

## SPECULATIVE BUBBLE AND ITS EXISTENCE IN STOCK MARKET OF PAKISTAN

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### Abstract

This empirical study is an attempt to detect speculative bubbles in different indexes of the Pakistan stock market (KSE-100, KSE-30 & KMI-30) using monthly time series data from (2005– 2020) to evaluate all four Rtaf (Recursive, Right tail Augmented Dickey-Fuller) tests. This includes: Standard ADF, Rolling-window ADF, Supreme ADF (SADF) and Generalized SADF (GSADF) with Monte-Carlo simulation, under Gaussian assumptions. The findings of this study confirms the two prominent episodes of exuberance and collapse of multiple speculative bubbles in the KSE-100 index while only a single (multiple) bubble in KSE-30 and KMI-30 indexes using RADF & GSADF tests. The results, in other words, suggest among all four tests, RADF and GSADF are better models to detect the past bubbles in PSX. These results contribute to scarce literature through testing and date stamping bubbles in different indexes of (PSX) with the use of (all) right-tailed tests. For future research, advanced techniques can be employed to predict future bubbles along with their direction.

**Keywords:** Multiple Bubbles, Pakistan Stock Exchange (PSX), Rtaf approach, Mildly explosive process

### Introduction

Generally, an unpredictable and discernible phenomenon of stock market bubble takes place in any stock market due to the drastic ups and downs in asset prices. This type of explosive behavior in asset prices is often attributed to cognitive-emotional bias that leads to group thinking or herding behavior according to behavioral finance theory (Liaqat, Nazir, and Ahmad, 2019). Moreover, understanding or detecting these speculative bubbles is of utmost importance as they manifest some serious economic consequences, perhaps could distort or cause misrepresentation of real economic activities such as real growth, future prospects, investment opportunities, expected inflation, and aggregated consumption or expenditure (Jorder, Ahmed, Haque and Hasanuzzaman, 2014). This calls into a question, what could cause these speculative bubbles? Usually, these speculative bubbles are often caused when the stock prices deviate from their true intrinsic or fundamentals value, consistently causing market overvaluation followed by market collapse (Reza, 2010). During a speculative bubble, the high active market trend also substantially influences the stock prices to deviate from their true intrinsic value. However, this substantial augmentation in the stock's prices is not the only reason of concern for the stock market bubble, other factors can also distort the stock market mechanism by causing such bubbles (Bansal and Yaron, 2014; Shiller, 2000 and Fama, 2013).

Behavioral finance reveals, bubbles may manifest in three folds: Firstly, it could be naturally based on fiat money due to the overconfidence of financial investors who rely



more on financial Guru, agent or broker rather than making rational calculative decisions. In which, the subjective social reality leads to the wrong judgment and irrational decisions which seems to be visible cognitive effects on financial investors. Secondly, it could occur due to informational monopolies who based on some inside information manipulate other investors by artificially increasing the prices of specific stocks of their choice with the intention to later beat the market. Lastly, political alliance with some running privileged class people also induces major economic events that lead to such economic or speculative bubbles (Jimenez, 2011). This phenomenon could be explained by various theories related to the formation or disappearance of asset pricing bubbles (Thomson and Hickson, 2006; Escobari and Jafarinejad, 2016 & Madjumerd, Zamanian, and Shahiki Tash, 2017). Even so, the quantification becomes more important as a future prediction of such incidents could prevent the financial investors from incurring huge losses, overcome the financial crisis, and even could possibly reduce systematic risk.

### **Problem Statement**

Speculative or asset pricing bubbles in the stock market often trigger disastrous financial crises that spread to the real economy, followed by market collapse (Reza, 2010). Due to which, recently many complicated time series methods are emerging including Rtadf (Recursive, Right tail Augmented Dickey-Fuller test) which has recently become the most popular tool to test bubbles as it enables not only to identify mild explosive behavior but also to determine exact origination and the termination date of bubbles. Therefore, this study is aims to detect speculative bubbles in different indexes of the Pakistan stock market (KSE-100, KSE-30 & KMI-30) using monthly time series data from (2005– 2020) to evaluate all four Rtadf (Recursive, Right tail Augmented Dickey-Fuller) tests.

### **Rationale of the Study**

Pakistani markets being an ideal example of a less efficient economy because information distortion, speculative buying behavior, inside trading spots are quite a common commodity on offer in this market which demands an additional consideration and need for investigating existence of speculative bubbles. Therefore, this study is an attempt to examine whether the sharp increase in the past decade in Pakistan's stock market index is driven by its fundamentals (actual performance) or exhibits some signs of speculative bubbles. The evolution of the price index (KSE-100) could be seen from the [Figure 1]. The increasing trend in our stock market is quite apparent along with dramatic abrupt fluctuations which further ensures little evidence of multiple shocks or bubbles in our market. Therefore, it is of utmost importance to examine whether the sharp increase in Pakistan's stock market index in the past decade is aligned with its true performance based on stock market fundamentals or exhibits some signs of asset pricing bubbles in different indices.

### **Significance of the study**

Brief literature reveals that lack of identification of type of bubble may cause serious adverse setbacks to any economy. Therefore, proper bubble identification is important and its evolution could help policymakers and financial investors: to mitigate their losses, better understand economic settings, overcome various financial crises and also to reduce the systematic risk while taking investment decisions.

## Research Objective

This study aims to investigate proper date stamping of single or multiple episodes of bubbles in different indexes of the Pakistan stock market (KSE 100, KSE 30 & KMI 30) using monthly time series data from (2005 – 2020) to evaluate all four Rtadf tests (Standard ADF, Rolling-window ADF, Supreme ADF (SADF, Phillip, Wu and YU 2011) and Generalized SADF (GSADF, Phillip, Shi and YU 2015) with Monte Carlo simulation, under the assumption of Gaussian innovations in our market.

## Research Questions

For this purpose, this study is an attempt to answer out the following research questions:

1. Are there any speculative or asset pricing bubbles in different indices of Pakistan's stock market using traditional indexation or the sharp increase in Pakistan's stock market in the past decade is aligned with its true performance based on stock market fundamentals?
2. What is the exact origination, explosion, and collapse time of the single or multiple bubbles in different indices of the PSX (KSE-100, KSE-30 & KMI-30)?
3. Which Right-tailed test (among all four tests) is better in detecting the bubbles in Pakistan's stock market?

## Literature Review

Mild explosive behavior or Bubbles usually do not exist in any market', as stated by the Efficient market hypothesis (EMH), though this has proven wrong yet time and again over the last four decades (Fama, 1965). The presence of speculative bubbles or such stochastic time series with drift has been reported by various researchers or practitioners from across the world in many studies. It is reported in one study, weak form of market efficiency is rejected in Pakistan, India and Sri-lanka which means in these market rational speculative bubbles do exist (Hamid, Suleman, Ali Shah, Akash & Shahid, 2017). In retrospect, this concept of investigating a rational bubble was firstly initiated by Blanchard (1979a) with the use of an overlapping generation model evolving from a rational expectation solution (Blanchard, 1979b). Later, this rational expectation concept provided a strong theoretical basis through which rational stock market bubbles can be measured. Moreover, timely identification of a type of speculative bubble may help the policy makers and the financial investors in making decisions regarding to international portfolio diversification. However, in real-world, finding the best fit model or procedure that can accurately detect existing or future stock market bubbles is quite challenging because these speculative bubbles are not caused by investors' rational behavior (Blanchard and Watson, 1982).

In this regard, financial theories suggest if there exists any bubble, the price of a stock must inherit its explosive properties (Caspi, 2017). This property paves the way for the researchers to explore various statistical models or tests for the analysis of bubbles. In this consideration, divergent statistical methods and tests have been proposed by many researchers to investigate the presence of rational bubbles in stock markets. In this regard, Restricted variance tests (Shiller, 1981), Specification test (West, 1988) were introduced. Among various models, the Johansen Co-integration model was most widely used which

was introduced to determine whether the prices and the dividends are integrated or not but this model was based on the linear autoregressive properties which also assumes the linearity of the stock market (Johansen, 1988 & Diba and Grossman, 1988). The major drawback of this model was the restriction of linearity assumption because there is no theoretical justification through which dynamics of any market could be assumed linear. In fact, several studies have documented that financial data or the stock prices specifically follows a non-linear pattern (Hsieh, 1991). Besides this, Non- Co-integration test (Taylor and David, 1988) was also introduced but this model too failed to accurately detect the existence of stock market bubbles as a consequence of misspecification, several biases and kurtosis (Beirens, 1997). Therefore, the efficacy of these models was questioned because in the presence of bubbles both co-integration and unit root tests fail to reject the hypothesis of the absence of bubbles (Evan, 1991). Hence, these linear testing strategies were found inadequate when it comes to detecting periodically fading of bubbles in any market because usually, such bubbles do not have integration or co-integration properties as indicated through the findings of Monte- Carlo simulations (Evan, 1991 & Caspi, 2017).

This eventually lead to construct Non-Linear testing models (Evan, 1991) followed by the Extended Augmented Dickey-Fuller test in which they assess whether the stock prices follow the stationary way or tilted towards mild explosive behavior (Hall and Sola 1993 & Hall, Psaradakis and Sola, 1999). However, like many other tests, this method too failed in short-run but was accurately able to predict the past bubbles (collapsed). Similarly, the traditional ADF test or the rolling version of this test i.e. RADF were then introduced along with the Monte Carlo simulation to get better results (Taipalus, 2012). In this domain of Recursive-Right tailed augmented dickey fuller (Rtadf) unit root tests Phillip, Wu and Yu (2011) has made a major contribution by introducing Supreme ADF (SADF) tests to more accurately detect the rational bubbles. Later, this model was extended to the Generalized (SADF) test by Phillip, Shi and Yu (2015). The strategies of these models are based on generalized rolling or recursive unit root technique which helps us to not only identify single or multiple bubbles in any market but also to date stamp their occurrence. Another considerable advantage of using this approach is that it allows to break the mechanism and account for the non-linear structure in any stock market while testing mild explosive processes. Additionally, this model employs the changes in the generalized dickey fuller tests are considered while detecting the bubbles where the null hypothesis, alternative hypothesis and unit root are mild explosive processes. This potential has permitted these rolling and recursive tests to better detect bubbles than the standard test methods.

Similarly, the major crisis like Global financial crisis (2008) has provoked many researchers and academicians to explore the existence of (single or multiple) stock market bubbles with the help of strategies discussed to not only date stamp its origination but also the collapse time period. There has been a growing literature in more developed and emerging markets as they have suffered most during such a crisis. This includes China, MENA markets i.e. including Bahrain, Israel, Oman, Saudia Arabia, Egypt, Turkey Jordan and Morocco, BRICS markets i.e. Brazil, Russia, India, China and SouthAfrica, Tehran, Israel, Hong Kong and Indonesia (Yao and Luo, 2009; Liu, Han, & Wang, 2016; Yu and Kabir Hasan, 2010; hang, Gil Alana, Aye, Gupta & Ranjbar, 2016; Madjumerd, Zamanian, and Shahiki Tash, 2017; Caspi, 2014; Caspi and Graham, 2018; Yui, Yu and Jin, 2013 & Almudhaf, 2018). Despite that in Pakistan, very few studies have been documented considering either presence or absence of the bubbles. According to Liaqat, Nazir and Ahmad (2019) multiple bubbles have been seen in KSE 100 index only using a single

GSADF right-tailed test from a specific period of (2007 – 2016) using monthly data but this study didn't mention the exact origination, explosion and collapse time of the bubbles.

Hence, this present study contributes to the literature as follows: Firstly, this study aims to investigate the date stamping of single or multiple episodes of bubbles. Secondly, different indexes of the Pakistan stock market (KSE-100, KSE-30 & KMI-30) are considered using monthly time series secondary data from the period of (2000 – 2020). Moreover, this study not uses only one specific test but evaluates all four (Recursive - Rtaadf) models which include: (Standard ADF, Rolling-window ADF, Supreme ADF (SADF, Phillip, Wu and YU 2011) and Generalized SADF (GSADF, Phillip, Shi and YU 2015) with Monte Carlo simulation, under the assumption of Gaussian innovations to see which model works better in our stock market in detecting past asset pricing bubbles.

### **Research Methodology and Data Collection**

This empirical study borrows its footing from the framework suggested by Philip, Wu and Yu (2011) and Phillip, Shi and YU (2015) also considered as an advanced approach to uncover single or multiple episodes of bubbles in a more sophisticated econometric way because ordinary left tailed- augmented dickey fuller test (ADF) ceases to identify fading of bubbles. Therefore, for the analysis Recursive Right-tailed ADF tests are used in this study to date stamp the origination and collapse time period of single or multiple bubbles in different indices of Pakistan's equity market (PSX). This includes:

1. KSE 100 index: Karachi Stock Exchange (100 index), was launched in Nov, 1991 with the base points of 2000. This index is used as a benchmark to compare the prices of listed/Delisted stocks on (PSX) overtime in which weights are assigned to the securities as per their free-float market capitalization.
2. KSE 30 index: Karachi Stock Exchange (30 index), which was launched in Sep, 2006, comprises of top 30 most liquid companies using free-float market capitalization methodology.
3. KMI 30 index: KSE Meezan (30 index), which was launched in 2009 - comprises of 30 companies that have been screened for strict Islamic Shariyah criteria, also based on float-adjusted market capitalization methodology. According to the reports, Islamic financing is a growing industry in Pakistan which have covered around 15% market share in the overall banking industry by the end of Dec 2019 (Sheikh, 2020).

### **Data Collection and Time period**

The empirical data employed is secondary time series (monthly) and to reflect the relationship between stock price with its market fundamentals – the Price to dividend ratio is computed by taking the cross averages of listed companies of all indexes (Caspi, 2017). From the sample period of Jan 2005 – Dec 2020 because in our stock market, proper data is available only from 2000 of all the firms because before this period many companies did not report or pay dividends regularly due to which most of the companies' data was missing. Since 2005, more than 80% of data was available therefore this time period is selected for the analysis purpose.

### Source of Data Used

The data is obtained from the official database of Thomson Reuters and the Pakistan stock exchange. Moreover, various national and international research studies have also been used to find the research gap. In appendix, Figure (2) shows the testing data of the price to dividend ratio of all the listed companies of KSE 100 index during the sample period of Jan 2005 – Dec 2020. In this figure, one can see the dramatic abrupt fluctuations in KSE 100 index's price to dividend ratio could be analyzed with little evidence of multiple shocks or bubbles in our market. Hence, this study has employed all the regression models for the empirical testing of stock market bubbles including ADF, Rolling window ADF (RADF), Supreme ADF (SADF) and Generalized SADF (GSADF) statistics with the inclusion of constant. The random step process of the test of Supreme ADF test is as follows:

$$y_t = dT^{-\eta} + \theta y_{t-1} + e_t, e_t \sim N(0, \delta^2), \theta = 1 \quad (1)$$

Where, d is constant, n is coefficient and e is the error term when the sample size (T) extends to infinity. The right-tailed test by considering subsequent autoregressive properties can be written as:

$$y_t = \mu + \delta y_{t-1} + \sum_{i=1}^p \phi_i y_{t-i} + e_t \quad (2)$$

Where  $y_t$  is the main variable, p means a maximum number of intervals and e is an error term. The normal range is from 0 to 1. In equation (1)  $\delta$ , r1, r2 sign approximate coefficient of ADF statistics with ADFr1, r2. However, the size of a window in regression is represented by rw i.e.  $rw = r2 - r1$  (Caspi, 2014). However, in case of multiple boom and collapse failures Generalized Sup ADF (GSADF) test is more appropriate. The divergence in alternative RtaDF tests is about the replacement of ADF statistics of r1 and r2 which can better be explained as follows: In standard ADF unit root test, these r1 and r2 statistics are fixed and are placed as first and last observation in the sample where  $rw = r0 = 1$ .

### Hypothesis

In this case, bubbles are tested based on the hypothesis:

$H_0$  = There exists no bubbles in the series along with unit root.

$H_1$  = There exists bubbles or mild explosive process in the series along with unit root.

### Sample size and Software

The sample size covers the Pakistan stock market (PSX) including all three major indexes i.e. KSE-100 index, KSE-30 index and KMI-30 index. The minimum window size considered is 27 as per the general rule of  $\lambda_0 = 0.01 + 1.8 / \sqrt{T}$  (Phillips et al., 2015). The p – values of the statistics are computed using Monte Carlo simulations under the assumption of the Gaussian method which is expected to be found robust even in the

presence of non – stationary volatility in the market. Moreover, it should also be noted all simulations are executed using Rtadf with the help of (Eviews) Software and Add-in (Caspi, 2015) rested on 1000 replications.

**Empirical Results & Analysis**

This empirical study has considered bubble discovery tests based on the volatility of right tailed ADF tests (Rtadf) in which the null hypothesis is a unit root (no bubbles) and the alternate hypothesis exhibits the existence of bubbles in the stock market.

| TABLE: 1 Testing Bubbles in KSE-100 index |                 |                   |                |                   |
|---|-----------------|-------------------|----------------|-------------------|
| INDEX                                     | ADF             | RADF              | SADF           | GSADF             |
| KSE 100 INDEX                             | -2.15<br>(0.78) | 2.79<br>(0.01)*** | 0.86<br>(0.14) | 2.90<br>(0.01)*** |
| Critical values                           |                 |                   |                |                   |
| 99 % Level                                | 0.83            | 0.79              | 2.00           | 2.55              |
| 95 % Level                                | -0.04           | 0.01              | 1.40           | 2.08              |
| 90 % Level                                | -0.44           | -0.35             | 1.05           | 1.85              |

This table reports the results of (KSE- 100 index) from the period of (2005-2020). of all four right-tailed (ADF) regression models such as standard ADF, Rolling-window ADF (RADF), Supreme ADF (SADF)and Generalized SADF (GSADF) statistics with the P-values computed through Monte Carlo simulations based on 1000 replications considering initial window size of 27 (sample size 191) through Eviews (Rtadf) Add ins. (\*\*\*) represents significance at 1% level of significance.

**Interpretation of Table 1: Testing Bubbles in KSE-100 index**

Table (1) shows the results (KSE- 100 index) of t-statistics of all four regression models such as standard ADF, Rolling-window ADF (RADF), Supreme ADF (SADF)and Generalized SADF (GSADF) statistics with the p-values computed through Monte Carlo simulations based on 1000 replications. In which, the null hypothesis (unit root or no bubbles) is rejected as RADF and GSADF t-statistics are found greater than its all critical values, also found statistically significant at 1%, 5% and 10% respectively under the Monte Carlo simulations. This clearly shows the strong evidence of multiple bubbles in PSX (KSE -100 index) from the period of Jan 2005- Dec 2020. Being able to discover multiple episodes of bubbles, starting and ending dates can be identified using the GSADF test.

**Interpretation of GSADF Test (Figure 5)**

The visual inspection of the date stamping procedure can be seen from the graphical illustration of the GSADF test [Figure 5]. In which, the blue line represents BSADF (Backward SADF) sequence and the red line shows the threshold sequence at 95% critical value sequence. The above-mentioned graph clearly shows BSADF sequence does cross the threshold rejection line in different times stating the existence of – two multiple bubbles. Firstly, the BSADF sequence stays above the threshold for about months in and around 2008 mainly cause of the global financial crisis of 2008 as stated earlier. By Feb 2007, the index had skyrocketed to 12,285 points and eventually reached the 14,814 points

highest ever benchmark in Dec 2007, a day before the assassination of Prime Minister - Mohtarma Benazir Bhutto. This was followed by the global financial crisis of 2008 in which record-high inflation in May by SBP resulted in a sharp fall in KSE. Then, our index again dropped by 1/3 which was an all-time high hit in April 2008 due to the increasing pressure about the shaky coalition government to handle the Taliban issue. Later on, the situation was to some extent controlled after the resignation of Pervaiz Musharraf at the end of 2008. Secondly, the run-up phase of another big bubble can be seen during the period of June 2013, this happened due to the excitement created ahead of Pakistan's reclassification into the MSCI emerging market and everyone expected huge foreign inflows from passive investors/index funds of about \$300 million – as stated by CEO of HBL management. But the panic caused by political upheaval, inconsistent economic policies and lack of interest shown by Emerging market (EM) funds, forced our local investors to unwind their positions by selling already acquired (heavy-weighted) stocks. This resulted in a net outflow of \$1.16 billion and dragged the entire market down in March 2014 (Dawn, 2017). Subsequently, our market quickly recovered after the mega public offerings led by sale of shares by the Government of Pakistan in which \$73 billion were raised by the end of 2014 through these offerings as compared to \$4 billion in 2013 this sudden growth led our market to be among the top ten performing markets in the world. This happened, because of political and economic front, declining dollar-rupee disparity, the significant interest of China to invest in Pakistan (Dawn, 2016). Although the effect of Covid-19 was greater than 2008, our market remained calm and confident which can be seen from the above graph as well. However, few 'blips' i.e. small episodes of bubbles below the level of threshold line should be eliminated from a priori as indicative of a bubble.

| TABLE: 2 Testing Bubbles in KSE-30 index |                 |                 |                 |                   |
|--|-----------------|-----------------|-----------------|-------------------|
| INDEX                                    | ADF             | RADF            | SADF            | GSADF             |
| KSE 30 INDEX                             | -2.87<br>(0.95) | 1.51<br>(0.10)* | -0.63<br>(0.82) | 2.87<br>(0.01)*** |
| Critical values                          |                 |                 |                 |                   |
| 99 % Level                               | 0.83            | 0.72            | 2.00            | 2.55              |
| 95 % Level                               | -0.03           | 0.01            | 1.40            | 2.08              |
| 90 % Level                               | -0.43           | -0.35           | 1.05            | 1.85              |

This table reports the results of (KSE- 30 index) from the period of (2005-2020) of all four right-tailed (ADF) regression models such as standard ADF, Rolling-window ADF (RADF), Supreme ADF (SADF) and Generalized SADF (GSADF) statistics with the P-values computed through Monte Carlo simulations based on 1000 replications considering initial window size of 27 with sample size 191 through Eviews (Rtadf) Add ins. (\*\*\*) represents significance at 1% level of significance and (\*) represents significance at 10% level of significance.



**Interpretation of Table 2: Testing Bubbles in KSE-30 index**

Table (2) shows the results (KSE -30 index) of t-statistics of all four regression models including standard ADF, Rolling-window ADF (RADF), Supreme ADF (SADF) and Generalized SADF (GSADF) statistics with the p-values computed through Monte Carlo simulations based on 1000 replications. In which, the null hypothesis (unit root or no bubbles) is rejected as RADF and GSADF t-statistics are found greater than its critical values, also statistically significant at 10% and 1% respectively under the Monte Carlo simulations. This also shows the strong evidence of multiple bubbles in PSX (KSE - 30 index) from the period of Jan 2005- Dec 2020. Being able to discover multiple episodes of bubbles, starting and ending dates can be identified using the GSADF test.

**Interpretation of GSADF Test– (Figure 8)**

The visual inspection of the date stamping procedure can be seen from the above graphical illustration of the GSADF test [Figure 8]. In which, the blue line represents BSADF (Backward SADF) sequence and the red line shows the threshold sequence at 95% critical value sequence. The above graph clearly shows BSADF sequence does cross the threshold rejection line in a single specific time-period stating the existence of a single episode of multiple bubbles (June 2013 – Sep 2014) as stated earlier. However, the extremely small spike can be seen as an effect of the global financial crisis which is almost insignificant in the case of KSE-30 index, which is not that compulsive because KSE-30 index was newly established in that period with the best performing highly liquid companies listed on an exchange.

**TABLE: 3 Testing Bubbles in KMI-30 index**

| INDEX           | ADF             | RADF            | SADF           | GSADF             |
|-----------------|-----------------|-----------------|----------------|-------------------|
| KMI 30 INDEX    | -2.21<br>(0.80) | 1.74<br>(0.06)* | 0.05<br>(0.52) | 2.52<br>(0.01)*** |
| Critical values |                 |                 |                |                   |
| 99 % Level      | 0.83            | 0.71            | 2.00           | 2.55              |
| 95 % Level      | -0.03           | 0.01            | 1.40           | 2.08              |
| 90 % Level      | -0.43           | -0.35           | 1.05           | 1.85              |

This table reports the results of (KMI 30 index) from the period of (2005-2020) of all four right-tailed (ADF) regression models such as standard ADF, Rolling-window ADF (RADF), Supreme ADF (SADF) and Generalized SADF (GSADF) statistics with the p-values computed through Monte Carlo simulations based on 1000 replications considering initial window size of 27 with sample size 191 through Eviews (Rtadf) Add ins. (\*\*\*) represents significance at 1% level of significance and (\*) represents significance at 10% level of significance.

**Interpretation of Table 3: Testing Bubbles in KMI-30 index**

Table (3) shows the results of (KMI-30 index) t-statistics of all four regression models including standard ADF, Rolling-window ADF (RADF), Supreme ADF (SADF) and Generalized SADF (GSADF) statistics with the p-values computed through Monte Carlo simulations based on 1000 replications. In which, the null hypothesis (unit root or no bubbles) is rejected as RADF and GSADF t-statistics are found greater than its

critical values, also statistically significant at 10% and 1% respectively under the Monte Carlo simulations. This also shows the strong evidence of multiple bubbles in PSX (KMI-30 index) from the period of Jan 2005- Dec 2020. Being able to discover multiple episodes of bubbles, starting and ending dates can be identified using the GSADF test.

#### Interpretation of GSADF Test– (Figure 11)

The visual inspection of the date stamping procedure can be seen from the above graphical illustration of the GSADF test [Figure 11]. In which, the blue line represents BSADF (Backward SADF) sequence and the red line shows the threshold sequence at 95% critical value sequence. The above graph clearly shows BSADF sequence does cross the threshold rejection line twice in stating the existence of – one clear multiple bubbles. (Note: Tiny blip should not be considered as indicative of bubble even if the BSADF sequence stays above the threshold). Firstly, from the period of (June 2013 – Sep 2014) as discussed earlier. However, the effect of the global financial crisis is not found in KMI 30 index as it was launched in 2009 but a small blip (not exactly a bubble) can be seen in the initial period of 2020. This happened because recently the government has issued Sukuk of 700 billion rupees to enable the Islamic banks to place their liquidity in Sukuk as they generally face the issue of having an adequate number of liquid instruments in short-term money market investments (Sheikh, 2020). Consequently, Islamic financing covered around 15% market share in the overall banking industry by the end of Dec 2019, making this industry relatively less risky as compared to others. However, since the lockdown which started in March extended to May 2020, caused by the Corona-virus outbreak the overall economy was drastically slowed down including the Islamic financing industry. According to the reports, this halal index has also reported a sharp decline in the remaining months of 2020 and lost around 1/3 of its value in the first quarter of 2020 as depicted in the graph (Sheikh, 2020).

**TABLE (4): Date Stamping Summary based on BSADF statistics in Different Indices of PSX**

| Index                |               | Types of bubbles | Start time    | Burst / peak time | Collapse time |
|----------------------|---------------|------------------|---------------|-------------------|---------------|
| <b>KSE 100 index</b> | First bubble  | Multiple         | There already | Dec, 2007         | Aug, 2008     |
|                      | Second bubble | Multiple         | June, 2013    | Feb, 2014         | Sep, 2014     |
| <b>KSE 30 index</b>  | First bubble  | Multiple         | June, 2013    | June, 2014        | March, 2015   |
| <b>KMI 30 index</b>  | First bubble  | Multiple         | June, 2013    | Aug, 2013         | Feb, 2015     |

Note: Resource - Research findings

## Conclusion

The present study is based on the dynamic price-to-dividend ratio model (Caspi, 2017), which predicts in the presence of a stock market bubble, the price –to-dividend ratio illustrates mildly explosive behavior i.e. it follows a stochastic process with a root. The empirical results of this have confirmed the two prominent episodes of exuberance and collapse of multiple bubbles in the KSE 100 index while only a single (multiple) bubbles has been recognized in KSE 30 and KMI 30 indices using right-tailed tests of RADF & GSADF. The results, in other words, suggest among all the right-tailed tests, RADF and GSADF are found better tests in detecting the past bubbles in Pakistan’s stock market. Moreover, these results are also found to be robust even in the presence of potential non-stationary volatility in the market.

The evolution of periodically collapsing of multiple bubbles has been examined thoroughly. The first bubble revolves around the sub-prime mortgage crisis from (Oct 2006 – Aug 2008). The second run-up phase of multiple bubbles occurred from (June 2013 to March 2015) due to the uncertain political upheaval, inconsistent economic policies and some irrational behavior of financial investors which is seen in all the indices. Although the effect of Covid-19 was greater than 2008, which has disrupted global stock markets completely, our market stayed calm and confident even in this catastrophic condition. Hence, the quick recovery and remarkable growth led our market (PSX) to be among the list of top ten performing markets in the world (Dawn, 2016).

## Recommendations

The findings of this study has confirmed that the sharp increase in the PSX in past decade is not aligned with its true performance based on its fundamentals. Thus, investors should be careful while making investment decisions.

The results can help financial investors to understand the evolution of past bubbles but for future research, various advanced techniques can be employed to predict the future bubbles along with their direction (bubble or crash).

## Limitations

Unavailability of data (80% data was available only after 2005) was the major issue. Only price to dividend variable is use to investigate mild explosive behavior along with it exact origination and the termination dates. Change in variable may change the results.

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## APPENDIX A

Figure 1 – KSE 100 index

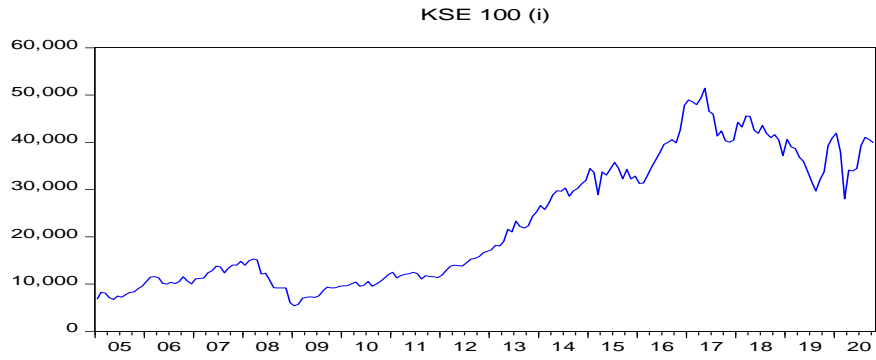


Figure 2 – Price to Dividend ratio (KSE 100 index)

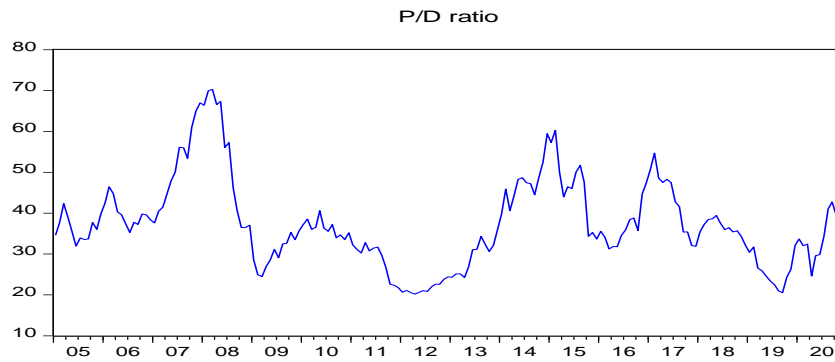


Figure 3

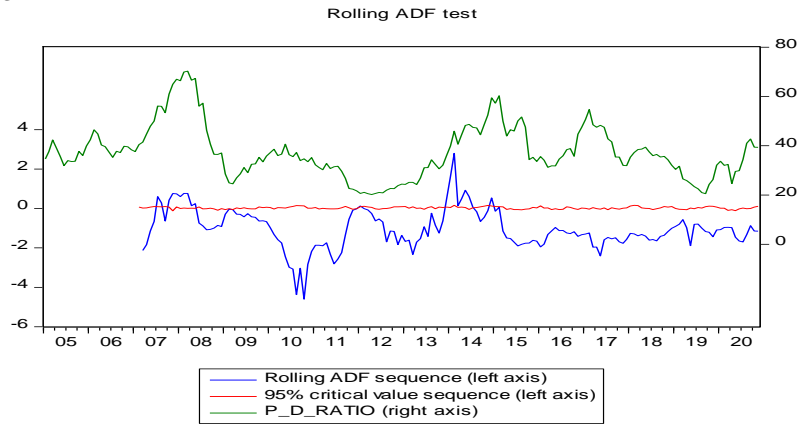


Figure 4

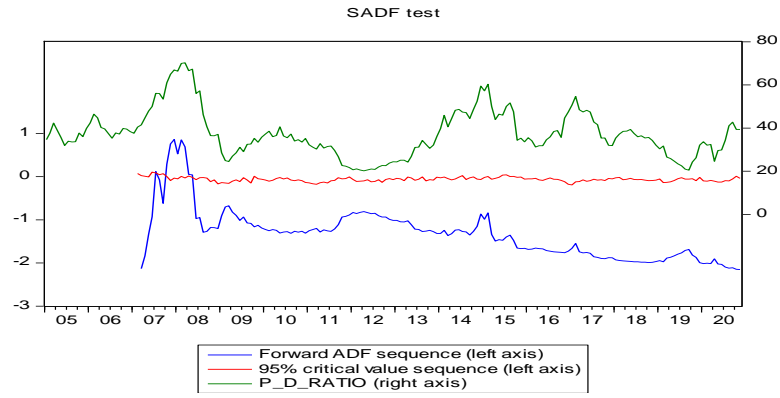




Figure 5

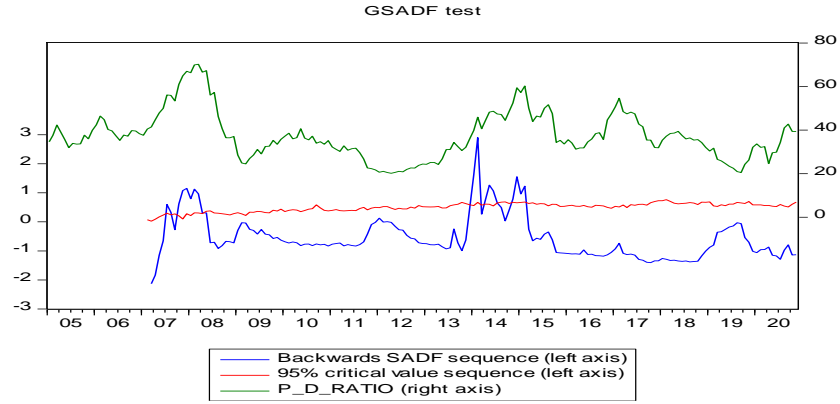


Figure 6

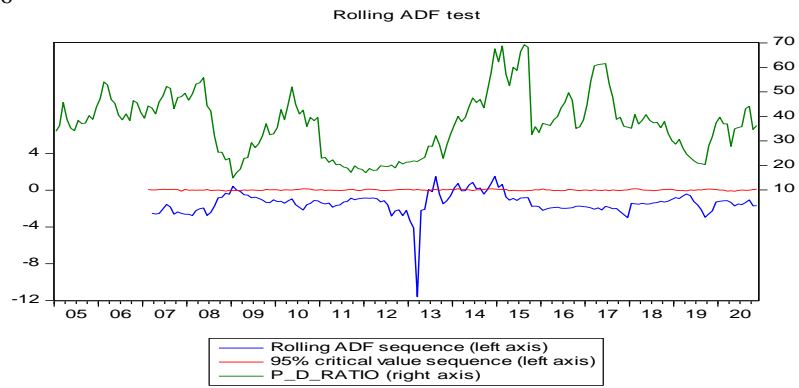


Figure 7

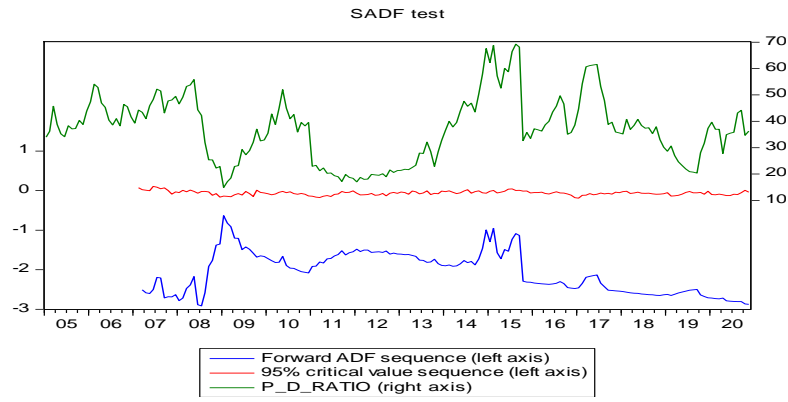


Figure 8

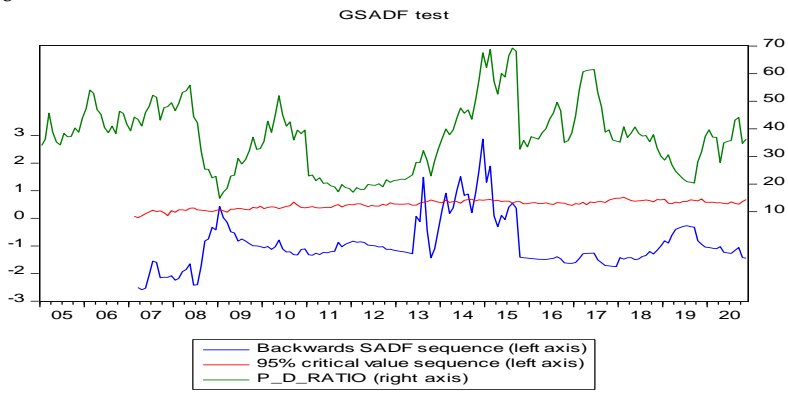


Figure 9

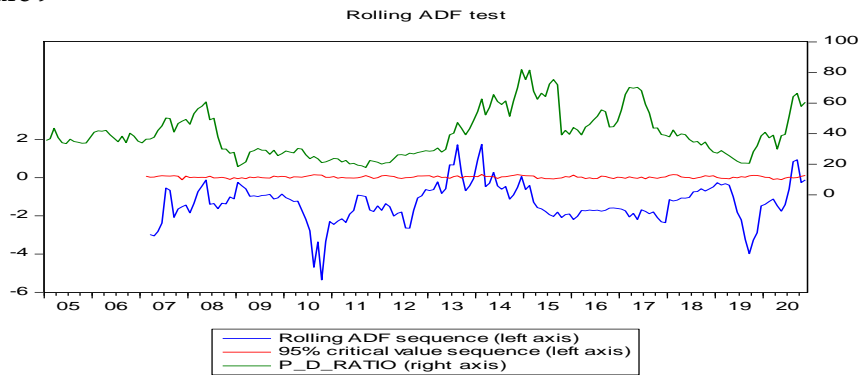


Figure 10

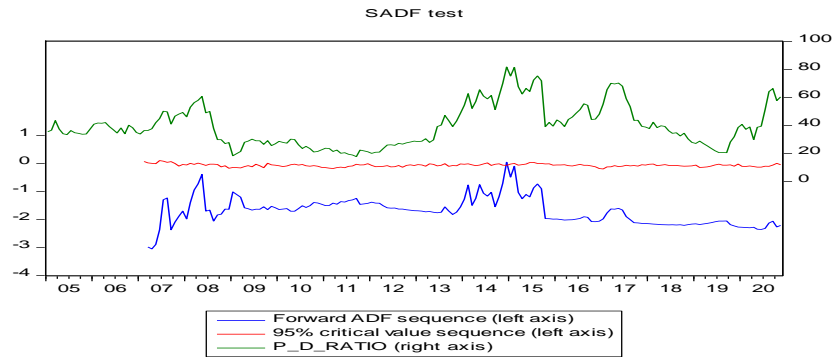


Figure 11

