles
17	Wang & Wong (2015)	Duration dependence test
18	Nneji (2015)	Regime Switching Model
19	Chang et al. (2016)	Generalized Sup Augmented Dicky-Fuller test (GSADF), Model of Phillips et al. (2015)
20	Phillips (2016)	Krugman (1991) stochastic process
21	Chen & Xie (2017)	The right-tailed unit root test (GSADF), the momentum threshold autoregressive (MTAR), and Exponential smooth transition autoregressive (ESTAR).
22	Costa et al. (2017)	Johansen non co-integration test and the Granger non causality test.
23	Tran (2017)	Non co-integration test of Taylor and Peel (1998) with the Residuals-Augmented Least Squares (RALS) method of Xia Im (1996) and Im and Schmidt (2008).
24	Deng et al. (2017)	Phillips et al. (2015) Recursive Explosive Root test, Phillips (2016) test, and Greenaway McGrevy test
25	Koehn & Pereira (2017)	Dynamic Conditional Correlation Volatility Model (DCC-GARCH) by Engle and Sheppard (2001)
26	Chen et al. (2018)	Log Periodic Power Law model (LPPL)
27	Caspi & Graham (2018)	The Dynamic book-to-market ratio model of Vuolteenaho (1999, 2002)
28	Szulczyk & Cheema (2019)	Recursive of (unit root test, Sup augmented dicky fuller test, co-integration tests, explosive test and duration dependence test)
29	Strauch (2020)	A modified version of Abreu and Brunnermeier (2003) model
30	Westphal & Sornette (2020)	A modified version of the agent-based Model (ABM) by Kaizoji et al. (2015)
31	Nazer (2020)	Descriptive Statistics and Supreme-Augmented Dicky Fuller test, Phillips and Yu (2011)

From table 1, we concluded from these variety of techniques that majority of studies follow the traditional way in detecting bubbles relying on aggregated market indices as many of bubble literature, (e.g. Al-Anaswah and Wilfling (2011), Lansing (2012), Liu et al. (2012), Asako and Liu (2013), Nartea and Cheema (2014), Wang and Wong (2015), Phillips (2011) (2016), Koehn and Pereira (2017), Tran (2017), Chen et al. (2018), Szulczyk and Cheema (2019)), however, number of studies able to detect only one bubble (e.g. Zhou and Sornette (2008), Liu et al. (2013), Mahmoud et al. (2013), Chen et al. (2018)) despite using long time series, while other studies fail to detect any bubbles (e.g. Yu and Hassan (2010), Nartea and Cheema (2014), Caspi and Graham (2019)), recently, a trend of studies develop new techniques in detecting bubbles using disaggregated data, studies applied on industry level include (e.g. Anderson et al. (2010), McMillan (2010), Caspi and Graham (2018)), while studies on company-level conducted by (e.g. Anderson and Brooks (2014) and Costa et al. (2017)).

Accordingly, our previous arguments present variety of techniques used to detect bubbles, this variability indicate that literature of bubbles still needs more research to guide researchers for appropriate techniques able to detect bubbles, and this can be achieved by applying them to different stock markets.

Data and Methodology

This section is divided into three parts, the first presents the research population, the second explains research sample and data, then finally the research model.

Research Population

The Egyptian exchange is one of the oldest stock markets in the Middle East, and the oldest in the Arab region, the Alexandria Exchange was established in 1883 followed by the Cairo Stock Exchange in 1903. Over the years, it occupies higher ranks among the emerging markets, in 1940 the Egyptian stock market was announced the fifth largest stock exchange in the world, but by the late of 1950s it witnessed a wave of nationalization led to a severe reduction in the number of listed firms which turned it into an inactive market until the introduction of the Capital Market Law 95 in 1992, this allows number of corrective steps to take place inside the market such as encouraging private investments and improving investors' protection, in 1994 the Exchange started to grow rapidly especially after the introduction of the Asset management Program that led to an increase in number of listed firms to be 1100 firms by the end of 2001.

In 2004 it was ranked the first among the Arab stock markets and the second active market among the emerging markets, according to classification of Morgan Stanley. In 2005, to apply disclosure and corporate governance rules, many companies were delisted from the exchange due to their failure to meet the rules. The Egyptian exchange won the award for the best stock exchange in Africa in a competition organized by the New York Stock Exchange in 2008, also in 2009, the Egyptian Stock Exchange was announced as the second-best emerging stock exchange in Africa EGX Report (2010), moreover, according to the classification of Morgan Stanley, the Egyptian Exchange was one of the best emerging stock markets, as was considered the fourth largest emerging financial market with a growth rate of 19% Metwally and Darwish (2015). In 2014, it was ranked the second active stock exchange in Africa EGX Report (2014).

Moreover, The Egyptian economy witnessed several changes in regulations and policies taken by policymakers to reduce the harmful effects resulting from the spread of speculative trading, the most important were the work of the Investor Protection Fund in (2014), updating the Egyptian code of Corporate Governance (2016), as it is the first comprehensive and updated release since 2005, issuing the new investment law in (2017), and adding the activity of direct investment companies to the activities of companies operating in the field of securities in (2018).

The Egyptian government has been taking steps to attract foreign investors and increase foreign currency inflows, In May 2023, the Ministry of Interior released a decision to grant foreign investors wishing to carry out business in Egypt a one-year residence. This residence can be renewed for six months or a year through the General Authority for Investment and Free Zones (GAFI) depending on how much time is needed to start the business.

The FDI Confidence Index 2023 report, ranked Egypt the 14th among emerging markets in terms of investor confidence, this report gives business leaders insights into which emerging markets are most appealing to investors now and over the next three years. As the number of foreign direct investment (FDI) projects into Egypt increased by more than 150% to reach 148 projects in 2022, with estimated capital investment of \$107 billion.⁴

Research Sample and Data

The current study applied on stocks of companies traded on the Egyptian Exchange, with a time series from January 2008 to December 2020, due to data availability, and by excluding financial and Banking services companies, we limit our research to companies that distribute cash dividends along the study period in order to calculate stocks' fundamental values, eventually, we reach to 110 companies (almost

⁴ The report indicates that the top three factors that investors prioritize when choosing where to make their FDI are transparency of government regulations, technological and innovation capabilities, and tax rates and ease of tax payments.

50% of the total traded companies of 214 and total listed companies 215 companies)⁵ relevant to be used to investigate our study purpose, the final sample is considered representative for three reasons; firstly, these companies are included in EGX100 index, this index consists of 100 firms considered the most active in terms of trading volume and liquidity, EGX 100 index including the 30 companies of EGX 30 index and the 70 companies of EGX 70 index, the three indices are updated twice a year in June and December, secondly the sample includes share prices of medium and small companies, called speculative shares, thirdly, the sample companies belong to different major economic sectors, each sector contains the most active companies traded in the stock market. The sectors included in our study are 14 sectors from the total 17 Egyptian economic sector, as follows: Food and Beverages- Chemicals-Basic Resources- Utilities- Gas and Petroleum- Industrial Goods, Services and Automobiles- Health Care and Pharmaceuticals- Household and Personal Products- Construction & building materials- Technology- Real Estate- Travel & Leisure- Telecommunication – Media, while, the other three sectors are related to Financial and banking services.⁶

According to previous studies, we intend to choose a time series through which monthly data are collected to measure the study variables, the type of data collected and analyzed to conduct this study is secondary data, data collected from secondary sources, within the Egyptian Exchange, the selection of the sample companies depends on the availability of data on dividends in addition to monthly closing prices of the 110 individual stocks traded on the Egyptian Exchange during the time period of the study, the study is applied on a time series that extends from January 2008 to December 2020, as the Egyptian environment witnessed many political and economic crises, that period also witnessed some fundamental changes in the Capital Market Law No. 95 of 1992 with the aim of reducing the harmful effects resulting from the spread of speculative trading, as well as raising the efficiency of the Egyptian Exchange, which is expected to have an impact on investors behavior and trading activity, data collected from the following three sources:

- a) Annual and Monthly reports of the Egyptian Exchange
- b) Egypt Information Dissemination Company (EGID)
- c) The financial statements of companies listed on the Egyptian Exchange.

The Model

We depend on model of Anderson and Brooks (2014) in measuring (relative bubble sizes) of companies' stock prices, the model uses dividend multiple of (Van Norden and Schaller, 1999) to construct fundamental values. The model presents a new technique in directly measuring size of speculative bubbles using market prices of individual stocks and dividend values, dividends used to construct fundamental values by following the discounted dividend stream model.

According to the discounted dividend stream model⁷, the fundamental value of a stock i is the present value of all its future dividends as shown in equation (1),

$$p_{i,t}^f = \sum_{g=1}^{\infty} \frac{1}{(1+r)^g} E_t(d_{i,t+g}) \quad (1)$$

where p^f is the fundamental value of stock i at time t , d is the dividend of stock i paid in time t , r is the discount rate. (The required rate of return, which is assumed constant), and $E_t(\cdot)$ is the expectations operator conditioning on information available at time t .

⁵ <https://www.egx.com.eg/ar/MarketIndicator.aspx>.

⁶ Fama and French (1993), indicated that banks and financial services companies are excluded from the sample due to their special nature, (Jansen, 2021) argued that all financial firms are dropped from his sample to avoid the idiosyncratic effect of highly regulated firms.

⁷ under the assumptions of rational expectations, risk-neutrality, constant discount rates and market equilibrium -the required return of an asset is the discount rate that relates a present value with its future cash flows (Fama and French, 1988)-, the no arbitrage condition must hold, and allowed for multi-period horizons.

If the actual price of the stock p^a contains a bubble, then it will follow the dynamic process depicts in equation (2),

$$p_{i,t}^a = p_{i,t}^f + b_{i,t} + u_{i,t} \quad (2)$$

where $b_{i,t}$ is the bubble component, and $u_{i,t}$ is a zero mean, random disturbance term.

According to Van Norden and Schaller (1999), vNS, if dividends follow a geometric random walk (i.e., log dividends follow a random walk with drift a), and given a constant discount rate, then the fundamental value of a stock must be a multiple of current dividends, shown in equation (3),

$$p_{i,t}^f = \rho d_{i,t} \quad (3)$$

Using a second order Taylor series expansion vNS show that the fundamental price of company i at time t can be approximated by a multiple ρ of the dividends the company paid then,

$$\rho = \frac{1+r}{e^{(a+\frac{\sigma^2}{2})}-1}$$

Where r is the subjective discount rate, and σ^2 is the variance of the innovations in the random walk with drift process for dividends. Anderson and Brooks (2014) followed vNS, as the approximation of the value of ρ to be used as a trailing average of the price-dividend ratio, the relative bubble size relative to the actual price is then,

$$B_{i,t} = \frac{b_{i,t}}{p_{i,t}} = \frac{p_{i,t} - p_{i,t}^f}{p_{i,t}} = 1 - \frac{\rho d_{i,t}}{p_{i,t}}$$

From here, the researchers through her study will depend on Equation number (4) which represented the model of (Anderson and Brooks, 2014) that they used in measuring size of (speculative bubbles) for individual stocks. Hence the relative bubble size as a proportion of the actual value is given by equation (4),

$$B_{i,t} = 1 - \frac{\rho d_{i,t}}{p_{i,t}} \quad (4)$$

Where B is the bubble size per stock, ρ is the price–dividend ratio, the inverse of dividend yield of (previous five years) for each company, as stated by (Anderson and Brooks, 2014) to ensure that there is no look-ahead bias in the calculation of this measure, the long-term average of ρ is calculated using data available up to that month. d is the dividend-based fundamental price is the current annual dividend being paid multiplied by ρ as per equation while, p indicates the actual price for each stock.

Empirical Findings

As shown in figure 1 and figure 2, the relative bubble sizes for the whole sample take the V shape pattern for three different period, which means that the Egyptian exchange had gone into three crashes and they were followed by a rebound during the periods from 2008-2009, 2011-2012, and 2016-2017, by 50%, 20% and 20% respectively⁸. Thus, we concluded from figures 1 and 2, that the Egyptian exchange had exposed to three negative bubbles during the study period.

⁸ There is no specific agreement on an indicator of the occurrence of crashes in stock markets, however, according to some Egyptian studies conducted on the Egyptian Exchange (e.g. Sabri (2004) and Ismail (2005)), a drop in the whole market prices of up to 25% is considered a crash. Consequently, according to studies (e.g. Berkman et al. (2011) and Muir (2017)) they argued that, the V shape pattern is usually associated with financial crisis and not associated with changes in fundamental factors, as stated by Goetzmann and Kim (2018), a crash is a rapid and unusual large decline in a stock market prices, as they identified 1,032 events for which market prices declined by more than 50% over a 12-month period, as this pattern only holds for large crashes, they found that markets tend to rebound in the year following the crash, they referred to this pattern of crash-and-rebound as a “negative bubble.”

Figure 1. Bubbles across time

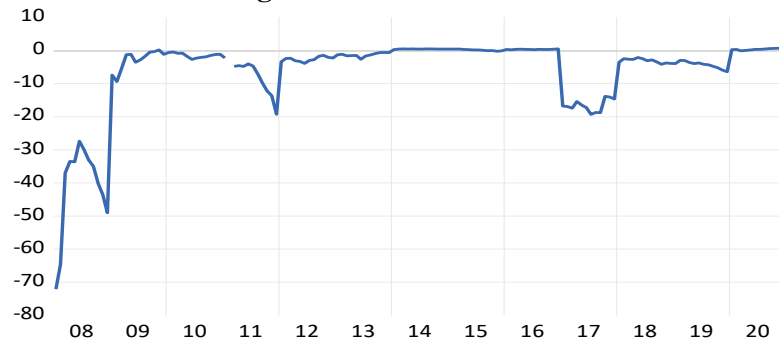
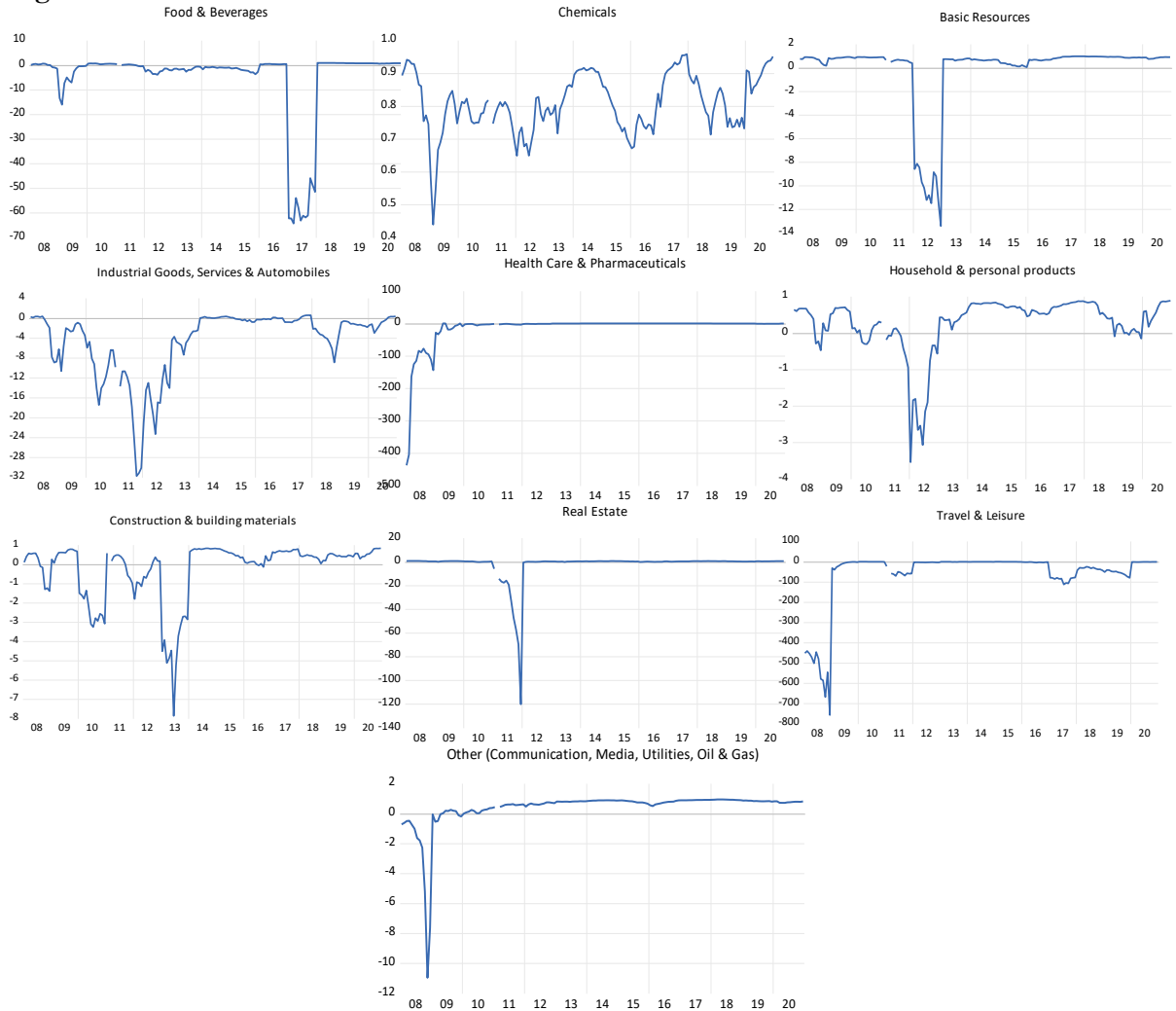


Figure 2. Bubbles across time & sectors



As for the summary statistics describing the relative bubble sizes⁹ of the whole sample are presented in table 2, the bubble size for each stock calculated on a monthly basis as a bubble deviation (the difference between a stock market price and its fundamental value), expressed as percentages of their market prices by using the method of constructing fundamentals shown in equation (4), through table 2 bubble sizes were averaged within each year from 2008 to 2020 for presentational ease.

Table 2. Summary Statistics for Bubble Deviations by Year

Year	Mean	Std. Dev.	Minimum	10 th Percentile	25 th Percentile	Median	75 th Percentile	90 th Percentile	Maximum
2008	-4157.90%	27811.91%	-394090.32%	-87.20%	66.74%	90.53%	96.51%	98.84%	99.98%
2009	-288.32%	2200.19%	-30329.17%	-81.31%	52.03%	88.26%	95.88%	98.60%	99.95%
2010	-145.65%	882.74%	-5761.13%	-149.27%	49.77%	86.97%	96.11%	99.21%	99.96%
2011	-793.17%	5029.71%	-95796.15%	-566.00%	20.03%	85.48%	94.49%	97.81%	99.94%
2012	-265.59%	1140.23%	-10281.46%	-809.55%	29.98%	83.26%	92.54%	97.59%	99.94%
2013	-128.64%	936.11%	-11109.31%	-140.71%	42.97%	81.95%	92.03%	97.51%	99.79%
2014	43.87%	220.54%	-2241.38%	15.29%	81.84%	91.75%	95.86%	98.35%	99.91%
2015	15.73%	302.21%	-3173.94%	-18.92%	66.97%	86.13%	95.40%	98.37%	99.49%
2016	33.27%	135.07%	-967.07%	-59.32%	47.57%	80.72%	93.30%	97.25%	99.97%
2017	-1662.76%	10339.73%	-77805.72%	-43.13%	78.65%	94.46%	98.05%	99.37%	100.00%
2018	-310.01%	2770.16%	-29376.30%	-39.14%	64.02%	93.26%	98.40%	99.51%	99.99%
2019	-433.86%	3994.46%	-47204.28%	-105.73%	45.25%	85.61%	94.88%	98.39%	99.96%
2020	36.60%	169.86%	-1800.11%	-37.74%	63.45%	88.63%	95.43%	98.33%	99.52%

Notes: According to Anderson and Brooks (2014), the bubble deviations are defined as the bubble size (difference between actual prices and their fundamental values, based on dividend payments) expressed as a proportion of the actual share price at that time. The bubble deviations are constructed using five-year windows to evaluate the long-term price-to-dividend ratios, rolled forward on a monthly basis. The figures for each year are averages of all months in that year.

Since the companies' stocks bubble sizes are compared cross-sectionally within each year separately, the results of the current study can be explained as follows:¹⁰

The mean of relative bubble sizes shown in column one of table 2, is appearing to be negative in most years except in 2014, 2015, 2016 and 2020 it appeared to be positive, However, the median of the relative bubble size, shown in column seven of table 2, has positive values for the whole sample years, so it is arguably a better summary statistic for conducting our analysis, as positive values may in part reflecting the increasing propensity over time for most of companies to pay dividends to investors.

The profile of the relative bubble sizes over time found to reach peaks only in four years 2008, 2014, 2017 and 2018, before subsequent market decline deflated the rise in values that had established.

The mean of relative bubble sizes as mentioned above, shows a negative sign that stocks in average were at their most undervalued, traded at below their fundamental values, during 2008 to 2013, and from

⁹ According to Anderson and Brooks (2014) a negative relative bubble size of a company's stock could occur if its bubble deviation falls (a stock market price is less than its fundamental value), as well as the company intended to increase its dividend payment relative to its historical average of price to dividend ratio. On the contrary, the relative bubble size of a company's stock will be positive and may approach 100% if (a stock market price exceeds its fundamental value) and its bubble deviation rises as the company decided to reduce its dividend payment relative to its historical value.

¹⁰ The summary statistics in table 2 reveals that the sample relative bubble sizes are bounded from above by 100% (if the entire stock price comprises a bubble and the fundamental value is zero) but they are not bounded from below and consequently the distribution of the relative bubble sizes shown to have a very long lower tail and is skewed, the same result as the study of Anderson and Brooks (2014).

2017 to 2019. While from 2014 to 2016 and in 2020 the mean gives positive values as stocks in average traded near above their fundamental values.

The year 2014, is particularly interesting. Since this year shown a subsequent rise in stock bubble sizes for most of the sample, we can say that this rise is due to decisions taken by the government to restructure the subsidy system to minimize the budget deficit. This lead Egypt's credit ratings to increase which regained confidence in the economy (EGX Report, 2014).

Despite companies' dividend payments had been increasing at a considerable rate and the bubble sizes are positive for most of the sample, the results haven't revealed any positive bubble for the whole period, but only the occurrence of three negative bubbles. Clearly, some stocks among the sample, considered here the most active in terms of trading are shown to be very under-valued, extremely trading less than their fundamental values, are responsible for causing the negative bubbles for the whole market as shown in figure 1.

As shown in Figure 1, The Egyptian Exchange is represented here by the heterogenous 110 companies' stocks, according to our results, the Egyptian exchange found to be exposed by three market crises lead to three negative bubbles during the period from 2008-2009, 2011-2012, and 2016-2017, by 50%, 20% and 20% respectively. We firstly concluded that the economy severely faced only by one bubble dominated in the period of 2008-2009 by 50% loss, but by making stocks homogenous and analyzing the bubble sizes of stocks separately across sectors as shown in figure 2, our conclusions apparently become false.

In addition to the study of Anderson and Brooks (2014), we extend our results to verify which industrial sectors each negative bubble comes from, as shown from figure 2 not all stocks of the sample caused the occurrence of the negative bubbles but only trading is concentrated on certain stocks -less than 25% of the stocks traded in the market - in other words, the tenth percentile and less than 25% of the sample assist in occurring three negative bubbles in different periods for the whole market, since stocks dominated in sectors and certain sectors are shown to be primarily exposed by negative bubbles, therefore our results can be explained as follows:

In 2008-2009, at the beginning of the year 2008, we can observe from figure 1 that the whole market begins with two consequent declines, 70%, and then by 50%, as the Egyptian exchange was affected by the global financial crisis occurred in the United States of America, and its effects were transmitted to the other financial markets including the Egyptian exchange. As its EGX 30 index dropped by the end of 2008 with a loss of 56 percent EGX Report (2009). The financial crisis causing a negative bubble by for the whole market as shown in figure 1, but with referring to each sector separately we find that not all sectors were affected by the crisis, by referring to Figure 2, it is clear that the negative bubble come primarily from only six sectors which are Travel and Leisure, Health Care and Others (Communication, Media, Utilities, Oil & Gas) by 800%, 150% and 11% respectively, however, the fundamental values of stocks are higher than their market prices, which reveal that investors decided to leave the market as this period indicates a huge fund outflows by investors from the Egyptian Exchange, negative bubbles are highly noticed during this period 2008- 2009 through these six sectors especially the Travel and Leisure sector, our results can be explained through the study of Hatab (2009), as he mentions that by late 2007 until the end of 2008, the Egyptian exchange exposed to three shocks, the first was a rush by foreigners to liquidate their assets to save their investments in their home countries in the beginning of the crisis. a second shock caused by May economic decrees which were interpreted by investors as a sign of rolling back reforms, especially those related to investment incentives, the third shock caused by rumors of imposing the government capital gains taxes in addition to the unprecedented inflation wave resulting from the increase in food prices which negatively affected investors' expectations about the performance

of the stock exchange and the Egyptian economy. Inflation rates averaged 9.5 % in 2007 and continued to escalate in the first quarter of 2008 reaching 14.4%. By the end of July, inflation rates were as high as 22%, and by August jumped to 25.6%.

In 2011-2012, The country was faced by political tensions presented in the 2011, January 25th revolution, this period characterized by uncertainty, topple the regime and loose security that caused unfavorable consequences to the Egyptian economy, lead to closing the Egyptian Exchange 55 days due to the intensive outflows since the revolution began, this political event discouraged the investment environment of Egypt, according to EGX Report (2011); EGX30 and EGX100 declined by 50% and 45% respectively, also the market capital lost about 194 billion pounds. The study of Berkman et al. (2011) can explain our results as they argued that if a country exposed to a political conflict, market returns are found to be negative at the beginning and during the political conflicts, after passing this conflict market returns start to recover and be positive. According to figures 1 and 3, they depict the selling pressure as investors withdraw their money from the Egyptian exchange as a result of their fear from the investment status of the Egyptian economy, causing a negative bubble, as shown in figure 2, the most affected sectors are Real Estate, Industrial Goods, Services & Automobiles, and Basic Resources by 120%, 32% and 13% respectively, while other sectors seen unaffected by price deviations. Our results are not consistent with findings of the study of Abdeldayem (2015), as he indicates that entrance of new investors initiated a positive bubble on stocks of the telecommunication sector after the Egyptian revolution. The results of his study may lack the precision as he used the Black-Scholes model which does not obtain an accurate estimation of stocks fundamental value because it builds on an arbitrage mechanism that is not applicable for preventing short selling in Egypt.

In 2016-2017, this period witnessed a great interval in the Egyptian economy, due to the foreign currency shortage, the central bank of Egypt as a step to achieve monetary stability to target lower levels of inflation, decided in 2016 November 3rd, to take several corrections in the foreign exchange policy by floating exchange rates to give flexibility to banks operating in Egypt to price the purchase and sale of foreign exchange with the aim of restoring its circulation within the legal channels and completely ending the parallel market of money (the black market).

Number of studies confirm that this policy as an encouraging step for investment succeeded in increasing investments and liquidity in the Egyptian stock exchange, also most of stock prices increased, for example, Elmogny (2021) reveals that investors achieved substantial daily and cumulative positive returns, for a period extending from the -10th day before the event to the +30th day after the event, which indicates that early information about this event reached the market ten days before its announcement, which had a positive impact on the returns and wealth of investors for a period that extended up to thirty days after the event.

According to AbdAllah (2019), the Egyptian pound (EGP) devalued by 32.3% and continued to lose value, as before the float decision, in October 2016 a U.S. dollar (USD) was worth 8.8 EGP, as per May 2017, the exchange rate was 18.1 USD/EGP by nearly 111% over a few months Mao (2022), therefore, as a result of the above arguments, the devaluation of the EGP should encourage flow of foreign fund to be invested in stocks as stocks become cheaper to foreign investors, however, our results reveal that this policy didn't lead to achieve a positive bubble which means that stocks were highly traded but not far from their fundamental values.

Moreover, and on the contrary to the results of these previous studies, our results here found a negative bubble happened in 2016-2017, which reveals that the economy didn't apply the appropriate procedures for encouraging investment in the Egyptian exchange after the announcement of this policy, which didn't encourage domestic investors nor foreigners to keep their money inside the Egyptian exchange,

on contrary a negative bubble occurred as investors waited for sustainable investment opportunities, however, they didn't find any, so they decided to invest their money in other attractive Emerging markets.

As mentioned by Ahmed (2019) in his study on the Egyptian Exchange that the domestic currency depreciation having a negative impact on stock prices as currency depreciation tends to exercise a stronger influence on stock returns than does currency appreciation, he finds that both positive and negative changes in EGP/USD exchange rates have a significant impact on stock prices, whether in the short or long run. However, currency depreciation exerts larger effects than does currency appreciation; due to investors fear from successive depreciations in the Egyptian pound, potential gains are more likely to be offset by exchange rate losses when converted back to an investor's home currency.

Our results can be also explained by the study of Abdel Aziz and Mahmoud (2022), they find that the value of foreign transactions in the Egyptian Stock Exchange took a general declining trend during the period from 2015 to 2020. But by dividing that period into two terms, they found that it took an upward trend in the first term from 2016 to 2018, where it rose from 4296 million pounds to 8751 million pounds (net purchases), then took a downward trend in the second term from 2018 to 2020, where it decreased from 8751 million pounds to reach a negative value (net sales) of -7330 million pounds. the decision to float has led to an increase in the net value of foreign transactions, but no significant statistical relationship was reached during the study period, this indicates that the capital that flowed into Egypt after the flotation of the Egyptian pound was hot money, also Kuchiki (2006) illustrates that short-term speculative money attacked less developed countries and depreciated their currencies, he mentioned that exchange rates determined in the currency market can generate psychological cycles the same as stock prices and these cycles generate both negative and positive bubbles, so when an exchange rate goes beyond a threshold investors become more pessimistic and their panic selling of the currency leads to a negative bubble.

As shown in Figure 2, our results indicate that the sectors primarily affected by this negative bubble were Travel and Leisure and Food and Beverages by 100% and 65% respectively.

Although the country went through other crises for example the revolution of June 30, 2013, clearly, it has no effect on the results, as the Egyptian Stock exchange violated expectations, with the first working day of the week coincided with the escalation wave by the Egyptian opposition against the President, the main index EGX30 rose by 1.5%, However, it was observed that the market ended up with net buying by foreigners and net selling by Egyptians and Arabs, whether at the level of individuals or institutions, which experts see as confirmation of the vision of foreigners that the events of June 30 are transient and not significantly affecting the situation in Egypt, consistently with, Eldomiaty et al. 2020, from studying the event of the 23rd of June 2013, when the former Minister of defense called on Egyptian political parties in his speech, calling citizens to delegate military forces the power to fight terrorism, followed by overthrowing the elected president, they concluded from their study that on contrary to the common belief that political events have systematic effects, they argues that, this political event is considered an anomaly which has idiosyncratic effects, as the Egyptian stock exchange and its indices EGX 30 and EGX 70 kept rising since 23rd of June 2013 till 4th of march 2014.

The Corona pandemic in the beginning of year 2020, as another crisis, found to have no effect on our results, during this period no bubbles is observed, despite other researches argued that the EGX 30 was affected by the spread of the pandemic, as its value decreased especially during the first trimester of the year 2020 from 14,000-point level to nearly 9,000-point level, with fluctuations in value of the index during the year, and the great and sharp shock experienced by the Egyptian Exchange led to the suspension of trading many times Gharbi et al. (2020). Despite these challenges, our results show that the crisis hasn't negatively affected the Egyptian Exchange with a negative bubble, may due to the exceptional decisions of the President of the Republic to allocate 20 billion pounds by the Central Bank

to support the stability of trading in the Egyptian Exchange, the activation of plans to restructure markets for the small and medium-sized companies, the establishment of the Egyptian Commodity Exchange Company in addition to develop the financial derivatives market "future contracts and options" to make them available to investors EGX Report (2020).

From Figure 2, we find that stocks related to the following three sectors (Chemicals, Household and Personal Products, Construction & building materials), haven't witnessed any bubbles during the research period, the values of their bubble deviation from fundamentals appeared to be less volatile overtime as they considered less risky and more secured from speculative bubbles, so these sectors could be attractive to risk averse investors to invest in as their stocks' values didn't greatly change negatively over time.

Conclusion

This study aimed to investigate the existence of speculative bubbles on individual stock prices of companies listed in the Egyptian stock exchange, by applying the model of Anderson and Brooks (2014), with a sample of 110 heterogenous companies belonging to the major sectors in the Egyptian economy, these companies are considered the most active in terms of trading and liquidity, and able to present the performance of the market, as our study considered the first study aims to detect bubbles using disaggregated data from different Egyptian companies, the research period is from year 2008 to year 2020 as the Egyptian economy passed by number of crises and policies, our results indicate that the Egyptian stock exchange had exposed to three negative bubbles during the study period, in addition to Anderson and Brooks (2014), we extended our analysis to study homogenous stocks by analyzing each sector separately, to reveal if bubbles concentrated in group of sectors and which sectors are responsible for arising each bubble, we find that the further analysis can better describe bubbles as few sectors show big bubble sizes as they mainly responsible for arising bubbles in the market, these sectors are, Food and Beverages, Basic Resources, Industrial Goods, Services and Automobiles, Health Care and Pharmaceuticals, Real Estate, Travel & Leisure, Other (Communication, Media, Utilities, Oil & Gas).

The results shown to be not compatible with the efficient market hypothesis, which indicates that stock prices at any time reflect their fundamental values Fama (1970), otherwise, bubbles occurrence can be explained due to the spread of investor behavior in stock markets as indicated by some recent studies (e.g. Eyden et al. (2023), Scherbina and Schlusche (2014)), so we can say that our findings support the behavioral finance theories (feedback theory) which states that investor pessimism or exuberance could generally manifest as mean reversion, but in the extreme might appear as a positive or negative bubble Shiller (2000), also he argued that initial declines in stock prices may discourage some investors from investing causing further declines, while Goetzmann and Kim (2018) mentioned that a decline in asset values by one-half is frightening to investors and may indicate a major change in market expectations about future returns and risks that may prompt them to leave the market, while Brunnermeier and Abreu (2003) argue that it is riskier for rational investors to ignore bubble than to sell them during rapid prices increase. we conclude from our study that stocks on the Egyptian Exchange lack investments, although the continuous distribution of cash dividends, providing opportunities to increase investments, because during the study period some stocks fundamental values are shown higher than their market prices and traded much less than their true values, so policy makers should exert more efforts to encourage investors to invest their money in the Egyptian stock exchange.

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